LIST OF FILES

ALASKA NORTHERN WATERS TASK FORCE, 2010-2012 (SCOMM 173)

MEMBERS:

REPRESENTATIVE REGGIE JOULE, CHAIR
SENATOR BERT STEDMAN, VICE-CHAIR
SENATOR LYMAN HOFFMAN
REPRESENTATIVE BOB HERRON
SENATOR DONALD OLSON, ALTERNATE
REPRESENTATIVE BRYCE EDGMON, ALTERNATE

Established by LR 54 (HCR 22), 2010

Contents: Final report, "Findings and Recommendations of the Alaska Northern Waters Task Force, January 2012," is available in the Legislative Library (LLIB 1200100) and online, http://housemajority.org/coms/anw/pdfs/27/NWTF Full Report Color.pdf
These files contain background, support, and reference material collected by the task force as well as material collected for the statewide meetings conducted by the task force. Additional material is archived on the House Majority website, now available at https://wayback.archive-it.org/org-305/20121230034031/http://housemajority.org/coms/anw/anw background 26.php

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Support Material (File 1):

1. Northern Water Task Force Internal Documents and Presentations
2. Arctic Council Information and Documents

Support Material (File 2):

3. Research Documents
   A. Preliminary Build-out Plan for Alaska Ocean Observing System, September 2011
   B. State of the Arctic Coast 2010
   C. Snow, Water, Ice and Permafrost in the Arctic, SWIPA Executive Summary
   D. Arctic Council, Arctic Offshore Oil and Gas Guidelines, 2009

Support Material (File 3):

3. Research Documents (cont.)
   E. The Shared Future: A Report of the Aspen Institute Commission on Arctic Climate Change, 2011
   F. An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska, USGS Circular 1370. Available online: http://pubs.usgs.gov/circ/1370/pdf/circ1370.pdf (Chapters 5-8 and Appendices available in file.)
4. Other Organizations Documents and Information
   G. Alaska Marine Policy Forum, Summary of Wednesday, May 25, 2011 Teleconference.
   H. Arctic Energy Network, Institute of the North
   I. North to Alaska: Invasive Species Edition produced by Milo Wrigley (CD available in file)
   J. Adapting to Climate Change in Alaska (Video CD available in file)

Reference Material (File 1):

1. Introductory Materials and Reference Materials Index
2. Summary of Proposed Federal Legislation
3. United States Arctic Policy
4. Information on the Interagency Ocean Policy Task Force
5. Information on the National Ocean Council
6. Information on the Climate Change Adaptation Task Force

Reference Material (File 2):

7. Information on the Arctic Marine Shipping Assessment
8. United States Arctic Research Commission Report

Reference Material (File 3):

9. National Oceanic and Atmospheric Administration Report
10. Arctic Report Card
11. Arctic Impact Assessment

12. U.S. Navy Report
13. United State Coast Guard Power Point Presentation on the Arctic
14. Alaska Climate Change Executive Roundtable Power

Point Presentation

Reference Material (File 4):

15. Governor's Subcabinet on Climate Change Reports
16. Press Releases
17. Endangered Species Act and NPRA Maps of the ranges of endangered wildlife, and "Designating Endangered Species in Alaska: A Cautionary Note," Resource Development Council Annual Conference, November 20, 2008 (CD available in file)
18. Arctic Brief, January 27, 2011 (CD available in file)

Minutes, December 2, 2010, Barrow, Alaska

Documents 2011 (File 1):

National Ocean Council strategic action plans to implement the *National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes*. A Regional Listening Session was held in Barrow, Alaska, June 9, 2011 at which representatives from the National Ocean Council described the policy and took questions and comments from the public.

Documents 2011 (File 2):

1. Changes in the Arctic: Background and Issues for Congress, by Ronald O'Rourke, Coordinator, Specialist in Naval Affairs, October 15, 2010
2. *Resource Review*, July 2011. Also available online: http://www.akrdc.org/newsletters/2011/
3. Training Mariners for Ice Navigation with Ship Simulator Exercises, White Paper, Alaska Maritime Training Center - AVTEC, Seward, Alaska, May 18, 2011
4. Miscellaneous articles printed from the internet
5. *Aleutian Wave,* April 2011 (newsletter of APICDA, Aleutian Pribilof Island Community Development Association)
6. 2011 Alaska Forum on the Environment, February 7-11, 2011, Anchorage, Alaska (Conference program)
7. *Magazin Deutschland,* No. 1, 2011, Feature articles on the Arctic (copy available in file)
8. Adapting to Climate Change in Alaska, Alaska Sea Grant

Marine Advisory Program, April 11, 2011. Video CD, 17 minutes. Also available online: https://seagrant.uaf.edu/map/climate/

Kotzebue Meeting, July 7, 2011:

1. Agenda
2. Presenters
3. Arctic Marine Shipping Assessment, University of the Arctic, Michael Sfraga. Workshop Report available online: http://www.uarctic.org/media/732588/AMSA workshop report final 09 2010 -3FYy.pdf
4. Shell Camden Bay and Chukchi Sea Program Update, Colleen McCarthy, July 2011
5. Subsistence Mapping in the Northwest Arctic Borough, Tom Okleasik
6. State/Federal Oil Spill Planning and Response in Northwest Alaska, State of Alaska Department of Environmental Conservation, July 7, 2011
7. Arctic Pollution Response, Captain Adam Shaw, U.S. Coast Guard, July 7, 2011
8. Oil Spill Prevention and Response in the U.S. Arctic Ocean: Unexamined Risks, Unacceptable Consequences, Marilyn Heiman, Director, U.S. Arctic Program, The Pew Environmental Group. Full report available online: http://www.pewtrusts.org/en/research-and-analysis/reports/2010/11/10/oil-spill-prevention-and-response-in-the-us-arctic-ocean-unexamined-risks-unacceptable-consequences

9. Lessons Learned from the Deep Water Horizon, Fran Ulmer, U.S. Arctic Research Commission.

File also includes:

A. "Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling, Recommendations." Full Report to the President available at: www.oilspillcommission.gov .

B. "Report on Goals and Objectives for Arctic Research 2009-2010,": http://www.arctic.gov/publications/goals/usarc goals 2009-10.pdf

"Scaling Studies in Arctic System Science and Policy Support: A Call to Research,": http://www.arctic.gov/publications/other/scaling studies.html

"SCICEX Phase II Science Plan, Part 1: Technical Guidance for Planning Accommodation Missions," June 2010:

https://nsidc.org/scicex/pdf/scicex plan phaseII.pdf

10. Northern Waters Task Force Overview by Chair, Representative Reggie Joule

11. Nana Resources Testimony Presentation

Nome Meeting, July 8, 2011:

1. Agenda
2. Presenters
3. Nome Update - Impacts on Changes, Mayor Denise Michels
4. Alaska Deep Draft Arctic Ports Study, Michael Lukshin, Alaska DOT&PF
5. Alaska Regional Ports Study, Stephen Boardman, Army Corps Engineer
6. Bering Strait Port Access Route Study, Captain Adam Shaw, U.S. Coast Guard
7. Arctic Search and Rescue, Captain Adam Shaw, U.S. Coast Guard
8. Alaska Landscape Conservation Project, Polly Weaver
9. Inuit Circumpolar Council Written Testimony, ICC President Jimmy Stotts
10. Transportation in Nome - A Historical Perspective

Note: Not all reports listed in Table of Contents were present in file.

Unalaska Meeting, August 24, 2011:

1. Agenda
2. Presenters
3. Comments of Captain Carter Whalen, President, Alaska Marine Pilots
4. Arctic Salvage Operations, Daniel L. Magone
5. 1982 Law of the Sea Convention, Rear Admiral Fred Kenney, U.S. Coast Guard
6. Bering Sea Fisheries Overview, Frank Kelty, City of Unalaska
7. Development and Implementation of an Arctic Fishery Management Plan, Steve A. MacLean, North Pacific Fishery Management Council
8. Arctic Fisheries Research, Dr. Gordon H. Kruse, School

of Fisheries and Ocean Sciences, University of Alaska Fairbanks
9. U.S. Customs and Border Protection Alaska
10. Seafood Industry in Alaska's Economy, Marine Conservation Alliance

Bethel Meeting, October 10, 2011:

1. Agenda
2. U.S. Arctic Research, Mary C. Pete, Commissioner, U.S. Arctic Research Commission
3. Impact of Climate Change on Alaska's Transportation Infrastructure, Michael J. Coffey, Alaska DOT&PF
4. Important Subsistence Issues in the AVCP Region, Timothy Andrew, Director of Natural Resources, Association of Village Council Presidents
5. Shoreline and Coastal Erosion: A Crisis for Historic Preservation, Steve Street, Association of Village Council Presidents
6. Bering Sea Datapoint Project, Mark Edward Springer
7. Written Testimony submitted to Task Force
8. Draft Recommendation of the Northern Waters Task Force *Messenger Quarterly,* Vol. XVI, No. 9, September 15, 2011, available online: http://www.ykhc.org/library/msg0911.pdf

Anchorage Meeting, October 11, 2011

1. Agenda
2. Overview of Research and Monitoring in the Arctic, Molly McCammon, Alaska Ocean Observing System
3. Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska, Leslie Holland-Bartels, USGS Arctic OCS Team
4. Arctic Marine Data Synthesis and Research Gaps, Melanie Smith, Audubon Alaska
5. Testimony of Captain Pete Garay, Alaska Marine Pilots
6. Arctic Infrastructure and Advocacy, Nils Andreassen, Institute of the North
7. Relationship Between Permafrost and Infrastructure, Billy Connor, University of Alaska Transportation Center

HCR

22

<TARGET><BILL>HCR 22</BILL><SUBJECT>HCR 22</SUBJECT><COMM>ANW27</COMM></TARGET>

Office of Representative Joule
Please contact Elizabeth or Christine with any questions at 465-4833

Taking Points for CS HCR 22

HCR 22 creates the Alaska Northern Water Task Force to facilitate State of Alaska leadership in the development of United States' policies related to the opening of Arctic waters.

As many of you know, the Arctic is changing. The ice pack is depleting by 9% per decade. From outer space, NASA has observed that the rate of depletion is accelerating due to interactions between the ice, oceans and atmosphere.

The melting of the sea ice is opening waters that in the past were frozen year-round. This has caused tremendous change already, including:

- **increased ship traffic, and it is projected that the Bering and Chukchi seas will become major marine highways in the near future**
- **the presence of cruise ships**
- **possibilities for new fisheries**
- **increased access to natural resources**
- **questions of territorial rights (Russia sending a flag to the ocean floor)**

Arctic nations like Norway, Canada, Iceland and Russia are actively promoting and defending their interests in increasingly ice-free areas. The U.S. is taking steps, as well. The U.S. Coast Guard has seriously stepped up its activities in an effort to handle all the new activity in the northern seas and is beginning to implement its 5-year Arctic plan.

Senator Begich has introduced 7 pieces of legislation that deal with the Arctic, and Senator Murkowski has introduced 2 bills, one of which relates to creating a deep water port in northern Alaska. The White House has approximately 30 agencies dealing with Arctic issues, and it has created 2 task forces that touch specifically on northern waters issues: the Interagency

Ocean Policy Task Force and the Climate Change Adaptation Task Force. Finally, international bodies like the Arctic Council and the Inuit Circumpolar Council have been working in this area, as well as organizations like the Institute of the North, Commonwealth North, and the US Arctic Research Commission.

As the only Arctic state in this nation, Alaska has a unique role and interest in the development of U.S. Arctic policy. This bill foresees the creation of a joint federal/state commission that will guide interagency and inter-jurisdictional actions in the Arctic. It provides an opportunity for the Legislature to take a proactive role in shaping this commission, and in doing so, ensuring that Alaska's interests are strongly represented.

The task force will be made up of 11 members as follows:

- **2 senators appointed by the Senate President**
- **2 representatives appointed by the Speaker of the House**
- **7 members appointed jointly by the Speaker and Senate President:**
  - **5 public, 3 of whom reside in coastal areas and 2 at-large**
  - **1 Executive Branch of the AK Government**
  - **1 from a federal agency w/a significant role in addressing northern waters issues**

The task force will hold 7 meetings total in the communities that are most directly impacted by the increased activity in the Arctic: Nome, Kotzebue, Barrow and Unalaska. There will also be hearings in Anchorage. The task force will present its findings to the Legislature in January 2012, including legislative proposals for consideration.

FISCAL NOTE: $150K FY 2011, $75K FY 2012

Ariigaa taikuu.

T Donny
S Hoffman
37 Edgmon
39 Foster
(HFIN) 40 Joule
38 Herron

Taking Points for HCR 22

26-LS1622\P – 4/3/2010

HCR 22 creates the Alaska Northern Water Task Force to facilitate State of Alaska leadership and regional coordination in the ongoing development of United States' policies related to the opening of Arctic waters.

As many of you know, the Arctic is changing. Recent warming trends are depleting the ice pack by 9% per decade. NASA has observed that the rate of depletion is accelerating due to interactions between the ice, oceans and atmosphere.

The melting of the sea ice is opening waters that were previously frozen year-round. Already, we have seen:

- **increased ship traffic, and it is projected that the Bering and Chukchi seas will become major marine highways in the near future**
- **an unannounced cruise ship docking in Barrow**
- **possibilities for new fisheries**
- **increased access to natural resources**
- **questions of territorial rights**

Arctic nations like Norway, Canada, Iceland and Russia are actively promoting and defending their interests in increasingly ice-free areas. The U.S. is taking steps, as well. In your bill packet, you will see that Senator Begich has introduced 7 pieces of legislation that deal with the Arctic, and Senator Murkowski has introduced 2 bills, one of which relates to creating a deep water port in northern Alaska. The White House has created 2 task forces that touch on northern waters issues: the Interagency Ocean Policy Task Force and the Climate Change Adaptation Task Force. Finally, international bodies like the Arctic Council and the Inuit Circumpolar

Council have been working in this area, as well as Alaska-based NGOs like the Institute of the North. + Commonwealth N.

As the only Arctic state in this nation, Alaska has a unique role and interest in the development of U.S. Arctic policy. This bill foresees the creation of a joint federal/state commission that will guide interagency and inter-jurisdictional actions in the Arctic. It provides an opportunity for the Legislature to take a proactive role in shaping this commission, and in doing so, ensuring that Alaska's interests are strongly represented.

The task force will be made up of 11 members as follows:

- **1 senator from along the Bering, Chukchi or Beaufort seas appointed by the Senate President (stayed same)**
- **3 reps (CRA had 2) from along the Bering, Chukchi or Beaufort seas appointed by the Speaker of the House**
- **7 members (CRA had 6) appointed jointly by the Speaker and Senate President representing the following entities:**
    - **Executive Branch of the AK Government**
    - **Mayors of the NSB, NAB, City of Nome and City of Unalaska (added)**
    - **US Coast Guard**
    - **A member of a federal agency w/a significant role in addressing northern waters issues (CRA had DOI)**

one more in Anc & one in D.C. for 2 members

The task force will hold 7 meetings (CRA had 5) total in the communities that are most directly feeling the impacts of the increased activity in the Arctic: Nome, Kotzebue, Barrow and Unalaska (one in each town, 3 in Anc). We will have hearings in Anchorage as well. The task force will present its findings to the Legislature in January 2012, including legislative proposals for consideration.

I thank the Committee for its time in considering creating this mechanism that will enable the State of Alaska to take a leadership role in the important issue of the northern waters and the opportunities the changing Arctic are presenting to us.

Taking Points for HCR 22 (HCRA) 3/30/2010

HCR 22 creates the Alaska Northern Water Task Force to facilitate State of Alaska leadership and regional coordination in the ongoing development of United States' policies related to the opening of Arctic waters.

As many of you know, the Arctic is changing. Recent warming trends are depleting the ice pack by 9% per decade. NASA has observed that the rate of depletion is accelerating due to interactions between the ice, oceans and atmosphere.

The melting of the sea ice is opening waters that were previously frozen year-round. Already, we have seen:

- **increased ship traffic, and it is projected that the Bering and Chukchi seas will become major marine highways in the near future**
- **an unannounced cruise ship docking in Barrow**
- **possibilities for new fisheries**
- **increased access to natural resources**
- **questions of territorial rights**
- increased coast guard

Arctic nations like Norway, Canada, Iceland and Russia are actively promoting and defending their interests in increasingly ice-free areas. The U.S. is taking steps, as well. In your bill packet, you will see that Senator Begich has introduced 7 pieces of legislation that deal with the Arctic, and Senator Murkowski has introduced 2 bills, one of which relates to creating a deep water port in northern Alaska. The White House has created 2 task forces that touch on northern waters issues: the Interagency Ocean Policy Task Force and the Climate Change Adaptation Task Force. Finally, international bodies like the Arctic Council and the Inuit Circumpolar

Thanks Alan A, Neal F, Bob H. for helping

4 eyes!

~~Bill Noll~~

Thumbs ↑

Alan A

Meade Treadwell

Bill N

Testifiers

(S) Tracy, AK House - 30 fed agencies (S) Denise Michaels, Nome

(S) Meade, USARC (S) Katie Baldwin, AK Humane

(S) Bill Noll

(S) ~~Bobby Schaeffer~~ Ukallaysaaq + Bob S. (+ ICC)

Council have been working in this area, as well as Alaska-based NGOs like the Institute of the North.

As the only Arctic state in this nation, Alaska has a unique role and interest in the development of U.S. Arctic policy. This bill foresees the creation of a joint federal/state commission that will guide interagency and inter-jurisdictional actions in the Arctic. It provides an opportunity for the Legislature to take a proactive role in shaping this commission, and in doing so, ensuring that Alaska's interests are strongly represented.

The task force will be made up of 9 members as follows:

- **1 senator from northwest AK appointed by the Senate President**
- **2 reps from northwest AK appointed by the Speaker of the House**
- **6 members appointed jointly by the Speaker and Senate President representing the following entities:**
    - **Executive Branch of the AK Government**
    - **Mayors of the NSB, NAB and City of Nome**
    - **US Coast Guard**
    - **Department of Interior**

The task force will hold 5 hearings total in the communities that are most directly feeling the impacts of the increased activity in the Arctic: Nome, Kotzebue and Barrow. We will have hearings in Anchorage as well. The task force will present its findings to the Legislature in January 2012, including legislative proposals for consideration.

I thank the Committee for its time in considering creating this mechanism that will enable the State of Alaska to take a leadership role in the important issue of the northern waters and the opportunities the changing Arctic are presenting to us.

SCR 17

E. Hensley

C. Hess

Jim Colvert

A. Austerman

T. Okleasik

D. Michaels, Nome - need state coordinator on all the processes going on, + w/ship assessment

- 1990 31 dockings, last summer 300

Andre Jacobs, AK House NY

Bill Noll, former DCCED + Seward Mayor

Andy Mack

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By the House Community and Regional Affairs Committee

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3. Fiscal Note
4. Summary of Senator Begich's bills relating to Arctic Policy – the Inuvikput Package
5. Article: Melting ice could mean new riches
6. Press Release: Murkowski Speaks at Arctic Policy Roundtable at New York Council on Foreign Relations
7. Opinion by Mayor Itta: Visit to New York, D.C. gets Arctic message across
8. White House Climate Change Adaptation Task Force Overview
9. White House Interagency Ocean Policy Task Force Overview
10. Arctic Marine Shipping Assessment: Scenarios of the Future
11. Northern Waters Commission: A Call to Action

CS FOR HOUSE CONCURRENT RESOLUTION NO. 22(FIN)

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY THE HOUSE FINANCE COMMITTEE

Offered: 4/9/10
Referred: Rules

Sponsor(s): HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of the interaction among the ice, oceans, and atmosphere; and

WHEREAS rapidly retreating sea ice is altering fish and wildlife habitats and affecting the accessibility and viability of certain species, on which many local communities rely for nutritional and cultural purposes; and

WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of 11 members as follows:

(1) two senators appointed by the President of the Senate;

(2) two representatives appointed by the Speaker of the House of Representatives; and

(3) seven members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) five public members, three of whom reside in coastal areas of the state;

(B) one member representing the executive branch of state government;

(C) one member representing the federal government; and be it

FURTHER RESOLVED that a vacancy on the task force shall be filled in the manner of the original appointment; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves and the chair may assign staff to provide support to the task force; and be it

FURTHER RESOLVED that the public members, and, if the member does not receive reimbursement for expenses from the federal government, the federal government member of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions and the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

HFIN

26-LS1622\T
Cook
4/8/2010

CS FOR HOUSE CONCURRENT RESOLUTION NO. 22( )

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY

Offered:
Referred:

Sponsor(s): HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

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WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

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(A) five public members, three of whom reside in coastal areas of the state;

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(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

26-LS1622\P
Cook
4/3/2010

CS FOR HOUSE CONCURRENT RESOLUTION NO. 22( )

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY

Offered:
Referred:

Sponsor(s): HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

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WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

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WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of 11 members as follows:

(1) one senator from an area along the Bering, Chukchi, and Beaufort Seas appointed by the President of the Senate;

(2) three representatives from areas along the Bering, Chukchi, and Beaufort Seas appointed by the Speaker of the House of Representatives; and

(3) seven members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) one member representing the United States Coast Guard;

(B) one member representing the executive branch of state government;

(C) the 4 mayors of the North Slope Borough, Northwest Arctic

Borough, City of Nome, and City of Unalaska; and

(D) one member representing a federal agency with a significant role in addressing northern waters issues; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves and the chair may assign staff to provide support to the task force; and be it

FURTHER RESOLVED that the municipal government and federal government members of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180 if they do not receive reimbursement for expenses from the municipal or federal government; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions and the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

26-LS1622\E
Cook
3/26/2010

CS FOR HOUSE CONCURRENT RESOLUTION NO. 22( )

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY

Offered:
Referred:

Sponsor(s): HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of the interaction among the ice, oceans, and atmosphere; and

WHEREAS rapidly retreating sea ice is altering fish and wildlife habitats and affecting the accessibility and viability of certain species, on which many local communities rely for nutritional and cultural purposes; and

WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of nine members as follows:

(1) one senator from Northwest Alaska appointed by the President of the Senate;

(2) two representatives from Northwest Alaska appointed by the Speaker of the House of Representatives; and

(3) six members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) one member representing the United States Coast Guard;

(B) one member representing the executive branch of state government;

(C) the mayors of the North Slope Borough, Northwest Arctic

Borough, and City of Nome; and

(D) one member representing the United States Department of the Interior; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves and the chair may assign staff to provide support to the task force; and be it

FURTHER RESOLVED that the municipal government and federal government members of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180 if they do not receive reimbursement for expenses from the municipal or federal government; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions and the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

Hostermann, Herron, Foster, Doyle

ALASKA STATE LEGISLATURE

House Community & Regional Affairs Committee

Rep. Cathy Muñoz, Co-Chair

State Capitol Building, Room 409
Juneau, Alaska 99801-1182
Phone (907) 465-3744
Fax (907) 465-2273
Rep_Cathy_Munoz@legis.state.ak.us

Rep. Bob Herron, Co-Chair

State Capitol Building, Room 411
Juneau, Alaska 99801
Phone: (907) 465-4942
Fax: (907) 465-4589
Rep_Bob_Herron@legis.state.ak.us

MEMORANDUM

Date: April 9, 2010

RE: Changes to House Concurrent Resolution 22, Northern Waters Task Force

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Changes from HCR 22 to CS HCR 22 (FIN):

- P. 2, line 20 of the CS: Merges the first two Resolves from the original bill for better readability.
- P. 2 line 21 of the CS: Changes the configuration of the Task Force from 11 to 9 members
  - 2 senators (not 1)
  - 2 reps (same)
  - 7 members appointed jointly (not 6)
    - 5 public, 3 of whom reside in coastal areas (i.e. 2 at-large) (not the 4 mayors)
    - 1 executive branch (same)
    - 1 federal (not 2)
- P. 3, line 1 of the CS: Clarifies that vacancy shall be filled in the manner of the original appointment
- P. 3, lines 4-5 of the CS: Provides that the legislators on the task force shall select a chair from amongst themselves, rather than the task force selecting a chair from among the entire legislature.
- P. 3, line 4 of the CS: Adds that the chair of the task force may assign staff to the task force.

- P. 3, line 7 of the CS: Replaces municipal members with public members to conform with the changed task force configuration.

- P. 3, lines 13-14 of the original bill: Removes "FURTHER RESOLVED that the Bush Caucus chair may assign staff to provide support services for the task force; and be it".

- P. 3, lines 11-20 of the CS: Combines the two RESOLVED clauses before and after the one removed.

- P. 3, lines 19-20 of the CS: Adds "(4) conduct hearings in the Northern Region of the state to fulfill its purpose; and be it" (originally another FURTHER RESOLVED on p.3, lines 23-24 of the original bill.)

During Session:
Alaska State Capitol
Juneau, Alaska 99801-1182
(907) 465-4833
Fax (907) 465-4586
1-800-782-4833
Representative_Reggie_Joule@legis.state.ak.us

During Interim:
P.O. Box 673
Kotzebue, Alaska 99752
(907) 442-3880
Fax (907) 442-3022

Alaska State Legislature
REPRESENTATIVE REGGIE JOULE

CHANGES BETWEEN 26-LS1622\E and T

Composition of the Task Force:

Pg. 2 line 21 – 11 members rather than 9

- 2 senators (not 1)
- 2 reps (same)
- 7 members appointed jointly (not 6)
  - 5 public, 3 of whom reside in coastal areas (i.e. 2 at-large) (not the 4 mayors)
  - 1 executive branch (same)
  - 1 federal (not 2)

Pg. 3 line 1 – vacancy shall be filled in the manner of the original appointment

HOUSE CONCURRENT RESOLUTION NO. 22

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY THE HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

Introduced: 3/24/10
Referred: Community and Regional Affairs, Finance

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of interaction among the ice, oceans, and atmosphere; and

WHEREAS rapidly retreating sea ice is altering fish and wildlife habitats and affecting the accessibility and viability of certain species, on which many local communities rely for nutritional and cultural purposes; and

WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch; and be it

condensed in CS; how matches SCRA

FURTHER RESOLVED that the task force shall consist of nine members as follows:

(1) one senator from Northwest Alaska appointed by the President of the Senate;

(2) two representatives from Northwest Alaska appointed by the Speaker of the House of Representatives; and

(3) six members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) one member representing the United States Coast Guard;

(B) one member representing the executive branch of state government;

(C) the mayors of the North Slope Borough, Northwest Arctic Borough, and City of Nome; and

(D) one member representing the United States Department of the Interior; and be it

FURTHER RESOLVED that the task force shall select a chair from among the members of the legislature; and be it

FURTHER RESOLVED that the municipal government and federal government members of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180 if they do not receive reimbursement for expenses from the municipal or federal government; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions; and be it

FURTHER RESOLVED that the Bush Caucus chair may assign staff to provide support services for the task force; and be it

FURTHER RESOLVED that the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process; and

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and be it

FURTHER RESOLVED that the task force shall conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall

be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

FISCAL NOTE

STATE OF ALASKA **DRAFT DRAFT DRAFT DRAFT** Fiscal Note Number:
2010 LEGISLATIVE SESSION Bill Version: **HCR 22**
() Publish Date:

Identifier (file name): HCR22-LEG-COU-3-25-10 - DRAFT
Dept. Affected: Legislature
Title: Establishing and relating to the Alaska Northern Waters Task Force
RDU: Legislative Council
Component: Council and Subcommittees
Sponsor: House Community and Regional Affairs
Requester: House Community and Regional Affairs
Component Number: 783

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

	Appropriation Required	Information					
OPERATING EXPENDITURES	**FY 2011**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
Personal Services							
Travel	96.1						
Contractual	10.0						
Supplies							
Equipment							
Land & Structures							
Grants & Claims							
Miscellaneous							
TOTAL OPERATING	**106.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
CAPITAL EXPENDITURES							
CHANGE IN REVENUES ( )							

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts							
1003 GF Match							
1004 GF	106.1						
1005 GF/Program Receipts							
1037 GF/Mental Health							
Other Interagency Receipts							
TOTAL	**106.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimate of any current year (FY2010) cost:

POSITIONS

Full-time							
Part-time							
Temporary							

ANALYSIS: *(Attach a separate page if necessary)*

HCR22 establishes the Alaska Northern Waters Task Force in the Legislative Branch. The Task Force consists of nine members composed of three Legislators, one member from the Executive Branch, and five public members. It is anticipated that the Task Force will hold six meetings. Travel funding is included in this fiscal note and includes the cost for experts to attend the meetings. Meetings will be held in the Legislative Information Offices or local government facilities at no cost to the Task Force. The Bush Caucus Chair may assign staff of the Bush Caucus Chair to support the Task Force. The Task Force will assess and facilitate the creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters; inform and incorporate local stakeholders input into the process, and identify and coordinate efforts of mutual concern for federal, state, and local agencies. Funding for professional services contracts is included in this fiscal note. Costs to teleconference meetings and print the proposals and reports due in January 2011 will be absorbed in the Legislative Affairs Agency Budget.

Prepared by: Karla Schofield, Deputy Director — Phone: 465-6626
Division: Legislative Affairs Agency — Date/Time: 3/25/10 4:36 PM
Approved by: Pamela Varni, Executive Director — Date: 3/25/2010
Legislative Affairs Agency

ALASKA STATE LEGISLATURE

House Community & Regional Affairs Committee

Rep. Cathy Muñoz, Co-Chair

State Capitol Building, Room 409
Juneau, Alaska 99801-1182
Phone (907) 465-3744
Fax (907) 465-2273
Rep_Cathy_Munoz@legis.state.ak.us

Rep. Bob Herron, Co-Chair

State Capitol Building, Room 411
Juneau, Alaska 99801
Phone: (907) 465-4942
Fax: (907) 465-4589
Rep_Bob_Herron@legis.state.ak.us

Sponsor Statement
House Concurrent Resolution 22
Establishing the Alaska Northern Waters Task Force

House Concurrent Resolution 22 establishes the Alaska Northern Waters Task Force to facilitate regional coordination and State of Alaska leadership in the ongoing development of the United States' policies related to the opening of Arctic marine transportation routes, national security, and resource development. The task force will comprise Legislators from Northwestern Alaska, leaders from Arctic communities, and key federal agencies. Together, they will assess and facilitate the creation of a joint state and federal entity to coordinate United States and Alaska interests that result from the opening of Arctic waters.

Perennial ice in the circumpolar Arctic waters is reducing in size at a rate of nine percent per decade. Arctic nations such as Norway, Canada and Russia are proactively promoting and defending their interests in increasingly ice-free areas. As the only Arctic state in this nation, Alaska has a unique role and interest in the development and evolution of U.S. policy in its northernmost region.

The creation of the Alaska Northern Waters Task Force anticipates increased federal attention to navigation routes, resource development, military activity and commerce in the Arctic. HCR 22 foresees the future creation of a joint federal/state commission that guides interagency and inter-jurisdiction actions in

the Arctic. It provides an opportunity for Alaska's Legislature and Arctic communities to assume a proactive role in shaping such a body, and ensures that Alaska's unique interests are strongly represented.

In the execution of its responsibilities, the Alaska Northern Waters Task Force will hold hearings in the northern communities of Barrow, Nome and Kotzebue, as well as Anchorage. By meeting in these regions, the task force will be able to seek guidance and feedback from the residents of the regions most likely to experience impacts from increased activity in the Arctic.

The Alaska Northern Waters Task Force will deliver its findings to the Alaska Legislature in January 2012, including legislative proposals for consideration.

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: **CS HCR22 (FIN)**
() Publish Date:

Identifier (file name): CS HCR22 (FIN)-LEG-COU-4-9-10
Dept. Affected: Legislature
Title: Establishing and relating to the Alaska Northern Waters Task Force
RDU: Legislative Council
Component: Council and Subcommittees
Sponsor: House Community and Regional Affairs
Requester: House Finance Committee
Component Number: 783

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

	Appropriation Required	Information					
OPERATING EXPENDITURES	**FY 2011**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
Personal Services							
Travel	140.0		70.0				
Contractual	10.0		5.0				
Supplies							
Equipment							
Land & Structures							
Grants & Claims							
Miscellaneous							
TOTAL OPERATING	**150.0**	**0.0**	**75.0**	**0.0**	**0.0**	**0.0**	**0.0**
CAPITAL EXPENDITURES							
CHANGE IN REVENUES ( )							

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts							
1003 GF Match							
1004 GF	150.0		75.0				
1005 GF/Program Receipts							
1037 GF/Mental Health							
Other Interagency Receipts							
TOTAL	**150.0**	**0.0**	**75.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimate of any current year (FY2010) cost:

POSITIONS

Full-time							
Part-time							
Temporary							

ANALYSIS: *(Attach a separate page if necessary)*

CS HCR22(FIN) establishes the Alaska Northern Waters Task Force in the Legislative Branch. The Task Force consists of eleven members composed of four Legislators, one member from the Executive Branch, and seven public members. It is anticipated that the Task Force will hold seven meetings in the first year and three meetings in the second year. Travel funding is included in this fiscal note and includes the cost for experts to attend the meetings. Meetings will be held in Barrow, Nome, Kotzebue, Unalaska and Anchorage at Legislative Information Offices or local government facilities at no rental cost to the Task Force. The Task Force Chair may assign their staff to support the Task Force. The Task Force will assess and facilitate the creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters; inform and incorporate local stakeholders input into the process, and identify and coordinate efforts of mutual concern for federal, state, and local agencies. Funding for professional services contracts is included in this fiscal note. Costs to teleconference meetings and print the proposals and reports due in January 2012 will be absorbed in the Legislative Affairs Agency Budget.

Prepared by: Karla Schofield, Deputy Director — Phone 465-6626
Division: Legislative Affairs Agency — Date/Time 4/9/10 4:11 PM
Approved by: Pamela Varni, Executive Director — Date 4/9/2010
Legislative Affairs Agency

(Revised 11/6/2009 OMB)

ANALYSIS CONTINUATION

7 meetings - all with travel
1 member of the Executive Branch - travel absorbed in Executive Branch budget
4 Legislators; 7 public members; 1 staff person, 4 experts

1 meeting	Airfare	247/day Per Diem			
Nome Meeting					
Nome Senator					
Bethel Senator	1062	494			
Kotzebue Legislator	427	494			
Nome Legislator					
Anchorage public member	568	494			
Fairbanks public member	986	494			
Barrow public member	1158	494			
Kotzebue public member	427	494			
Nome public member					
Anchorage Fed public member	568	494			
Kotzebue Staff person	427	494			
Anchorage Expert	568	494			
Anchorage Expert	568	494			
Washington, DC Expert	1450	988			
Washington, DC Expert	1450	988			
	9,659.00	6,916	16,575	1	16,575

3 meetings	Airfare	278/day Per Diem			
Anchorage Meeting					
Nome Legislator	568	556			
Bethel Legislator	494	556			
Kotzebue Legislator	568	556			
Nome Legislator	568	556			
Anchorage public member					
Fairbanks public member	418	556			
Barrow public member	709	556			
Kotzebue public member	568	556			
Nome public member	568	556			
Anchorage Fed public member					
Kotzebue Staff person	568	556			
Anchorage Expert					
Anchorage Expert					
Washington, DC Expert	1309	1112			
Washington, DC Expert	1309	1112			
	7,647	7,228	14,875	3	44,625

ANALYSIS CONTINUATION

1 meeting	Airfare	254/day Per Diem			
Barrow Meeting					
Nome Legislator	1160	508			
Bethel Legislator	1098	508			
Kotzebue Legislator	1290	508			
Nome Legislator	1160	508			
Anchorage public member	846	508			
Fairbanks public member	576	508			
Barrow Member					
Kotzebue Member	1290	508			
Nome Member	1160	508			
Anchorage Fed public member	846	508			
Kotzebue Staff person	1290	508			
Anchorage Expert	846	508			
Anchorage Expert	846	508			
Washington, DC Expert	1751	1016			
Washington, DC Expert	1751	1016			
	15,910	8,128	24,038	1	24,038

1 meeting	Airfare	282/day Per Diem			
Kotzebue					
Nome Legislator	427	564			
Bethel Legislator	878	564			
Kotzebue Legislator					
Nome Legislator	427	564			
Anchorage public member	568	564			
Fairbanks public member	986	564			
Barrow Member	1158	564			
Kotzebue Member					
Nome Member	427	564			
Anchorage Fed public member	568	564			
Kotzebue Staff person					
Anchorage Energy	568	564			
Anchorage Expert	568	564			
Washington, DC Expert	1670	1128			
Washington, DC Expert	1670	1128			
	9,915	7,896	17,811	1	17,811

FISCAL NOTE

STATE OF ALASKA **BILL NO.** CS HCR 22 (FIN)
2010 LEGISLATIVE SESSION

ANALYSIS CONTINUATION

1 meeting	Airfare	207/day Per Diem			
Unalaska					
Nome Legislator	1298	414			
Bethel Legislator	1226	414			
Kotzebue Legislator	1298	414			
Nome Legislator	1298	414			
Anchorage public member	1038	414			
Fairbanks public member	1164	414			
Barrow Member	1345	414			
Kotzebue Member	1298	414			
Nome Member	1298	414			
Anchorage Federal member	1038	414			
Kotzebue Staff person	1298	414			
Anchorage Expert	1038	414			
Anchorage Expert	1038	414			
Washington, DC Expert	2344	828			
Washington, DC Expert	2344	828			
	20,363	7,038	27,401	1	27,401
Juneau Trip					
Nome public member	978	756			
Barrow public member	1216	756			
	2,194	1,512	3,706	1	3,706
D.C. Trip - 2 people					
Nome	1,447	900			
Kotzebue	1,444	900			
	2,891	1800	4,691	1	4,691
					138,847

HFIN
4/9/10

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: **WD 26-LS1622/T**
() Publish Date:

Identifier (file name): Work Draft 26-LS1622/T
Title: Establishing and relating to the Alaska Northern Waters Task Force
Sponsor: House Community and Regional Affairs
Requester: House Community and Regional Affairs

Dept. Affected: Legislature
RDU: Legislative Council
Component: Council and Subcommittees
Component Number: 783

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

	Appropriation Required	Information					
OPERATING EXPENDITURES	**FY 2011**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
Personal Services							
Travel	140.0		70.0				
Contractual	10.0		5.0				
Supplies							
Equipment							
Land & Structures							
Grants & Claims							
Miscellaneous							
TOTAL OPERATING	**150.0**	**0.0**	**75.0**	**0.0**	**0.0**	**0.0**	**0.0**
CAPITAL EXPENDITURES							
CHANGE IN REVENUES ( )							

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts							
1003 GF Match							
1004 GF	150.0		75.0				
1005 GF/Program Receipts							
1037 GF/Mental Health							
Other Interagency Receipts							
TOTAL	**150.0**	**0.0**	**75.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimate of any current year (FY2010) cost:

POSITIONS

Full-time							
Part-time							
Temporary							

ANALYSIS: *(Attach a separate page if necessary)*

Work Draft 26-LS1622/T establishes the Alaska Northern Waters Task Force in the Legislative Branch. The Task Force consists of eleven members composed of four Legislators, one member from the Executive Branch, and seven public members. It is anticipated that the Task Force will hold seven meetings in the first year and three meetings in the second year. Travel funding is included in this fiscal note and includes the cost for experts to attend the meetings. Meetings will be held in Barrow, Nome, Kotzebue, Unalaska and Anchorage at Legislative Information Offices or local government facilities at no rental cost to the Task Force. The Task Force Chair may assign their staff to support the Task Force. The Task Force will assess and facilitate the creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters; inform and incorporate local stakeholders input into the process, and identify and coordinate efforts of mutual concern for federal, state, and local agencies. Funding for professional services contracts is included in this fiscal note. Costs to teleconference meetings and print the proposals and reports due in January 2012 will be absorbed in the Legislative Affairs Agency Budget.

Prepared by: Karla Schofield, Deputy Director — Phone 465-6626
Division: Legislative Affairs Agency — Date/Time 4/9/10 8:48 AM
Approved by: Pamela Varni, Executive Director — Date 4/9/2010
Legislative Affairs Agency

ANALYSIS CONTINUATION

7 meetings - all with travel
1 member of the Executive Branch - travel absorbed in Executive Branch budget
4 Legislators; 7 public members; 1 staff person, 4 experts

1 meeting	Airfare	247/day Per Diem			
Nome Meeting					
Nome Senator					
Bethel Senator	1062	494			
Kotzebue Legislator	427	494			
Nome Legislator					
Anchorage public member	568	494			
Fairbanks public member	986	494			
Barrow public member	1158	494			
Kotzebue public member	427	494			
Nome public member					
Anchorage Fed public member	568	494			
Kotzebue Staff person	427	494			
Anchorage Expert	568	494			
Anchorage Expert	568	494			
Washington, DC Expert	1450	988			
Washington, DC Expert	1450	988			
	9,659.00	6,916	16,575	1	16,575

3 meetings	Airfare	278/day Per Diem			
Anchorage Meeting					
Nome Legislator	568	556			
Bethel Legislator	494	556			
Kotzebue Legislator	568	556			
Nome Legislator	568	556			
Anchorage public member					
Fairbanks public member	418	556			
Barrow public member	709	556			
Kotzebue public member	568	556			
Nome public member	568	556			
Anchorage Fed public member					
Kotzebue Staff person	568	556			
Anchorage Expert					
Anchorage Expert					
Washington, DC Expert	1309	1112			
Washington, DC Expert	1309	1112			
	7,647	7,228	14,875	3	44,625

STATE OF ALASKA
2010 LEGISLATIVE SESSION

BILL NO. Work Draft 26-LS2611/T

ANALYSIS CONTINUATION

1 meeting	Airfare	254/day Per Diem			
Barrow Meeting					
Nome Legislator	1160	508			
Bethel Legislator	1098	508			
Kotzebue Legislator	1290	508			
Nome Legislator	1160	508			
Anchorage public member	846	508			
Fairbanks public member	576	508			
Barrow Member					
Kotzebue Member	1290	508			
Nome Member	1160	508			
Anchorage Fed public member	846	508			
Kotzebue Staff person	1290	508			
Anchorage Expert	846	508			
Anchorage Expert	846	508			
Washington, DC Expert	1751	1016			
Washington, DC Expert	1751	1016			
	15,910	8,128	24,038	1	24,038

1 meeting	Airfare	282/day Per Diem			
Kotzebue					
Nome Legislator	427	564			
Bethel Legislator	878	564			
Kotzebue Legislator					
Nome Legislator	427	564			
Anchorage public member	568	564			
Fairbanks public member	986	564			
Barrow Member	1158	564			
Kotzebue Member					
Nome Member	427	564			
Anchorage Fed public member	568	564			
Kotzebue Staff person					
Anchorage Energy	568	564			
Anchorage Expert	568	564			
Washington, DC Expert	1670	1128			
Washington, DC Expert	1670	1128			
	9,915	7,896	17,811	1	17,811

STATE OF ALASKA
2010 LEGISLATIVE SESSION

BILL NO. Work Draft 26-LS1622/T

ANALYSIS CONTINUATION

1 meeting	Airfare	207/day Per Diem			
Unalaska					
Nome Legislator	1298	414			
Bethel Legislator	1226	414			
Kotzebue Legislator	1298	414			
Nome Legislator	1298	414			
Anchorage public member	1038	414			
Fairbanks public member	1164	414			
Barrow Member	1345	414			
Kotzebue Member	1298	414			
Nome Member	1298	414			
Anchorage Federal member	1038	414			
Kotzebue Staff person	1298	414			
Anchorage Expert	1038	414			
Anchorage Expert	1038	414			
Washington, DC Expert	2344	828			
Washington, DC Expert	2344	828			
	20,363	7,038	27,401	1	27,401
Juneau Trip					
Nome public member	978	756			
Barrow public member	1216	756			
	2,194	1,512	3,706	1	3,706
D.C. Trip - 2 people					
Nome	1,447	900			
Kotzebue	1,444	900			
	2,891	1800	4,691	1	4,691
					138,847

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: **WD 26-LS1622\P**
() Publish Date:

Identifier (file name):	Work Draft 26-LS1622\P	Dept. Affected:	Legislature
Title	Establishing and relating to the Alaska Northern Waters Task Force	RDU	Legislative Council
		Component	Council and Subcommittees
Sponsor	House Community and Regional Affairs		
Requester	House Community and Regional Affairs	Component Number	783

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

	Appropriation Required	Information					
OPERATING EXPENDITURES	**FY 2011**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
Personal Services							
Travel	155.0		80.0				
Contractual	10.0		5.0				
Supplies							
Equipment							
Land & Structures							
Grants & Claims							
Miscellaneous							
TOTAL OPERATING	**165.0**	**0.0**	**85.0**	**0.0**	**0.0**	**0.0**	**0.0**
CAPITAL EXPENDITURES							
CHANGE IN REVENUES ( )							

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts							
1003 GF Match							
1004 GF	165.0		85.0				
1005 GF/Program Receipts							
1037 GF/Mental Health							
Other Interagency Receipts							
TOTAL	**165.0**	**0.0**	**85.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimate of any current year (FY2010) cost:

POSITIONS

Full-time							
Part-time							
Temporary							

ANALYSIS: *(Attach a separate page if necessary)*

Work Draft 26-LS1622\P establishes the Alaska Northern Waters Task Force in the Legislative Branch. The Task Force consists of twelve members composed of five Legislators, one member from the Executive Branch, and six public members. It is anticipated that the Task Force will hold seven meetings in the first year and three meetings in the second year. Travel funding is included in this fiscal note and includes the cost for experts to attend the meetings. Meetings will be held in Barrow, Nome, Kotzebue, Unalaska and Anchorage at Legislative Information Offices or local government facilities at no rental cost to the Task Force. The Task Force Chair may assign their staff to support the Task Force. The Task Force will assess and facilitate the creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters; inform and incorporate local stakeholders input into the process, and identify and coordinate efforts of mutual concern for federal, state, and local agencies. Funding for professional services contracts is included in this fiscal note. Costs to teleconference meetings and print the proposals and reports due in January 2012 will be absorbed in the Legislative Affairs Agency Budget.

Prepared by:	Karla Schofield, Deputy Director	Phone	465-6626
Division	Legislative Affairs Agency	Date/Time	4/6/10 8:55 AM
Approved by:	Pamela Varni, Executive Director	Date	4/6/2010
	Legislative Affairs Agency		

ANALYSIS CONTINUATION

7 meetings - all with travel
1 member of the Executive Branch - will pay own travel
5 Legislators; 6 public members; 1 staff person, 4 experts

1 meeting	Airfare	247/day Per Diem			
Nome Meeting					
Bethel Legislator	1062	494			
Bethel Legislator	1062	494			
Kotzebue Legislator	427	494			
Nome Legislator					
Nome Legislator					
Juneau Coast Guard member	880	494			
North Slope Borough - Barrow	1158	494			
NW Arctic Mayor - Kotzebue	427	494			
Nome Mayor					
Unalaska Mayor	1298	494			
Anchorage Federal Exec Member	568	494			
Kotzebue Staff person	427	494			
Anchorage Energy Expert	568	494			
Anchorage Energy Expert	568	494			
Washington, DC Energy Expert	1450	988			
Washington, DC Energy Expert	1450	988			
	11,345.00	7,410	18,755	1	18,755

3 meetings	Airfare	278/day Per Diem			
Anchorage Meeting					
Bethel Legislator	494	556			
Bethel Legislator	494	556			
Kotzebue Legislator	568	556			
Nome Legislator	568	556			
Nome Legislator	568	556			
Juneau Coast Guard member	506	556			
North Slope Borough - Barrow	709	556			
NW Arctic Mayor - Kotzebue	568	556			
Nome Mayor	568	556			
Unalaska Mayor	1038	556			
Anchorage Federal Exec member	0	0			
Kotzebue Staff person	568	556			
Anchorage Energy Expert	0	0			
Anchorage Energy Expert	0	0			
Washington, DC Energy Expert	1309	1112			
Washington, DC Energy Expert	1309	1112			
	9,267	8,340	17,607	3	52,821

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

BILL NO. Work Draft 26-LS1622\P

ANALYSIS CONTINUATION

1 meeting	Airfare	254/day Per Diem			
Barrow Meeting					
Bethel Legislator	1098	508			
Bethel Legislator	1098	508			
Kotzebue Legislator	1290	508			
Nome Legislator	1160	508			
Nome Legislator	1160	508			
Juneau Coast Guard member	1195	508			
North Slope Borough - Barrow					
NW Arctic Mayor - Kotzebue	1290	508			
Nome Mayor	1160	508			
Unalaska Mayor	1748	508			
Anchorage Federal Exec member	846	508			
Kotzebue Staff person	1290	508			
Anchorage Energy Expert	846	508			
Anchorage Energy Expert	846	508			
Washington, DC Energy Expert	1751	1016			
Washington, DC Energy Expert	1751	1016			
	18,529	8,636	27,165	1	27,165

1 meeting	Airfare	282/day Per Diem			
Kotzebue					
Bethel Legislator	878	564			
Bethel Legislator	878	564			
Kotzebue Legislator					
Nome Legislator	427	564			
Nome Legislator	427	564			
Juneau Coast Guard member	1078	564			
North Slope Borough - Barrow	1158	564			
NW Arctic Mayor - Kotzebue					
Nome Mayor	427	564			
Unalaska Mayor	1298	564			
Anchorage Federal Exec member	568	564			
Kotzebue Staff person					
Anchorage Energy Expert	568	564			
Anchorage Energy Expert	568	564			
Washington, DC Energy Expert	1670	1128			
Washington, DC Energy Expert	1670	1128			
	11,615	8,460	20,075	1	20,075

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

BILL NO. Work Draft 26-LS1622\P

ANALYSIS CONTINUATION

1 meeting	Airfare	207/day Per Diem			
Unalaska					
Bethel Legislator	1226	414			
Bethel Legislator	1226	414			
Kotzebue Legislator	1298	414			
Nome Legislator	1298	414			
Nome Legislator	1298	414			
Juneau Coast Guard member	1238	414			
North Slope Borough - Barrow	1345	414			
NW Arctic Mayor - Kotzebue	1298	414			
Nome Mayor	1298	414			
Unalaska Mayor					
Anchorage Federal Exec member	1038	414			
Kotzebue Staff person	1298	414			
Anchorage Energy Expert	1038	414			
Anchorage Energy Expert	1038	414			
Washington, DC Energy Expert	2344	828			
Washington, DC Energy Expert	2344	828			
	20,625	7,038	27,663	1	27,663
Juneau Trip					
Nome Mayor	978	756			
Barrow Mayor	1216	756			
	2,194	1,512	3,706	1	3,706
D.C. Trip - 2 people					
Nome	1,447	900			
Kotzebue	1,444	900			
	2,891	1800	4,691	1	4,691
					154,876

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: **WD 26-LS1622\P**
() Publish Date:

Identifier (file name):	Work Draft 26-LS1622\P	Dept. Affected:	Legislature
Title	Establishing and relating to the Alaska Northern Waters Task Force	RDU	Legislative Council
		Component	Council and Subcommittees
Sponsor	House Community and Regional Affairs		
Requester	House Community and Regional Affairs	Component Number	783

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

	Appropriation Required	Information					
OPERATING EXPENDITURES	**FY 2011**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
Personal Services							
Travel	146.0		75.0				
Contractual	10.0		5.0				
Supplies							
Equipment							
Land & Structures							
Grants & Claims							
Miscellaneous							
TOTAL OPERATING	**156.0**	**0.0**	**80.0**	**0.0**	**0.0**	**0.0**	**0.0**
CAPITAL EXPENDITURES							
CHANGE IN REVENUES ( )							

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts							
1003 GF Match							
1004 GF	156.0		80.0				
1005 GF/Program Receipts							
1037 GF/Mental Health							
Other Interagency Receipts							
TOTAL	**156.0**	**0.0**	**80.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimate of any current year (FY2010) cost:

POSITIONS

Full-time							
Part-time							
Temporary							

ANALYSIS: *(Attach a separate page if necessary)*

Work Draft 26-LS1622\P establishes the Alaska Northern Waters Task Force in the Legislative Branch. The Task Force consists of eleven members composed of four Legislators, one member from the Executive Branch, and six public members. It is anticipated that the Task Force will hold seven meetings in the first year and three meetings in the second year. Travel funding is included in this fiscal note and includes the cost for experts to attend the meetings. Meetings will be held in Barrow, Nome, Kotzebue, Unalaska and Anchorage at Legislative Information Offices or local government facilities at no rental cost to the Task Force. The Task Force Chair may assign their staff to support the Task Force. The Task Force will assess and facilitate the creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters; inform and incorporate local stakeholders input into the process, and identify and coordinate efforts of mutual concern for federal, state, and local agencies. Funding for professional services contracts is included in this fiscal note. Costs to teleconference meetings and print the proposals and reports due in January 2012 will be absorbed in the Legislative Affairs Agency Budget.

Prepared by:	Karla Schofield, Deputy Director	Phone	465-6626
Division	Legislative Affairs Agency	Date/Time	4/5/10 1:17 PM
Approved by:	Pamela Varni, Executive Director	Date	4/5/2010
	Legislative Affairs Agency		

FISCAL NOTE

STATE OF ALASKA **BILL NO.** Work Draft 26-LS1622\P
2010 LEGISLATIVE SESSION

ANALYSIS CONTINUATION

7 meetings - all with travel
1 member of the Executive Branch - will pay own travel
4 Legislators; 6 public members; 1 staff person, 4 experts

1 meeting Nome Meeting	Airfare	247/day Per Diem			
Bethel Legislator	1062	494			
Kotzebue Legislator	427	494			
Nome Legislator					
Nome Legislator					
Juneau Coast Guard member	880	494			
North Slope Borough - Barrow	1158	494			
NW Arctic Mayor - Kotzebue	427	494			
Nome Mayor					
Unalaska Mayor	1298	494			
Anchorage Federal Exec Member	568	494			
Kotzebue Staff person	427	494			
Anchorage Energy Expert	568	494			
Anchorage Energy Expert	568	494			
Washington, DC Energy Expert	1450	988			
Washington, DC Energy Expert	1450	988			
	9,221.00	6,422	15,643	1	15,643

3 meetings Anchorage Meeting	Airfare	278/day Per Diem			
Bethel Legislator	494	556			
Kotzebue Legislator	568	556			
Nome Legislator	568	556			
Nome Legislator	568	556			
Juneau Coast Guard member	506	556			
North Slope Borough - Barrow	709	556			
NW Arctic Mayor - Kotzebue	568	556			
Nome Mayor	568	556			
Unalaska Mayor	1038	556			
Anchorage Federal Exec member	0	0			
Kotzebue Staff person	568	556			
Anchorage Energy Expert	0	0			
Anchorage Energy Expert	0	0			
Washington, DC Energy Expert	1309	1112			
Washington, DC Energy Expert	1309	1112			
	8,773	7,784	16,557	3	49,671

FISCAL NOTE

STATE OF ALASKA **BILL NO.** Work Draft 26-LS1622\P
2010 LEGISLATIVE SESSION

ANALYSIS CONTINUATION

1 meeting	Airfare	254/day Per Diem			
Barrow Meeting					
Bethel Legislator	1098	508			
Kotzebue Legislator	1290	508			
Nome Legislator	1160	508			
Nome Legislator	1160	508			
Juneau Coast Guard member	1195	508			
North Slope Borough - Barrow					
NW Arctic Mayor - Kotzebue	1290	508			
Nome Mayor	1160	508			
Unalaska Mayor	1748	508			
Anchorage Federal Exec member	846	508			
Kotzebue Staff person	1290	508			
Anchorage Energy Expert	846	508			
Anchorage Energy Expert	846	508			
Washington, DC Energy Expert	1751	1016			
Washington, DC Energy Expert	1751	1016			
	17,431	8,128	25,559	1	25,559

1 meeting	Airfare	282/day Per Diem			
Kotzebue					
Bethel Legislator	878	564			
Kotzebue Legislator					
Nome Legislator	427	564			
Nome Legislator	427	564			
Juneau Coast Guard member	1078	564			
North Slope Borough - Barrow	1158	564			
NW Arctic Mayor - Kotzebue					
Nome Mayor	427	564			
Unalaska Mayor	1298	564			
Anchorage Federal Exec member	568	564			
Kotzebue Staff person					
Anchorage Energy Expert	568	564			
Anchorage Energy Expert	568	564			
Washington, DC Energy Expert	1670	1128			
Washington, DC Energy Expert	1670	1128			
	10,737	7,896	18,633	1	18,633

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

BILL NO. Work Draft 26-LS1622\P

ANALYSIS CONTINUATION

1 meeting		207/day			
Unalaska	Airfare	Per Diem			
Bethel Legislator	1226	414			
Kotzebue Legislator	1298	414			
Nome Legislator	1298	414			
Nome Legislator	1298	414			
Juneau Coast Guard member	1238	414			
North Slope Borough - Barrow	1345	414			
NW Arctic Mayor - Kotzebue	1298	414			
Nome Mayor	1298	414			
Unalaska Mayor					
Anchorage Federal Exec member	1038	414			
Kotzebue Staff person	1298	414			
Anchorage Energy Expert	1038	414			
Anchorage Energy Expert	1038	414			
Washington, DC Energy Expert	2344	828			
Washington, DC Energy Expert	2344	828			
	19,399	6,624	26,023	1	26,023
Juneau Trip					
Nome Mayor	978	756			
Barrow Mayor	1216	756			
	2,194	1,512	3,706	1	3,706
D.C. Trip - 2 people					
Nome	1,447	900			
Kotzebue	1.444	900			
	2,891	1800	4,691	1	4,691
					143,926

CRA

FISCAL NOTE

STATE OF ALASKA
2010 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: **HCR 22**
() Publish Date:

Identifier (file name):	HCR22-LEG-COU-3-26-10	Dept. Affected:	Legislature
Title	Establishing and relating to the Alaska Northern Waters Task Force	RDU	Legislative Council
		Component	Council and Subcommittees
Sponsor	House Community and Regional Affairs		
Requester	House Community and Regional Affairs	Component Number	783

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

	Appropriation Required	Information					
OPERATING EXPENDITURES	**FY 2011**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
Personal Services							
Travel	84.0						
Contractual	10.0						
Supplies							
Equipment							
Land & Structures							
Grants & Claims							
Miscellaneous							
TOTAL OPERATING	**94.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
CAPITAL EXPENDITURES							
CHANGE IN REVENUES ( )							

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts							
1003 GF Match							
1004 GF	94.0						
1005 GF/Program Receipts							
1037 GF/Mental Health							
Other Interagency Receipts							
TOTAL	**94.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimate of any current year (FY2010) cost:

POSITIONS

Full-time							
Part-time							
Temporary							

ANALYSIS: *(Attach a separate page if necessary)*

HCR22 establishes the Alaska Northern Waters Task Force in the Legislative Branch. The Task Force consists of nine members composed of three Legislators, one member from the Executive Branch, and five public members. It is anticipated that the Task Force will hold five meetings. Travel funding is included in this fiscal note and includes the cost for experts to attend the meetings. Meetings will be held in Barrow, Nome, Kotzebue, and Anchorage at Legislative Information Offices or local government facilities at no rental cost to the Task Force. The Bush Caucus Chair may assign staff of the Bush Caucus Chair to support the Task Force. The Task Force will assess and facilitate the creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters; inform and incorporate local stakeholders input into the process, and identify and coordinate efforts of mutual concern for federal, state, and local agencies. Funding for professional services contracts is included in this fiscal note. Costs to teleconference meetings and print the proposals and reports due in January 2011 will be absorbed in the

Prepared by:	Karla Schofield, Deputy Director	Phone	465-6626
Division	Legislative Affairs Agency	Date/Time	3/26/10 3:12 PM
Approved by:	Pamela Varni, Executive Director	Date	3/26/2010
	Legislative Affairs Agency		

ANALYSIS CONTINUATION

5 meetings - all with travel

1 member of the Executive Branch - absorb travel in Executive Branch Budget.
3 Legislators; 5 public members; 1 staff person, 4 experts

1 meeting	Airfare	247/day Per Diem			
Nome Meeting					
Bethel Legislator	1062	494			
Kotzebue Legislator	427	494			
Nome Legislator	0	0			
Juneau Coast Guard member	880	494			
North Slope Borough - Barrow	1158	494			
NW Arctic Mayor - Kotzebue	427	494			
Nome Mayor	0	0			
Anchorage Interior Dept member	568	494			
Kotzebue Staff person	427	494			
Anchorage Energy Expert	568	494			
Anchorage Energy Expert	568	494			
Washington, DC Energy Expert	1450	988			
Washington, DC Energy Expert	1450	988			
	8,985.00	6,422	15,407	1	15,407

2 meetings	Airfare	278/day Per Diem			
Anchorage Meeting					
Bethel Legislator	494	556			
Kotzebue Legislator	568	556			
Nome Legislator	568	556			
Juneau Coast Guard member	506	556			
North Slope Borough - Barrow	709	556			
NW Arctic Mayor - Kotzebue	568	556			
Nome Mayor	568	556			
Anchorage Interior Dept member	0	0			
Kotzebue Staff person	568	556			
Anchorage Energy Expert	0	0			
Anchorage Energy Expert	0	0			
Washington, DC Energy Expert	1309	1112			
Washington, DC Energy Expert	1309	1112			
	7,167	6,672	13,839	2	27,678

FISCAL NOTE

STATE OF ALASKA **BILL NO.** HCR 22
2010 LEGISLATIVE SESSION

ANALYSIS CONTINUATION

1 meeting	Airfare	278/day Per Diem			
Barrow Meeting					
Bethel Legislator	1098	508			
Kotzebue Legislator	1290	508			
Nome Legislator	1160	508			
Juneau Coast Guard member	1195	508			
North Slope Borough - Barrow	0	0			
NW Arctic Mayor - Kotzebue	1290	508			
Nome Mayor	1160	508			
Anchorage Interior Dept member	846	508			
Kotzebue Staff person	1290	508			
Anchorage Energy Expert	846	508			
Anchorage Energy Expert	846	508			
Washington, DC Energy Expert	1751	1016			
Washington, DC Energy Expert	1751	1016			
	14,523	7,112	21,635	1	21,635

1 meeting	Airfare	Per Diem 282/day			
Kotzebue					
Bethel Legislator	878	564			
Kotzebue Legislator	0	0			
Nome Legislator	427	564			
Juneau Coast Guard member	1078	564			
North Slope Borough - Barrow	1158	564			
NW Arctic Mayor - Kotzebue	0	0			
Nome Mayor	427	564			
Anchorage Interior Dept member	568	564			
Kotzebue Staff person	0	0			
Anchorage Energy Expert	568	564			
Anchorage Energy Expert	568	564			
Washington, DC Energy Expert	1670	1128			
Washington, DC Energy Expert	1670	1128			
	9,012	6,768	15,780	1	15,780
Testify in Juneau during Session					
Nome Mayor	978	756			
Barrow Mayor	1216	756			
	2,194	1,512	3,706	1	3,706
					84,206

Senator Begich - Inuvikput Package

Introduced August 3, 2009, the *Inuvikput Package* consists of seven pieces of legislation:

S.1560 Arctic OCS Revenue Sharing Act - Alaska Natives who have subsisted on marine mammals and other arctic resources for thousands of years would bear the direct risks of increased commercial activity in their waters. This bill directs a portion of federal revenues from offshore oil and gas development - the same share Louisiana receives from drilling in the adjacent Gulf of Mexico - to the State of Alaska with a percentage of those funds directed to those most affected.

S.1561 Arctic Marine Shipping Assessment Implementation Act - As the polar icecap recedes, the Arctic region is increasingly accessible to shipping and tourism. This bill is designed to ensure safe and reliable maritime transportation in the Arctic and protect its waters. It would boost the nation's investment in needed infrastructure, including replacement of America's aging fleet of icebreakers and building new forward operating air bases for the Coast Guard to assert our national interest in the region.

S.1562 Arctic Science, Coordination and Integration Act - Numerous scientists and agencies conduct important and needed research into various aspects of the Arctic but concerns remain that these efforts are not well coordinated and leave gaps in our understanding of Arctic issues. This bill calls on the National Research Council to undertake a study toward a comprehensive strategy to coordinate Arctic research and make recommendations to Congress on a long-term Arctic Ocean research plan.

S.1563 Arctic Ambassador Act - Russia, Canada, Norway and other Arctic nations are represented at the ambassadorial level before the Arctic Council and U.S. interests would benefit from an enhanced diplomatic presence in Arctic matters. This bill is intended to strengthen U.S. representation before the Arctic Council and other international forums by appointment of a U.S. ambassador to the Arctic.

S.1564 Arctic Oil Spill Research and Recovery Act - Vast energy reserves are believed to lie beneath Arctic waters and it is vital that any development of such resources be conducted in a responsible manner that protects the environment upon which residents of the region depend. This bill directs the Secretary of Commerce to conduct research to improve oil spill prevention, response and recovery in Arctic conditions and requires the Coast Guard to assess and reduce risk from such development.

S.1565 Arctic Health Research Act - People of the Arctic suffer from increased rates of alcohol abuse, diabetes, high blood pressure, and death from injury and suicide. This act would initiate a study into the mental, behavioral and physical health problems in the Arctic, institute an Arctic health assessment program at the Centers for Disease Control and create an "Arctic desk" at the National Institute of Health that was called for in 1984 but has never been established.

S.1566 Arctic Climate Change Adaptation Act - Alaska villages and public infrastructure are already suffering from coastal erosion, flooding, permafrost melting and other impacts of climate change. This bill would help the State of Alaska, Alaska Native organizations, affected Arctic communities and the private sector adapt to the impacts of climate change and assist in dealing with habitat restoration, clean energy development and other economic development activities.

Melting ice could mean new riches

Jill Burke
Mar 1, 2010

"It's not a question of if but when."

That's what Mead Treadwell, chairman of the U.S. Arctic Research Commission, told a New York City crowd Monday about the prospect of a booming northwest passage.

Treadwell made the remarks during a moderated panel discussion, "Will the Bering Strait become the Panama Canal of the North?" hosted by the Council on Foreign Relations at Alaska House New York. (Alaska House is a nonprofit organization founded by Alaska Dispatch publisher Alice Rogoff to promote education about Alaska and its Native culture and foster economic development within the state.)

The day's discussion, which pulled together Alaska's congressional delegates, regional leaders and industry representatives, centered on the sense of urgency seemingly missing both in the state and nationwide for developing the infrastructure -- like deep water ports and international rules -- that will be needed to tap into a new hustling, bustling Bering Strait.

Two of the world's largest mining operations are above the Arctic Circle, including the Red Dog zinc mine in Alaska off the coast of Kivalina, according to Treadwell -- and the Arctic is poised to deliver even more resources. Minerals, fishing, oil and gas, exploration and science, and tourism all have northern footholds. Capturing opportunities related to those activities with the prospect of shorter shipping routes as ice recedes is something Americans need to be thinking about now, Treadwell said.

The challenge is building the infrastructure. Deep water ports are needed to accommodate large container ships and provide an anchor for the military presence that will need to increase to keep pace with a rise in offshore activity near the United States' northern coast.

Participants, including Rogoff, suggested that developing port infrastructure for Alaska's western coast, from Adak to Barrow, could be an economic boom as important to the state as the trans-Alaska oil pipeline, particularly when even a handful of new port jobs has the potential to pull villages teetering on the brink of economic failure into sustainability.

Alaska Sens. Lisa Murkowski, a Republican, and Mark Begich, a Democrat, attended the event and told participants they are aware of the critical role Alaska is poised to play in a changing Arctic environment. Murkowski is pushing for a Department of Defense and Homeland Security feasibility study for a deep water port off Alaska's shores.

"This study will determine whether it is in the strategic interest of the United States, as I believe it is, to build a port and where it might be located. A deep water port would not only serve our military and Coast Guard needs, but as we develop our offshore oil and gas reserves and see more shipping, tourism and vessel traffic in the Arctic, a deep water port could provide valuable support," Murkowski said.

A full transcript of the day's discussion will be posted online at the Council on Foreign Relations' Web site.

Contact Jill Burke at jill(at)alaskadispatch.com

Keyword Search Go

United States Senator Lisa Murkowski

Monday March 01 2010

Murkowski Speaks at Arctic Policy Roundtable at New York Council on Foreign Relations

NEW YORK - U.S. Sen. Lisa Murkowski, R-Alaska, helped lead a discussion on U.S. Arctic policy at a roundtable forum today at the Council on Foreign Relations in New York City. Also participating in the discussion was U.S. Sen. Mark Begich, D-Alaska, a number of Arctic policy experts and several Alaskans, including Mayor Edward Itta of the North Slope Borough. Following is a text of Sen. Murkowski's remarks as prepared for delivery:

"Good afternoon. It is my distinct pleasure to be back at the Council on Foreign Relations today to discuss one of my favorite subjects, the Arctic. As all of us in this room are aware, the United States is an Arctic nation because of Alaska. But, what does it mean to be an Arctic nation? I believe that the Federal Government is just waking up to this reality and we are frantically trying to define exactly what that distinction means. In my view, being an Arctic nation means that the United States has certain obligations and responsibilities in the region to the land, the water and the people. And we all need to help our nation understand what those are.

"The pace of change in the Arctic demands that greater attention be focused on the region. The implications of the dynamic changing Arctic for the residents and important U.S. security, economic, environmental, and political interests, depend on it.

"One of those responsibilities I spoke of is to have the necessary infrastructure in the region. I recently introduced legislation that directs the Department of Defense and the Department of Homeland Security to study the feasibility, location and resource needs for an Arctic deep water port. This study will determine whether it is in the strategic interest of the United States, as I believe it is, to build a port and where it might be located. A deep water port would not only serve our military and Coast Guard needs, but as we develop our offshore oil and gas reserves and see more shipping, tourism and vessel traffic in the Arctic, a deep water port could provide valuable support. I will insure that the Navy and Coast Guard actively consult with the communities and leaders of the region, as well as the State of Alaska.

"As we all are keenly aware, while the Arctic is becoming more and more ice free in the summer months, Arctic ice is not going to completely disappear. One of the major challenges that we face is our aging ice breaker fleet. I was able to get an appropriation to refurbish the Polar Star last year, and the Coast Guard has embarked on a study to determine whether we need to rebuild or replace our aging polar class vessels, but no matter the result of the study, we must have the commitment of the Administration and Congress that ice breakers are a national priority. And I will do all I can to advocate that position.

"As you know, I am a strong proponent of ratification of the United Nations Convention on the Law of the Sea. The United States must ratify the treaty but we remain at a stalemate: the White House seeks to move forward and the Senate waits for stronger support from the

Administration. As the only Arctic nation not a party to the treaty, failure to ratify continues to keep the United States at a disadvantage internationally and outside the process, without a seat at the table.

"Even though we are not a party to the Treaty, the United States is making progress on mapping our extended continental shelf. The results of Coast Guard ice breaker HEALY's hydrographic missions in the Arctic have been remarkable and I have supported this initiative with appropriations and legislation to authorize more funding. I was gratified to see the cooperation in the Beaufort between with the HEALY and the Canadian icebreaker the Louie St. Laurent. This is yet one example of international cooperation in the Arctic.

"While I was pleased that the United States released its long awaited Arctic Regional Policy in early 2009, implementation is still lagging. It may be necessary for Congress to step in and help move the process. While certain branches of the government, like the Navy and Coast Guard, are developing and implementing their portions of the policy, it is still not nearly to the degree I would like. Certainly other Arctic and non-Arctic nations are moving much more quickly to develop policies and support them, than we are.

"I believe we are at a very critical time in the Arctic. As many of us have identified, there are two paths we can go down in regards to international relations -- one is a path of competition and conflict, and the other is one of cooperation and diplomacy. This decision, and the direction it takes, will require vision and dynamic leadership, both at home and abroad. I believe the United States, as one of the most powerful Arctic nations, must step up and provide it.

"A changing Arctic brings risks and challenges to the environment and indigenous people of the region. But it also brings opportunity and awareness, and if we can work to identify and minimize the risks, and use the opportunities to better the lives of the people of the Arctic region, we can all prosper.

"Thank you and I look forward to a lively conversation this afternoon."

# # #

BOOKMARK PRINTER FRIENDLY

BROWSE BY: March 2010 GO

03/25/10 -
Murkowski Opposes Health Care Reconciliation Bill

03/24/10 -
Murkowski Meets with Coast Guard Commandant Nominee

03/24/10 -
Murkowski, Johnson Introduce Bill to Address and Reduce Fetal Alcohol Disorders

03/23/10

The Arctic Sounder

Published on March 18th, 2010

Opinion: Visit to New York, D.C. gets Arctic message across

By EDWARD ITTA

We Inupiaq like to say that the Arctic Ocean is our garden. It feeds us with its bounty of whales, seals, walrus, ugruk, fish and other subsistence foods. Our harvest is better in some years than in others. Weather, ice and ocean currents all affect the amount of "crops" we are able to feed to our families from year to year.

These are times of change for the ocean. Offshore oil and gas exploration is gearing up. We have seen plenty of evidence that climate change may cause dramatic shifts in the polar ice cap and in our weather. Receding ice could open up new shipping routes between Europe and Asia. We may see increased ocean traffic from commercial fishing boats and tourist ships.

What can we do about it? As mayor, I believe the borough should be engaged in the planning, monitoring, research and mitigation efforts that are being crafted right now as government agencies at all levels respond with a new sense of urgency to challenges and opportunities in the Arctic Ocean. That's why I spent the past week in New York and Washington, D.C. I joined Senators Begich and Murkowski in New York and the three of us made presentations on adapting to climate change in the Arctic to a group of policymakers, business people, scientists and journalists, who then participated in a roundtable discussion.

Policymakers are eager to hear our views, because they recognize that we have the most intimate knowledge of the Arctic and the most to lose if the ocean is not adequately protected. My message to them was that we don't want offshore development, but if it is going to happen, we insist on participating in decisions that will govern offshore activities and precautions. I showed them the Arctic policy principles adopted by ICC in 1984 as an example of longstanding Inuit leadership on protecting the polar region.

In Washington, I met with several of the highest officials in the Interior Department, including Interior Secretary Ken Salazar; his assistant secretary for Land and Minerals Management, Wilma Lewis; Liz Burnbaum, director of the Minerals Management Service (MMS); and Bob Abbey, director for BLM. I stressed that if the government is going to allow OCS activity, then it should set the bar very high when it comes to clean and cautious operations in the water.

I said that the shutdown requirement MMS wrote into Shell's Camden Bay permit is a good step in the right direction, since it gives that requirement the force of law for the first time. I argued for larger deferral areas around traditional Barter Island and Cross Island whaling areas, a moratorium on leasing new acreage, zero discharge of drilling wastes, a cumulative impacts analysis, and the need for better baseline science.

I invited Secretary Salazar to visit the North Slope this summer so he can get a first-hand look at some of the places that mean so much to our people. He agreed to pay us a visit in August.

At NOAA, I talked with two key officials about their efforts in preparing a new Environmental Impact Statement concerning the effects of oil and gas activities in the Arctic Ocean. Rather than the annual Incidental Harassment Authorizations (IHA) that are now issued, they are looking at doing five-year Incidental Take Authorizations. They believe it will build certainty and flexibility into their mitigation requirements, and I can see their point. I told them that we need more monitoring and study of the effects of noise on migrating whales. I discussed the Obama administration's new planning initiative for oceans and coastal areas with the head of the President's Council on Environmental Quality (CEQ). CEQ is spearheading the president's effort to deal with climate change. How this new ocean planning program will work is still something of a mystery, but it has a high priority in the administration. I focused on the need to be sensitive about traditional uses of the coastal and ocean areas and to make sure our voices are heard as these large-scale management programs are designed.

At the U.S. Fish and Wildlife Service, we discussed the ongoing management plan for Steller's eiders. I pointed out that our people are conservationists by nature and that education efforts about threatened species can be much more effective than hardball enforcement tactics. I thanked them for establishing a liaison position in Barrow (now held by Emma Huntsman) and said I look forward to better communication between the community and the agency.

Although I spent time with Senators Murkowski and Begich in New York, I was able to meet with each of them again in D.C. I also met with Congressman Young. In each case, I went over a range of issues that we can work on together, and I thanked them for legislation they sponsored in response to my eight-point OCS policy position.

All in all, it was a very productive week. If our voice is going to be heard in the halls of political power, it will be because we take our message to the decision makers and state our point clearly and forcefully. My staff and I will continue to engage with the agencies that shape the regulatory framework for North Slope activities of all kinds. In these challenging times,

these changing times, I want to make sure they can't forget our concerns as they plan the future in offices that are thousands of miles from the Arctic.

Edward Itta is mayor of the North Slope Borough.

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White House Climate Change Adaptation Task Force

In 2009, the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA) initiated the Interagency Climate Change Adaptation Task Force, which includes representatives from more than 20 Federal Agencies. When the President signed the Executive Order on Federal Leadership in Environmental, Energy, and Economic Performance, on October 5, 2009, he called on the Task Force to develop, within one year, Federal recommendations for adapting to climate change impacts both domestically and internationally.

Interim Progress Report

On March 16, 2010, the Task Force released an Interim Progress Report which outlines the Task Force's progress to date and recommends key components to include in a national strategy on climate change adaptation. These six components include:

1. Integration of Science into Adaptation Decisions and Policy
2. Communications and Capacity-building
3. Coordination and Collaboration
4. Prioritization
5. A Flexible Framework for Agencies
6. Evaluation

The Interim Progress Report is available for 60 days of public comment. Submit your comment here.

Workgroups

The Interagency Climate Change Adaptation Task Force formed workgroups to consider the capabilities of the Federal Government to respond to the impacts of climate change on various critical sectors, institutions, and agency mission responsibilities. Five initial workgroups began by reviewing existing policies, operations, procedures, and other tools that affect the Federal Government's response, and will suggest options for improving the government's capacity for adaptation to climate change. The five initial workgroups are focused on the following topics:

- **Agency Adaptation**: Develop recommendations on how agencies should plan and implement adaptation
- **Science Inputs to Policy**: Develop recommendations to couple the production of scientific and technical support to adaptation planning, prioritization, and resilience building within the USG, in the US, and internationally
- **Insurance**: Develop recommendations on opportunities for the United States Government to support insurance and adaptation issues
- **Water Resources Adaptation**: Develop recommendations on how Federal water management agencies should plan and implement adaptation actions related to climate impacts on water resources
- **International Resilience**: Develop recommendations on opportunities for the United States Government to support and lead international adaptation efforts

These workgroups have defined their scope and end products, and have begun initial analysis. Most workgroups have used stakeholder listening sessions to solicit feedback from various government and regional actors on adaptation issues within their respective issue area.

Listening Sessions

The five initial Interagency Climate Change Adaptation Task Force workgroups hosted twenty listening sessions with key stakeholders and experts. The listening sessions were designed to engage the expertise and recommendations of external organizations into the workgroup deliberations early in this review process.

Final Product

In October 2010, the Task Force will report to the President on the development of domestic and international dimensions of a U.S. approach to climate change adaptation and what Federal Agencies are doing to support this effort. The Task Force also will recommend additional aspects to consider in the development of a comprehensive national strategy.

White House Interagency Ocean Policy Task Force

On June 12, 2009, President Obama sent a memorandum to the heads of executive departments and federal agencies establishing an Interagency Ocean Policy Task Force, led by the White House Council on Environmental Quality. The Task Force is charged with developing a recommendation for a national policy that ensures protection, maintenance, and restoration of oceans, our coasts and the Great Lakes. It will also recommend a framework for improved stewardship, and effective coastal and marine spatial planning.

The oceans, our coasts, and the Great Lakes provide jobs, food, energy resources, ecological services, recreation, and tourism opportunities, and play critical roles in our Nation's transportation, economy, and trade, as well as the global mobility of our Armed Forces and the maintenance of international peace and security," President Obama wrote in the memorandum. "We have a stewardship responsibility to maintain healthy, resilient, and sustainable oceans, coasts and Great Lakes resources for the benefit of this and future generations."

"The challenges our oceans, coasts, and Great Lakes are facing are complex, and to meet these challenges we must have the participation of a wide spectrum of views from within the federal government," said Nancy Sutley, Chair of the White House Council on Environmental Quality. "The Task Force has a wealth of opportunity to make our oceans, coasts and Great Lakes healthier - both environmentally and economically."

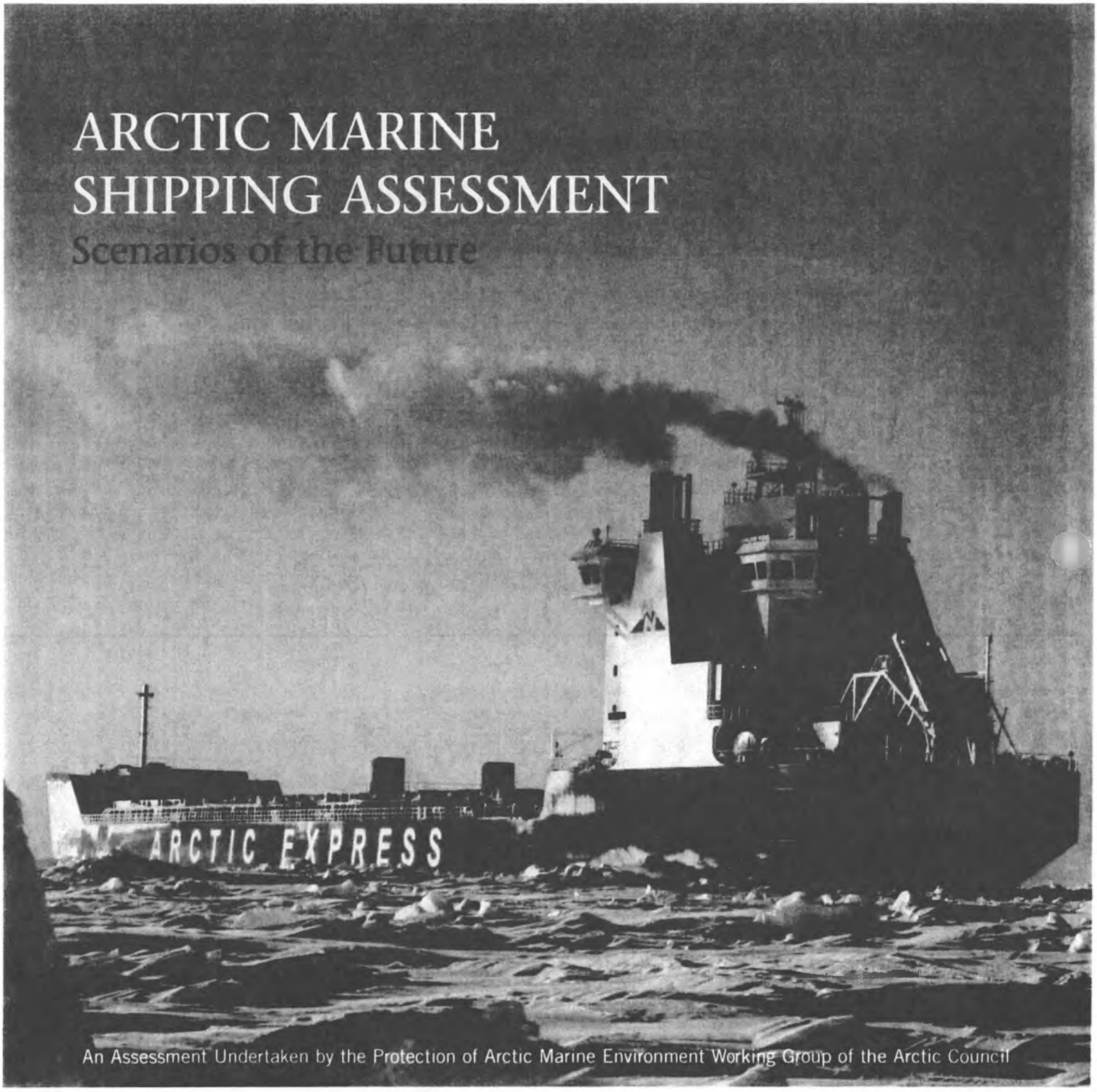
The recommendations and frameworks developed by the Task Force will be cost effective and improve coordination across federal agencies. The Chair will terminate the Task Force upon the completion of its duties.

The time period to submit comments to the Task Force has closed, but you can read comments from others. The Task Force's Interim Framework is open for comment through Friday, February 12, 2010.

Read the President's Proclamation on National Oceans Month

ARCTIC MARINE SHIPPING ASSESSMENT

Scenarios of the Future



An Assessment Undertaken by the Protection of Arctic Marine Environment Working Group of the Arctic Council

Scenarios on the Future of Arctic Marine Navigation in 2050

Arctic Marine Shipping Assessment (AMSA)

The Arctic Council – an intergovernmental forum that addresses environmental protection and sustainable development issues, as well as challenges faced by the Arctic governments and people – is conducting an assessment of current and future Arctic marine activity. The lead countries for AMSA are Canada, Finland and the United States with the Arctic Council's working group on Protection of the Arctic Marine Environment (PAME) responsible for the assessment. A key element of AMSA is the creation of a set of scenarios, or plausible futures, for Arctic marine navigation.

Scenario Framework

The high-level scenario summaries were created at two AMSA/PAME Scenarios Workshops held in San Francisco (April 2007) and Helsinki (July 2007). The workshops were designed and facilitated by Global Business Network of San Francisco. Through brainstorming, work in small groups and spirited plenary discussion, workshop participants collectively agreed that the two factors detailed below – Governance and Resources & Trade – are the most important and uncertain in shaping the future of Arctic marine navigation in mid-century. By crossing these two critical uncertainties, participants formed the scenario matrix illustrated to the right. This framework also allows the incorporation of many of the uncertainties explored at the workshops, while still creating four different scenario spaces that are plausible and relevant to the range of Arctic stakeholders. When completed, the scenario stories willbe posted on the PAME website, www.pame.is.

Governance

This uncertainty axis describes the degree of relative *Governance stability*, both within the Arctic region and internationally.

← **Less stability** implies shortfalls in legal structure and transparency, as well as a propensity for stakeholders to work on a more unilateral basis rather than by collaborating in a cooperative, international fashion.

→ **More stability** implies not only efficiently operating legal and regulatory structures, but an international atmosphere more conducive to collaborative and cooperative development.

Resources & Trade

This uncertainty axis describes the level of demand for Arctic natural resources and trade. Framing this in a global context exposes the scenarios to a broader range of potential market developments, such as the rise of Asia or political instability in the Middle East.

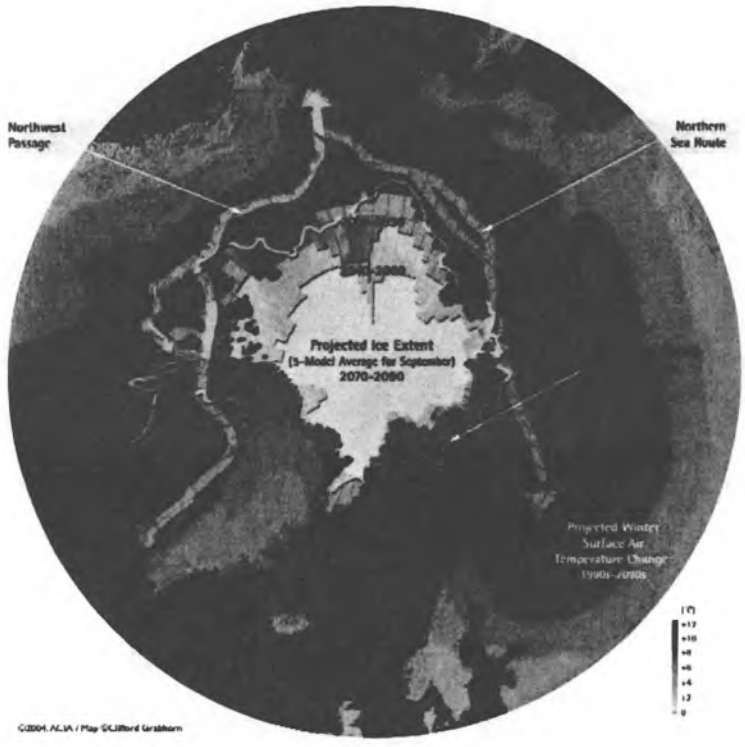
↑ **More demand** implies exactly that – higher demand from more players and markets around the world – for natural resources and commerce in the Arctic.

↓ **Less demand** is also straight forward, with fewer global players interested in utilizing Arctic commerce and natural resources.

Development of the AMSA scenarios is being facilitated by Global Business Network of San Francisco.
Support for this effort has been provided by: Aker Arctic Technology, BP Shipping, Finnish Ministry of Foreign Affairs, Institute of the North, Transport Canada, U.S. Arctic Research Commission, U.S. Department of State and U.S. National Oceanic & Atmospheric Administration.

Arctic Climate Impact Assessment Key Finding #6:

"Reduced sea ice is very likely to increase marine transport and access to resources."



Institute of the North
935 W. Third Avenue
Anchorage, Alaska 99501 USA
Tel: 1.907.771.2445 Fax: 1.907.771.2466
Web Site: www.institutenorth.org
E-mail: institute@institutenorth.org

AMSA Chair & Scenarios Lead
U.S. Arctic Research Commission
420 L Street, Suite 315
Anchorage, Alaska 99501-1971 USA
Tel: 1.907.271.4577 Fax: 1.907.271.4578
E-mail: usarc@acsalaska.net

Arctic Council
Secretariat
Polarmiljosenteret
NO-9296 Tromso Norway
Tel: 47.77.75.01.40 Fax: 47.77.75.05.01
E-mail: AC-chair@arctic-council.org

Protection of the Arctic Marine Environment
Secretariat
Borgir, Nordurslod
600 Akureyri, Iceland
Tel: 354.461.1355 Fax: 354.462.3390
E-mail: pame@pame.is

Major International LLC
4167 Apollo Drive
Anchorage, Alaska 99504
skymajor@aol.com
907-227-7015

March 27, 2010

Northern Waters Commission

A Call to Action

China declares itself an Arctic nation. Building an icebreaker.

Canada renames the much sought-after Northwest Passage the "Canadian Northwest Passage."

Two new-built container ships cut the shipping time from East Asia to Rotterdam in half. Sea route across northern Russia. Icebreaker escorts not needed.

Norway seeks talks with Alaskans.

Canada – Alaska border dispute flares up.

Iceland envisions a transshipment role for itself.

Russia claims undersea territories and resources.

Disclaimer.
This paper is NOT -- repeat NOT -- a treatise on global warming or explanations for it. This is a look at Alaska's potential role in new strategies and opportunities brought forward by receding sea ice in Northern Waters,

Discussion

Reports clearly indicate that the sea ice in Northern latitudes is receding.

No matter what the cause might be, what meaning does that fact have for Alaska and the United States?

Other nations and their governments are already hard at work on their own interests. Russian, Canada, Norway, Iceland and even our own Federal government are players.

These governments and their commercial partners are at the table. What should the State of Alaska and the Alaskan people be doing? We are not very active yet, but we should be.

How and when do we claim our place at the table? Or should we maintain a subordinate, quasi-colonial posture? Most are repulsed by the very thought of the latter.

The situation in Northern Waters could be summed up as follows.

The waters north and northwest of Alaska have strategic importance for at least these four reasons:

1. **Protection of routes of ocean transit.**
2. **Mineral and other resource rights, sub-surface and on-shore.**
3. **Territorial rights and claims by foreign governments.**
4. **Rights and welfare of local inhabitants.**

As governments, the interests listed above are shared by the Federal government and the State of Alaska.

Some independent Federal agencies are taking actions, and some bilateral or multilateral international forums exist. Not all these agencies are coordinating with one another.

Although these shared interests are critical, yet, as of now, there is no organized Federal-State mechanism for handling or even discussing these matters.

Fortunately, there is an approach that is time-proven and very successful.

Suggestion

1. Use the very successful Fishery Management Council model, on which Federal and State appointees sit, deliberate, form policy and approve actions.

2. Feds and State agree to form a **Northern Waters Commission** (working title).

3. A balanced membership is formed comprised of Federal and State of Alaska appointees.

The **Northern Waters Commission** would be the forum at which to discuss policy issues, such as those listed in the four strategic areas above.

Regular meetings would be held, just as with the North Pacific Fishery Management Council, in a balanced atmosphere, with advice and input from staff, local governments, public agencies and the public.

Initial discussions about the **Northern Waters Commission** have been held with members and staff of our Congressional delegation, members of the State Legislative and Executive branches, the US Arctic Research Commission, the Mayor of the North Slope Borough, and experienced members of the public.

There is universal acknowledgement of the general issues involved with receding sea ice, and there is a real interest in the course of action outlined above as a means of addressing those issues.

As further background, in New York City a March 1, 2010 conference was held at the Council on Foreign Relations on the general subject of the retreating sea ice in the North. Senators Murkowski and Begich both made statements there, as well as Mayor Edward Itta.

Many notables were at the conference including the Norwegian Ambassador to the United Nations; David Rockefeller Jr.; Theodore Roosevelt IV; Nome Mayor Denise Michels; Alaska State Representative Carl Gatto; Bering Straits Native Corporation executive Gail Schubert; Alaska Native Arts Foundation chair Alice Rogoff; US Arctic Research Commission chair Mead Treadwell; and former Alaska Commissioner of Commerce, Community and Economic Development Bill Noll.

There was also an evening reception on March 1st at the Alaska House New York on the same subject. Mead Treadwell, Alice Rogoff and Bill Noll shared the podium at the reception. Mead gave a great power point presentation, followed by a lively Q&A.

About 80 had attended the Council on Foreign Relations event. Follow up is expected. As one example, an officer from Norway's General Consulate requested bilateral talks with Alaskans on this general subject.

Here is a link to the text of the afternoon session at Council on Foreign Relations, including the remarks by Senator Murkowski, Senator Begich and Mayor Itta:
http://www.cfr.org/publication/21623/adapting_to_climate_change_in_the_arctic_coordinating_a_federal_state_and_private_sector_response.html?breadcrumb=%2Fbios%2F13363%2Fscott_g_borgerson

Here is a link to the evening session at Alaska House New York:
http://www.ustream.tv/recorded/5121092

So, the question is, what to do next?

Recommendation

The State of Alaska perform work to create a report that will be the basis for taking actions deemed prudent to protect the interests of Alaska and Alaskans and advance these interests in the face of the receding sea ice.

There are and will be opportunities for people and businesses. Will Alaska play the role of a colony or foil for Federal and international protagonists? Or will Alaska step into the breach and take its rightful place alongside the sovereign powers already working for their own ends?

Proposed Scope of Work

A. The current and recent commercial and recreational marine transits passing Alaska over the top across Russia and Canada. The nature of this shipping and its potential. The economics.

B. Estimated oil, gas and other minerals in Northern Waters and their value.

C. Territorial claims to sea, sub-sea or land areas and resources.

D. Current actions by the US Coast Guard and the US Navy. Port potentials.

E. Other commercial potential such as tug support, pilotage, and ice breakers.

F. Shoreside support needs and potential for commerce. Infrastructure.

G. Social and economic potentials for local residents, businesses and governments.

H. Federal agencies currently involved in any way. International forums.

I. Existing Federal laws and regulations, and those pending in Congress.

J. The Law of the Sea Treaty: situation report.

K. The North Pacific Fishery Management Council budget and funding source.

L. Public hearings in key Northern locations.

Respectfully submitted.

William C. (Bill) Noll, Owner

Former Mayor of Seward

Former Alaska Commissioner of Commerce, Community and Economic Development

Founding president, Seward Association for the Advancement of Marine Science, dba Alaska Sealife Center

ALASKA STATE LEGISLATURE

House Community & Regional Affairs Committee

Rep. Cathy Muñoz, Co-Chair

State Capitol Building, Room 409
Juneau, Alaska 99801-1182
Phone (907) 465-3744
Fax (907) 465-2273
Rep_Cathy_Munoz@legis.state.ak.us

Rep. Bob Herron, Co-Chair

State Capitol Building, Room 411
Juneau, Alaska 99801
Phone: (907) 465-4942
Fax: (907) 465-4589
Rep_Bob_Herron@legis.state.ak.us

MEMORANDUM

Date: March 30, 2010

To: Representative Bill Stoltze, Co-Chair
Representative Mike Hawker, Co-Chair
House Finance Committee

From: Rep. Bob Herron, Co-Chair
Rep. Cathy Muñoz, Co-Chair

RE: CS House Concurrent Resolution 22, Northern Waters Task Force

---

I respectfully request a hearing for CS HCR 22 (CRA), "Establishing and relating to the Alaska Northern Waters Task Force."

HCR 22 establishes the Alaska Northern Waters Task Force to facilitate regional coordination and State of Alaska leadership in the ongoing development of the United States' policies related to the opening of Arctic marine transportation routes, national security, and resource development.

List of Expected Witnesses:

- Elizabeth Hensley & Christine Hess, Aides to Rep. Joule (in person)
- Rep. Reggie Joule (in person)
- Mead Treadwell, U.S. Arctic Research Commission (offnet)
- Tracey Foster, Alaska House (New York) (offnet)
- Bill Noll, Self (Anchorage LIO)
- Denise Michaels, City of Nome (Nome LIO)
- ~~Bobby Schaeffer~~, North West Arctic Borough (Kotzebue LIO)
- Andy Mack, Special Asst. for Gov. & External Affairs, North Slope Borough

Tom Okleasik

If you have any questions or need additional information, please call Rob Earl at 465-5141.

26-LS1622\
Cook
4/6/10

AMENDMENT #1

OFFERED IN THE HOUSE BY REPRESENTATIVE JOULE

TO: CSHCR 22(CRA)

Page 2, line 21:

Delete "nine"

Insert "12"

Page 2, line 22:

Delete "one senator from Northwest Alaska"

Insert "two senators from an area along the Bering, Chukchi, or Beaufort Sea"

Page 2, line 24:

Delete "two representatives from Northwest Alaska"

Insert "three representatives from areas along the Bering, Chukchi, or Beaufort Seas"

Page 2, line 26:

Delete "six"

Insert "seven"

Page 3, line 1:

Delete "and City of Nome"

Insert ", City of Nome, and City of Unalaska"

Page 3, lines 2 - 3:

Delete "the United States Department of the Interior"

Insert "a federal agency with a significant role in addressing northern waters issues"

Larry Hartig, DEC

301 will be joined by firearm

- lots of activity going on
- consider all the groups like Arctic Council, APG, Ad-Hoc Wking Grp
- jurisdictional boundaries
- possible limits on fed agencies participation

Could have value in communication aspect on local level & among leg levels.

sukugee = don't know my people → Rep. Thomas

Andy Mack, NSB Cw + Ext Affairs

(5) expect Exec. Order soon to form nat'l policy - this is tremendous mechanism to do this.

- Arctic Oil + Gas Guidelines, subject to or adopted by AC

Tom Okleasik, NWAB

Piichuq — here now

(5)

Bill Noll, Anc

(5) New FN says it's well-funded for local partic. but not enough

Meade Treadwell, USARC chair

9th yr, chair since 06

- "Safe, secure, reliable" shipping plan
- open invitation Kim (Ken) Taylor for ex officio member

3 pts for why impt:

(1) as citizen see state interest in fed decisions

(2) fed coop ← int'l + nat'l decisions happening

2011 S+R 1st binding treaty of AC!

IMO met in London to set mandatory codes in Arctic waters doesn't know what dept in state gov looks at it.

(3) reviewing boundaries in dn (a) Law o' Sea (b) Canada boundaries

pilotage issues

(3) investment ports, etc + research w/ AK having huge role

- approaching markets - he went to Iceland to see about ports
  Iceland wants twin tender w/ AK before Jamaica ports.
  Joint investment

Feds won't be precluded from participating, at least USARC won't. US Coastguard Empl. Act.

Tracey Foster, exec Dir AK House NY, Council on Foreign Relations 4x (5)

AMENDMENT

OFFERED IN THE HOUSE BY REPRESENTATIVE JOULE

TO: CSHCR 22( ), Draft Version "E"

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Delete "the United States Department of the Interior"

Insert "a federal agency with a significant role in addressing northern waters issues"

26-LS1622\C
Cook
4/5/2010

CS FOR HOUSE CONCURRENT RESOLUTION NO. 22( )

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY

Offered:
Referred:

Sponsor(s): HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of the interaction among the ice, oceans, and atmosphere; and

WHEREAS rapidly retreating sea ice is altering fish and wildlife habitats and affecting the accessibility and viability of certain species, on which many local communities rely for nutritional and cultural purposes; and

WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of 11 members as follows:

(1) one senator from an area along the Bering, Chukchi, or Beaufort Seas appointed by the President of the Senate;

(2) three representatives from areas along the Bering, Chukchi, or Beaufort Seas appointed by the Speaker of the House of Representatives; and

(3) seven members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) one member representing the United States Coast Guard;

(B) one member representing the executive branch of state government;

(C) the mayors of the North Slope Borough, Northwest Arctic

Borough, City of Nome, and City of Unalaska; and

(D) one member representing a federal agency with a significant role in addressing northern waters issues; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves and the chair may assign staff to provide support to the task force; and be it

FURTHER RESOLVED that the municipal government and federal government members of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180 if they do not receive reimbursement for expenses from the municipal or federal government; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions and the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

ALASKA STATE LEGISLATURE

House Community & Regional Affairs Committee

Rep. Cathy Muñoz, Co-Chair

State Capitol Building, Room 409
Juneau, Alaska 99801-1182
Phone (907) 465-3744
Fax (907) 465-2273
Rep_Cathy_Munoz@legis.state.ak.us

Rep. Bob Herron, Co-Chair

State Capitol Building, Room 411
Juneau, Alaska 99801
Phone: (907) 465-4942
Fax: (907) 465-4589
Rep_Bob_Herron@legis.state.ak.us

MEMORANDUM

Date: April 2, 2010

To: Representative Bill Stoltze, Co-Chair
Representative Mike Hawker, Co-Chair
House Finance Committee

From: Rep. Bob Herron, Co-Chair
Rep. Cathy Muñoz, Co-Chair

RE: CS House Concurrent Resolution 22, Northern Waters Task Force

---

I respectfully request a hearing for CS HCR 22 (CRA), "Establishing and relating to the Alaska Northern Waters Task Force."

HCR 22 establishes the Alaska Northern Waters Task Force to facilitate regional coordination and State of Alaska leadership in the ongoing development of the United States' policies related to the opening of Arctic marine transportation routes, national security, and resource development.

List of Expected Witnesses:

- Elizabeth Hensley & Christine Hess, Aides to Rep. Joule (in person)
- Rep. Reggie Joule (in person)
- Mead Treadwell, U.S. Arctic Research Commission (offnet)
- Tracey Foster, Alaska House (New York) (offnet)
- Bill Noll, Self (Anchorage LIO)
- Denise Michaels, City of Nome (Nome LIO)
- Tom Okleasik, Director of Northwest Arctic Borough Planning Dept.(Kotz LIO)
- Andy Mack, Special Asst. for Gov. & External Affairs, North Slope Borough

If you have any questions or need additional information, please call Rob Earl at 465-5141.

SENATE CONCURRENT RESOLUTION NO. 17

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - SECOND SESSION

BY THE SENATE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

Introduced:
Referred:

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of interaction among the ice, oceans, and atmosphere; and

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WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

State - fed

$ in budget already

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

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WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of nine members as follows:

(1) one senator from Northwest Alaska appointed by the President of the Senate;

(2) two representatives from Northwest Alaska appointed by the Speaker of the House of Representatives; and

(3) six members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) one member representing the United States Coast Guard;

(B) one member representing the executive branch of state government;

(C) the mayors of the North Slope Borough, Northwest Arctic

Borough, and City of Nome; and

(D) one member representing the United States Department of the Interior; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves and the chair may assign staff to provide support to the task force; and be it

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GovTrack.us

Congress > Legislation

H.R. 3619: Coast Guard Authorization Act of 2010

111th Congress
2009-2010

To authorize appropriations for the Coast Guard for fiscal year 2010, and for other purposes.

Overview

Sponsor: Rep. James Oberstar [D-MN8] **show cosponsors (1)**

Text: Summary | Full Text

Cost: less than $1 per American over the next two years.

Status:

☑ Introduced	Sep 22, 2009
☑ Referred to Committee	View Committee Assignments
☑ Reported by Committee	Sep 24, 2009
☑ Amendments (13 proposed)	View Amendments
☑ Passed House	Oct 23, 2009
☐ Senate Vote	...
☐ Signed by President	...

This bill has been passed in the House. The bill now goes on to be voted on in the Senate. Keep in mind that debate may be taking place on a companion bill in the Senate, rather than on this particular bill. [Last Updated: Jan 6, 2010 3:43AM]

Last Action: Nov 2, 2009: Read twice. Placed on Senate Legislative Calendar under General Orders. Calendar No. 195.

Other Titles:
-- Alien Smuggling and Terrorism Prevention Act of 2009
-- America's Waterway Watch Act
-- Coast Guard Acquisition Reform Act of 2009
-- Coast Guard Modernization Act of 2009
-- Cruise Vessel Security and Safety Act of 2009
-- Great Lakes Icebreaker Replacement Act
-- Maritime Safety Act of 2009
-- Maritime Workforce Development Act
-- United States Coast Guard Servicemember Benefits Improvements Act
-- United States Mariner and Vessel Protection Act of 2009

Related: See the Related Legislation page for other bills related to this one and a list of subject terms that have been applied to this bill. Sometimes the text of one bill or resolution is incorporated into another, and in those cases the original bill or resolution, as it would appear here, would seem to be abandoned.

Votes: Oct 23, 2009: This bill **passed** in the **House of Representatives** by roll call vote. The totals were 385 Ayes, 11 Nays, 36 Present/Not Voting. Vote Details.

You are not tracking any senators or representatives. To see their votes here, look up a Member of Congress.

View all 2 votes on this bill.

Question & Answer

Have a question about this bill? Submit a short fact-oriented question and see if it will be answered by other visitors.

Because the U.S. Congress posts most legislative information online one legislative day after events occur, GovTrack is usually one legislative day behind. For more information about where this data comes from, see About GovTrack.us.

To cite this information, click a citation format for a suggestion: APA | MLA | Wikipedia Template.

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(c) LESSEE DEFINED.—In this section, the term "lessee" means the holder of a lease (as defined in section 1331(c) of title 43, United States Code), who, prior to giving the written notice in subsection (a)(1), has entered into a binding agreement to employ a suitable vessel documented or to be documented under 12111(d) of title 46, United States Code.

(d) SAVINGS PROVISION.—Nothing in subsection (a) may be construed to authorize the employment in the coastwise trade of a vessel that does not meet the requirements of 12111 of title 46, United States Code.

SEC. 311. ARCTIC MARINE SHIPPING ASSESSMENT IMPLEMENTATION.

(a) PURPOSE.—The purpose of this section is to ensure safe and secure maritime shipping in the Arctic including the availability of aids to navigation, vessel escorts, spill response capability, and maritime search and rescue in the Arctic.

(b) INTERNATIONAL MARITIME ORGANIZATION AGREEMENTS.—To carry out the purpose of this section, the Secretary of the department in which the Coast Guard is operating is encouraged to enter into negotiations through the International Maritime Organization to conclude and execute agreements to promote coordinated action among the United States, Russia, Canada, Iceland,

Norway, and Denmark and other seafaring and Arctic nations to ensure, in the Arctic—

(1) placement and maintenance of aids to navigation;

(2) appropriate marine safety, tug, and salvage capabilities;

(3) oil spill prevention and response capability;

(4) maritime domain awareness, including long-range vessel tracking; and

(5) search and rescue.

(c) COORDINATION BY COMMITTEE ON THE MARITIME TRANSPORTATION SYSTEM.—The Committee on the Maritime Transportation System established under a directive of the President in the Ocean Action Plan, issued December 17, 2004, shall coordinate the establishment of domestic transportation policies in the Arctic necessary to carry out the purpose of this section.

(d) AGREEMENTS AND CONTRACTS.—The Secretary of the department in which the Coast Guard is operating may, subject to the availability of appropriations, enter into cooperative agreements, contracts, or other agreements with, or make grants to individuals and governments to carry out the purpose of this section or any agreements established under subsection (b).

(e) ICEBREAKING.—The Secretary of the department in which the Coast Guard is operating shall promote safe maritime navigation by means of icebreaking where needed to carry out the purposes of this section.

(f) DEMONSTRATION PROJECTS.—The Secretary of Transportation may enter into cooperative agreements, contracts, or other agreements with, or make grants to, individuals to conduct demonstration projects to reduce emissions (including black carbon and other emissions that could contribute to climate change) or discharges from vessels operating in the Arctic.

(g) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated—

(1) to the Secretary of the department in which the Coast Guard is operating—

(A) $5,000,000 for each of fiscal years 2011 through 2015 for seasonal operations in the Arctic; and

(B) $10,000,000 for each of fiscal years 2012 through 2015 to carry out agreements established under subsection (d); and

(2) to the Secretary of Transportation $5,000,000 for each of fiscal years 2011 through 2015 to conduct demonstration projects under subsection (f).

(h) ICEBREAKERS.—

(1) ANALYSES.—Not later than 90 days after the date of enactment of this Act or the date of completion of the ongoing High Latitude Study to assess Arctic polar ice-breaking mission requirements, which ever occurs later, the Commandant of the Coast Guard shall—

(A) conduct a comparative cost-benefit analysis of—

(i) rebuilding, renovating, or improving the existing fleet of icebreakers for operation by the Coast Guard,

(ii) constructing new icebreakers for operation by the Coast Guard, and

(iii) any combination of the activities described in clauses (i) and (ii), to carry out the missions of the Coast Guard; and

(B) conduct an analysis of the impact on mission capacity and the ability of the United States to maintain a presence in the Arctic regions through the year 2020 if recapitalization of the icebreaker fleet, either by constructing new icebreakers or rebuilding, renovating, or improving the existing fleet of icebreakers, is not fully funded.

(2) REPORTS TO CONGRESS.—

(A) Not later than 90 days after the date of enactment of this Act or the date of completion of the ongoing High Latitude Study to assess Arctic ice-breaking mission requirements, which ever occurs later, the Commandant of the Coast Guard shall submit a report containing the results of the study, together with recommendations the Commandant deems appropriate under section 93(a)(24) of title 14, United States Code, to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Transportation and Infrastructure.

(B) Not later than 1 year after the date of enactment of this Act, the Commandant shall submit reports containing the results of the analyses required under subparagraphs (A) and (B) of paragraph (1), together with recommendations the Commandant deems appropriate under section 93(a)(24) of title 14, United States Code, to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Transportation and Infrastructure.

Support Material (File 1)

<TARGET><BILL></BILL><SUBJECT>Support Material (File 1)</SUBJECT><COMM>ANW27</COMM></TARGET>

NWTF

Support Material

1 Northern Water Task Force Internal Documents & Presentations

2 Arctic Council Information & Documents

3 Research Documents

4 Other Organizations Documents & Information

5

6

7

8

AVERY READY INDEX® 600084

1

Northern Waters Task Force Internal Documents and Presentations

Northern Waters Task Force

An Introduction

NWTF: Introduction

The Northern Waters Task Force (NWTF) was created by HCR 22 during the 2010 legislative session.

NWTF: Membership

- The NWTF is comprised of legislators, leaders of Arctic communities, and members of key state and federal agencies.
- Membership includes:

Rep. Reggie Joule
Kotzebue, Chair

Sen. Bert Stedman
Sitka, Vice-Chair

Sen. Lyman Hoffman
Bethel

Rep. Bob Herron
Bethel

NWTF: Membership

DEC Commissioner
Larry Hartig

Mayor Edward Itta
North Slope Borough

Chris Hladick
Unalaska City Manager

Mayor Denise Michels
Nome

Chuck Greene
Vice-President, NANA Corp.

Dave Kubiak
Alaska Marine
Conservation Council

Alternates: Sen. Donald Olson; Rep. Bryce Edgmon; Richard Glenn, *Arctic Slope Regional Corp*oration; Commissioner Cora Campbell, *Alaska Dept. of Fish & Game; Rear Admiral Ostebo, Federal Liaison*

NWTF: Duties

- According to the resolution the task force will:
  - Create a state and federal commission responsible for overseeing development
  - Facilitate regional coordination, cooperation, and outreach in creating a commission to keep local stakeholders informed and able to engage
  - Identify and coordinate efforts of mutual concern for federal, state, local and international agencies
  - Conduct hearings in the northern region of the state to fulfill the above purposes

NWTF: Meetings

- Past Meetings
  - Anchorage- October 1st, 2010
    - *Introduction of issues and organizational meeting*
  - Barrow- December 2nd-3rd, 2010
    - *Local, regional and international perspective on the Arctic*
  - Juneau - March 14th, 2011
    - *Organizational meeting*

- Upcoming Meetings
  - Girdwood – June 19th-21st
    - *Arctic Imperative*
  - Kotzebue and Nome – July 5th-6th
  - Unalaska – August 24th-27th
  - Bethel – October

On the web at *www.housemajority.org/joule*

NWTF: Why monitor the Arctic?

- Loss of sea ice has led to increased human activity in the Arctic and has raised a variety of concerns about future development
- Forecasts predict the possibility of an ice-free Arctic within 20-30 years
- An ice-free Arctic would create new challenges and opportunities for
    - Arctic inhabitants
    - Communities
    - State of Alaska
    - United States
    - other countries

NWTF: Areas the task force is addressing

- Arctic Governance
- Oil, Gas and Mineral Development
- Arctic Fisheries
- Marine Transportation
- Arctic Research
- Arctic Infrastructure

NWTF: Arctic Governance

- The United States is an Arctic country by virtue of Alaska's geography
- Eight countries have territory north of the Arctic Circle
  - Finland
  - Sweden
  - Iceland
  - United States
  - Canada
  - Russia
  - Norway
  - Denmark (Greenland)
- The last five countries are on the Arctic coast

NWTF: Indigenous Engagement

- Seven of the eight countries in the Arctic are home to indigenous peoples.

- The indigenous populations have a unique and vast knowledge of the Arctic region and environments developed over a long period of time.

NWTF: Questions to Consider

- How does the US govern the Arctic internally while cooperating with the state and local Arctic communities and peoples?

- How do we govern the Arctic region cooperatively
  with other Arctic nations?

NWTF: Oil, Gas and Mineral Exploration

- A 2008 US geological survey estimates 13% of the earth's undiscovered oil reserves and 30% of the undiscovered gas reserves are in the Arctic.
- The majority of the oil is likely be offshore.
- <u>In perspective, this equates to:</u>
  - 90 billion barrels of oil
  - 1,700 trillion cubic feet of natural gas
  - 44 billion barrels of natural gas liquids

NWTF: Question to consider

- How do we develop our resources responsibly while maintaining sustainable environments and thriving Arctic communities?

- How do we develop Arctic resources cooperatively with other nations

  while maintaining sustainable environments and thriving Arctic communities?

NWTF: Arctic fisheries

- Alaska and the Arctic contain some of the worlds largest and most valuable fisheries.

- Scientists are discovering that a number of sub-arctic species, such as cod, herring and pollock,

  are expanding their habitation further north and creating commercial fishing opportunities.

- The North Pacific Fisheries Management Council currently bans commercial fishing in the Arctic.

NWTF: Question to consider

- Should commercial fishing be banned in the Arctic?
- Who will manage and monitor Arctic fisheries for sustainability?
- How would you manage an Arctic Ocean fisheries management area with other countries?

NWTF: Marine Transportation

- Diminished sea-ice has led to increases in commercial shipping on two trans-Arctic sea routes.
- An estimated 6,000 individual vessels operate in the Arctic (2009, AMSA).
- Tourism and passenger vessels visits are increasing.
- In 2007, an estimated 2.4 million cruise ship passengers traveled to Arctic destinations.

NWTF: Question to consider

- Who will govern shipping, security and safety in the Arctic Ocean?
- How do you govern shipping cooperatively with other nations?

NWTF: Infrastructure

Arctic Infrastructure Investment and Long-term Planning

The increase in human activity will require new infrastructure to support increased activities in

- fishing
- oil and gas development
- marine transportation

NWTF: Question to consider

- What infrastructure is needed to support increased activity in resource development, transportation, fisheries and national security?
- How can the infrastructure development be accomplished cooperatively with local communities to meet everyone's needs?
- Who is responsible for long-term planning and monitoring?

NWTF: Research

- What research needs to be done to ensure sustainable development while protecting the region?
- How do we work collaboratively with other Arctic countries on research to obtain the best available data?
- How do we decide what research is important?
- What research is still missing?

Northern Waters Task Force

HEARING TO DO LIST

Get a date and location for meeting

Pick topics

Select speakers working with task force group

Invite speakers and confirm attendance

Check hotel availability and secure rooms for 11 members plus speakers, maybe cut room rate deal

Secure a public forum for hearing

Arrange recording with DP

Press release for meeting and radio

Notify clerk's office for posting

Arrange travel/hotel for 11 members

Set up meeting/dinner with leadership

Notify radio and arrange radio interview for some members

Arrange for radio coverage

Get notification of meetings on local TV

Arrange for coffee/tea/cookies at meeting

Have Meeting

Go home for rest and restart

Question motivating workshop: What are the existing and future challenges in coordinating and managing multiple uses of the Chukchi and Beaufort Sea and how might different ways of working together affect our success?

Strengthening Institutions Workshop Model 1: Alaska Ocean Management at Present

Context of this institutional alternative: Across the U.S., the management systems related to balancing human uses of the U.S. marine environment are maintained by separate agencies and their mandates within defined jurisdictions, typically related around sectors (e.g., fishing, oil and gas, etc.). Feedback from stakeholder groups is similarly clustered among sectors, rather than across the system as a whole. This pattern of agencies and stakeholders creates some efficiency with regard to decisions on individual projects and permits, but also requires supplemental rules dealing with competing or incompatible uses and may duplicate some types of public participation. At the same time, cooperative arrangements such as the Alaska Eskimo Whaling Commission Conflict Avoidance Agreement and others have arisen over time to fill in management gaps where specific coordination is needed. This alternative describes the existing Alaska Coastal Management Program and the other agencies and institutions responsible for managing and conserving ocean resources.

Alaska Ocean Management at Present: the State convenes

What is the focus?
The focus of collaboration in the present-day is to maintain a networked approach to balancing human uses of the environment through existing regulatory programs. The Alaska Coastal Management Program (ACMP) is a hub through which allowable uses are permitted and evaluated for impacts against coastal resources. As new challenges (e.g., climate change and Endangered Species Act-listed species) have arisen or agencies are directed to operate at a landscape scale rather than an agency or species-scale, new collaborative structures have formed to promote close cooperation of agency research efforts along the coastal zone (e.g., North Slope Science Initiative, climate change landscape cooperative – though these efforts focus mostly on terrestrial resources).

Who collaborates and how?
DNR's Division of Coastal and Ocean Management (DCOM) is the hub of the network, linked to state and federal agencies such as: the Bureau of Ocean Energy Management, the National Oceanic and Atmospheric Administration, the Alaska Department of Fish & Game, Alaska Department of Environmental Conservation, U.S. Fish & Wildlife Service, the Environmental Protection Agency, the Coast Guard, and the Department of Defense. Coastal districts are then linked into the process through ACMP coastal management plan development and ACMP consistency

reviews of proposed projects. Many existing institutions (laws, policies and regulations) require or otherwise allow coordination across agencies, such as the Outer Continental Shelf Lands Act, the Coastal Zone Management Act, the Clean Air Act, the Clean Water Act, etc. The state receives notices, along with the other agencies, of proposed federal actions that allow agencies with different mandates and expertise to weigh in on the nature and probability of any adverse impact. Consistency across the whole network (DCOM and linked agencies) could be guided by the Governor's Ocean Policy Coordinator but this position has not been staffed in recent years.

The network links its planning and decision-making process to multiple sources of research and information relating to marine science and knowledge of human uses of the seas. Specific types of development projects, or specific permits, require monitoring of environmental quality as a condition of approval.

Two key processes involve participation of local coastal jurisdictions. The first is the development of a local coastal plan. Local coastal plans are created to guide development and conservation, and submitted to the Alaska Coastal Management Program for approval. District plans include enforceable policies and may contain designated areas that are to be conserved for subsistence or other sensitive resources. Once the plan is approved, the consistency review process becomes the main vehicle for coordinating management. The consistency review process uses local coastal plans in force and other data sources to evaluate the compatibility of proposed development and uses with existing lawful uses of the marine environment or desired uses. Even if a coastal district does not have a plan in force, some deference is given to issues of local concern, if the issue is documented in writing, is not already adequately governed by state or federal authorities, and the local district has demonstrated expertise. The consistency review process is designed to build understanding and consensus. Projects that are found to be inconsistent at the local level can be appealed through the Coastal Management Program within the Division of Coastal and Ocean Management. Coastal districts that disagree with a consistency determination may also file an appeal. Both type of appeals are heard by the DNR Commissioner.

In addition to specific project reviews, coastal districts are involved in the Alaska Coastal Management Program Working Group made up of eight agency representatives, six Department of Natural Resources division contacts, and four coastal resource district representatives. The working group meets via teleconference monthly to disseminate information, discusses interagency disagreements, and coordinate assistance to the coastal districts.

Why collaborate?

The collaborative nature of the ACMP is designed to allow Alaska and local regions to air their views related to federally-permitted activities within the coastal zone. Other agencies are brought into the network as needed for their input and/or approval. A key benefit to the consistency review is to balance development and

conservation needs along the coast, to build consensus and reduce conflict relating to coastal development. The development of coastal plans is geared towards building consensus on priorities at the local, regional, and state level but the process also fosters open dialogue related to which activities are deemed to be incompatible. Through this aspect of collaboration, future decision-making is expected to be less contentious.

How are conflicts resolved?
During implementation of the consistency review process, conflicts between local coastal districts and the Division of Coastal and Ocean Management are resolved through an internal appeals process, and if that does not resolve the issue, through elevating decisions to the Commissioner's Office.

Question motivating workshop: What are the existing and future challenges in coordinating and managing multiple uses of the Chukchi and Beaufort Sea and how might different ways of working together affect our success?

Strengthening Institutions Workshop Model 2: Co-management plus

Context of this institutional alternative: Whaling communities have been responsible for regulating their bowhead whale subsistence hunts since 1986 through a cooperative agreement with the National Oceanic and Atmospheric Administration. As development activity, vessel traffic and research has increased in the Beaufort and Chukchi Seas, the AEWC have taken on more responsibility in making sure that incompatible activities are separated either in space or time through voluntary agreements with private sector interests (e.g. oil and gas companies). These agreements (for all subsistence-hunted marine mammal species) in turn allow the National Marine Fisheries Service, the U.S. Fish & Wildlife Service and the Bureau of Ocean Energy Management, Regulation and Enforcement to make required findings through their regulatory processes that subsistence is not impacted by development activities. AEWC Chairman Harry Brower Jr. has described these coordination agreements (Conflict Avoidance Agreements) as a type of marine spatial planning. This alternative builds on the CAA as a mechanism for coordinating human uses in the marine environment, but also strengthens consultation and adds an expanded monitoring program.

Co-management plus: the Arctic Seas Council Convenes

What is the focus?
The focus of collaboration in this alternative is twofold: coordinating multiple uses of the marine environment and building a hub for ecosystem-based monitoring.

Who collaborates and how?
In this alternative, a co-management organization similar to the Alaska Eskimo Whaling Commission, coordinates human uses of the Beaufort and Chukchi Seas that may affect subsistence by establishing a linked but separate organization to hold pre and post-open water season meetings dedicated to coordination of uses in the Beaufort and Chukchi Seas. Pre and post-open water meetings would become formalized through MOUs as the primary venue for coordination across marine species, government agencies, the private sector, and researchers. In these two meetings, the AEWC commissioners are joined by Beaufort and Chukchi village representatives from the Eskimo Walrus Commission, the Nanuuq Commission, the Ice Seals Committee, the Alaska Beluga Whale Committee, representatives of each village tribal government, the North Slope Borough, the Northwest Arctic Borough, and the North Slope Borough Science Advisory Committee. The new group takes the name, "The Arctic Seas Council" to reflect their broad mandate and vision focused around ecosystems rather than species.

The subsistence rights-holders would have voting rights, the other members would be observers. The Arctic Seas Council would standardize the Conflict Avoidance Agreement (CAA) process to engage in pre-open water season consultations in a timely and predictable fashion. All companies, agencies and researchers requiring a CAA or a Plan of Cooperation (POC) would be expected to apply by a set deadline, and the group would consider all of the activities together. In the past, many companies, agencies and researchers have waited too long to engage in the process, requiring a lot of ad-hoc meetings in the spring subsistence season. As this season is an important one for preparing for whaling, walrus hunting and ice seal hunting, standardizing the process allows everyone greater time to focus on their preparations. The final agreed CAA could then be taken to individual villages for their approval.

In the pre-open water meeting, the Arctic Seas Council would review development proposals, vessel tracking, whaling GPS data, marine mammal tagging data and other information to support decision-making related to solving spatial or temporal conflicts between proposed uses. If desired, the resulting areas and strategies for avoiding conflict could be converted into a GIS format and distributed to each party in an appropriate format.

The post-open water season meeting would be convened by the Arctic Seas Council and cooperating federal and state agencies as a public meeting. Results of activities would be discussed and monitoring systems would be evaluated. Changes in the next year's CAA would be discussed and recommendations prepared for the next year's pre-open water season meeting.

In order to foster ecosystem-based management and adaptive management, the Arctic Seas Council database could become a common gathering point for integrating scientific data across monitoring schemes and traditional knowledge studies. A scientific and traditional knowledge working group would be kept apprised of monitoring and synthesis efforts across agencies and organizations. This work would also be coordinated with the Canadian Beaufort Sea Partnership and Russian marine scientists. This working group could also be convened with additional experts to create decision support tools or answer other questions. The AEWC science hub could be funded as a research center similar to the Alaska Climate Center recently developed by the Department of the Interior.

Why collaborate?
Collaboration can help to avoid conflicts over subsistence resources and other activities, helps to protect community well-being, avoids incompatible activities, and provides more certainty for communities and industry by working out compromises in advance. For instance, the reduction of shipping vessel speed and coordination of ship movements conserve both bowhead whales and community access to whales. In exchange for standardizing the CAA process across sectors, both industry and subsistence hunters could gain a higher level of certainty.

How are conflicts resolved?
Any conflicts arising during deliberation on the Conflict Avoidance Agreement would be solved through consensus. If the group is unable to reach consensus, each private sector stakeholder who requires a CAA would need to sign CAAs with all parties separately.

Question motivating workshop: What are the existing and future challenges in coordinating and managing multiple uses of the Chukchi and Beaufort Sea and how might different ways of working together affect our success?

Strengthening Institutions Workshop Model 3: Marine Systems Knowledge Cooperative

Context of this institutional alternative: At present, the governance systems managing human uses of the U.S. marine environment are fragmented along agency and jurisdictional lines and are often out of sync with spatial and temporal characteristics of the marine system[1]. In a sector by sector approach, the impacts of one sector on another are only considered implicitly and often resolved politically without full information. In an ecosystem-based management approach, tradeoffs between sectors can be made explicit and transparently evaluated. This alternative builds on the National Ocean Council Priority Objectives for strengthening the knowledge base in Alaska to conserve resources but also for adapting to climate change, ocean acidification, changing transportation issues, and responding to emerging national security requirements and foreign policy goals unique to the Arctic.

Marine Systems Knowledge Cooperative: NOAA Convenes

What is the focus?
The focus of collaboration in this alternative is to build a more systematic approach to understanding and predicting change in the Beaufort and Chukchi Seas and to use the growing knowledge base to understand and manage trade-offs.

Who collaborates and how?
In this alternative, NOAA convenes an advisory group made of up of four major groups with management responsibilities or vested interests: 1) federal and state agencies, 2) Alaska Native village councils and major organizations, 3) industry, and 4) NGOs. The Advisory group would take the name, "Marine Systems Knowledge Cooperative". The group would establish a research cooperative, drafts a set of priority research questions, and creates a work plan and budget plan to oversee the development of an integrated assessment of the baseline conditions found in the Chukchi and Beaufort Seas. The assessment is conducting using existing authorities. Establishment of baseline conditions would help stakeholders understand the ecosystem, investigate the resilience and vulnerability of the area and use that information as a decision-making tool.

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[1] Crowder, L.B. et al. 2006. Resolving mismatches in U.S. ocean governance. Science 4(313):617-618

Meetings of the advisory group would be held biannually at first, but emergency meetings could be called at the request of the chairman. The meetings would be run by consensus, and where consensus isn't possible, through strong majority voting.

In order to foster ecosystem-based management and adaptive management, a scientific and traditional knowledge working group would keep track of monitoring and synthesis efforts across agencies and organizations, coordinated with the Canadian Beaufort Sea Partnership and Russian marine scientists. This working group could also convene with additional experts to create decision support tools or answer other questions.

Why collaborate?
Collaboration would bring knowledge from different sectors, agencies and sources to bear on important questions relating to management under current and future challenges and uncertainties. Together with the science and traditional knowledge working group, the advisory council builds a stronger knowledge base to conserve resources and sustainably exploit others, better understand the resilience of coastal communities, and avoid incompatible activities. By pooling resources and focusing on high priority research areas, the advisory council would be able to leverage cooperation and expected gains into successful federal grants in an era of dwindling funding.

How are conflicts resolved?
Any conflicts arising during deliberation on the strategic plan would be solved through consensus, and if not achievable, then by a strong majority vote. Reports of the science and traditional knowledge working group could be published independent of the advisory council's review.

Question motivating workshop: What are the existing and future challenges in coordinating and managing multiple uses of the Chukchi and Beaufort Sea and how might different ways of working together affect our success?

Strengthening Institutions Workshop Model 4: Regional Ocean Roundtable

Context of this institutional alternative: At present, the governance systems managing human uses of the marine environment are fragmented along agency and jurisdictional lines and are often out of sync with characteristics of the marine system[2] and priorities of local stakeholders. Feedback from stakeholder groups is similarly fragmented among sectors, and not across the (social and ecological) system as a whole. Using a marine spatial management approach, tradeoffs between sectors can be made explicit and transparently evaluated. This alternative builds on the existing Alaska coastal management program to strengthen the cross-scale (local, regional, state, and federal) cooperative management structure that allows local and regional expertise to guide the evaluation of trade-offs and relies on democratic deliberation to guide management decision-making.

Regional Ocean Roundtable: Chukchi and Beaufort Seas Regional Roundtables Convene

What is the focus?
The focus of collaboration in this alternative is to build an inclusive advisory body to:

1. serve as a venue for updating local coastal plans through new sources of data
2. to reduce conflict with a new decision-making process and
3. to guide future planning efforts.

Who collaborates and how?
In this alternative, each coastal region establishes a collaborative advisory body, the Regional Ocean Roundtable, made up of:

- borough representatives,
- Alaska Native government entities (village councils, regional tribal organizations, co-management groups),
- state and federal agencies

The advisory body's purpose is to plan for better coordination of compatible uses of the marine environment. The group establishes a research agenda to:

1. update the inventory coastal and marine resources in the coastal district areas and adjacent waters that affect the area by supporting the using ShoreZone mapping and data collection effort for the region,

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[2] Crowder, L.B. et al. 2006. Resolving mismatches in U.S. ocean governance. Science 4(313):617-618

2. expand the determination of human uses that occur in the coastal districts and adjacent waters through research that integrates Indigenous science, and traditional knowledge, and

3. adopt an existing or develop a method of explicitly evaluating effective ways to balance resource development.

The group links its planning and internal decision-making process to an existing marine science knowledge network (e.g., NSF-funded, UAF, NPRB, AOOS and/or other groups) that is broadened to include Indigenous scientists and traditional knowledge holders.

Including methods for monitoring efforts in the planning and decision-making process allows decision-makers to more accurately predict and evaluate impacts from development or other human uses of the marine environment. This planning and research approach is accomplished using existing authorities. Local coastal plans are revised using updated data, and submitted to the Alaska Coastal Management Program for approval. A new regulatory process is introduced that requires approval from the DNR Commissioner within 45 days, with an appeal process back to the Chukchi or Beaufort Regional Ocean Roundtable within a 90-day period if the Commissioner does not approve the plan.

The new plans aim to guide decision-making, and regulatory bodies agree to adhere to the plan to the greatest extent possible, given existing authorities. The consistency process uses the plans to identify issues of local concern and evaluate the compatibility of proposed development and uses with existing lawful uses of the marine environment or desired uses either in time or in space. The area designation process is strengthened to allow for more deference to local concerns.

Meetings of the Regional Ocean Roundtable are held quarterly during planning stages. The meetings would be run by consensus, and where consensus isn't possible, through strong majority voting. Once the plan is approved, the consistency review process remains the main vehicle for coordinating management. Pre-consistency review assistance meetings are held for large or controversial projects and involve the advisory body as well as the project proponent. These meetings are designed to build understanding and consensus. Projects that are found to be inconsistent at the local level can be appealed to the Alaska Coastal Management Program within the Division of Coastal and Ocean Management. The Regional Roundtable is connected to state and federal agencies and to the National Ocean Council to coordinate across jurisdictions.

Why collaborate?

Collaboration brings knowledge from different sources of expertise to bear on important questions relating to ocean conservation. Together with the marine science, Indigenous science and traditional knowledge networks, the Regional Ocean Roundtable builds a stronger knowledge base to conserve resources and sustainably and safely develop others, better understand the priorities and values of

coastal communities, and avoid incompatible activities. By using the planning stage to build consensus on priorities, making sure there is transparency in the process by which activities are deemed to be incompatible, future decision-making could reduce conflict and enable greater certainty.

How are conflicts resolved?
Any conflicts arising during deliberation on the coastal district management plan would be solved through consensus, and if not achievable, then by a strong majority vote. During implementation of the consistency review process, conflicts between local coastal districts and the Division of Coastal and Ocean Management are resolved through consensus, or, if required, by elevating decisions to the Commissioner's Office. Any conflicts arising during deliberation on the coastal district management plan would be solved through consensus, and if not achievable, then by an appeals process to the Commissioner's office, and finally, to the Chukchi or Beaufort Regional Ocean Roundtable.

Question motivating workshop: What are the existing and future challenges in coordinating and managing multiple uses of the Chukchi and Beaufort Sea and how might different ways of working together affect our success?

Strengthening Institutions Workshop Model 5: Coastal Zone Management Plus

Context of this institutional alternative: At present, the governance systems managing human uses of the marine environment are fragmented along agency and jurisdictional lines and are often out of sync with characteristics of the marine system[3] and priorities of local stakeholders. Feedback from stakeholder groups is similarly fragmented among sectors, and not across the (social and ecological) system as a whole. When new or growing uses are introduced into regional waters, managing the seascape often becomes more complex than existing regulatory frameworks are designed to handle. As a result, ad-hoc arrangements often become the standard method of doing business whether or not they are adequate to the task. This alternative builds on the Alaska coastal management program to build a new, comprehensive approach to governing multiple uses of the oceans built through extensive stakeholder engagement and the construction of marine knowledge for decision support tools.

Coastal Zone Management Plus: The State Convenes

What is the focus?
The focus of collaboration in this alternative is to build a comprehensive network of stakeholders, rights-holders and decision-makers to coordinate ocean uses, understand environmental change and create applied science and traditional knowledge-based tools for decision-making.

Who collaborates and how?
In this alternative, the Division of Coastal and Ocean Management is given a new mandate to develop a new way to coordinate competing uses of the ocean. The Division creates three bodies: an advisory body (the Alaska Ocean Advisory Council) of local, regional, tribal and state government officials to create new a new management system, a public-private partnership organization to build public consensus for the goals and process of ocean management (the Alaska Ocean Partnership) and a scientific and traditional knowledge research advisory group (the Alaska Ocean Research Advisory Council). The Ocean Science Advisory Council establishes a research agenda to 1) inventory coastal and marine resources in the coastal district areas and adjacent waters that affect the area using ShoreZone maps for the region, 2) determine which human uses are occurring in the coastal districts

[3] Crowder, L.B. et al. 2006. Resolving mismatches in U.S. ocean governance. Science 4(313):617-618

and adjacent waters through research, and 3) adopt an existing or develop a method of explicitly evaluating trade-offs.

Including monitoring efforts and a broad set of ecological and social indicators in the planning and decision-making process allows decision-makers to more accurately predict and evaluate impacts from development or other human uses of the marine environment. The explicit linkage of monitoring with policy processes allows active adaptive management. Local coastal plans are revised using updated data, and submitted to the Alaska Coastal Management Program for approval.

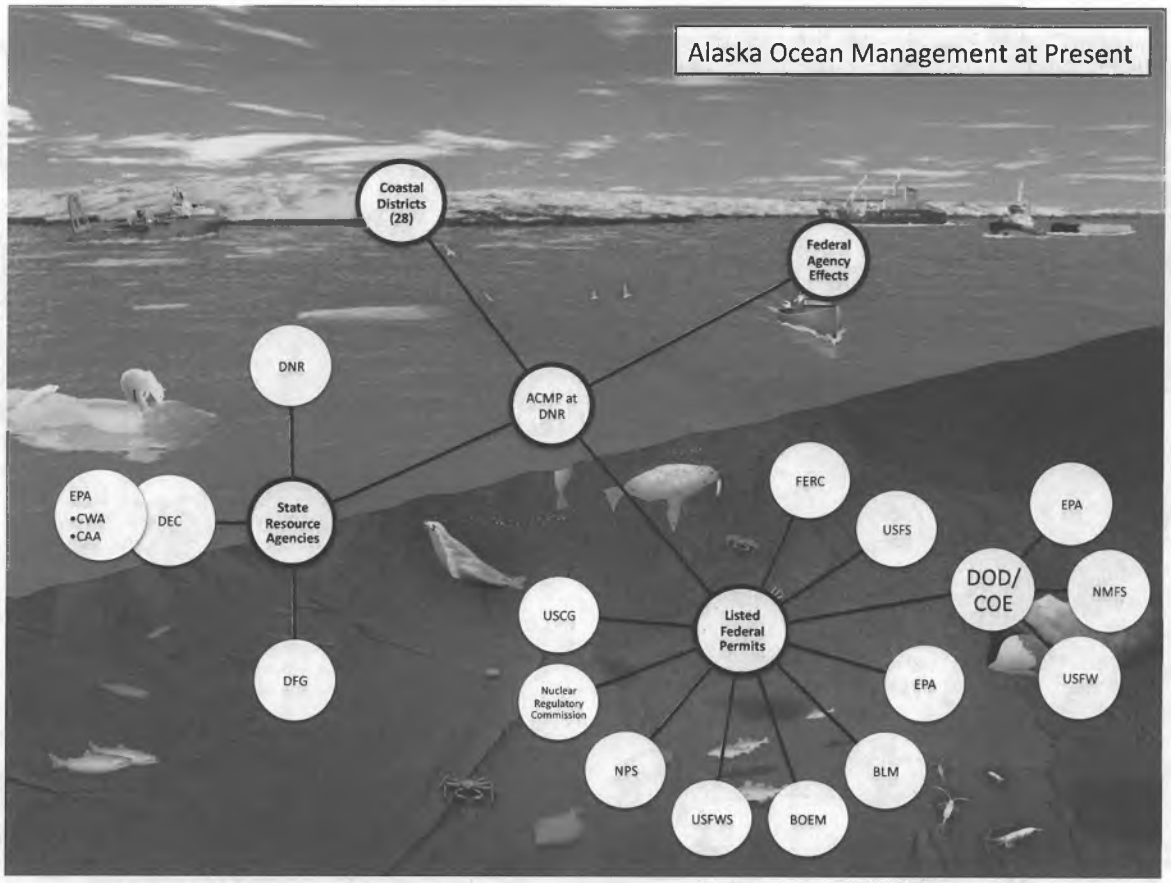
Meetings of the Alaska Ocean Advisory Council are held monthly during planning stages for a new Alaska Ocean Policy Act adopting a vision, goals, objectives and updated regional coastal district plans. The meetings would be run by consensus, and where consensus isn't possible, through strong majority voting. Once regional plans are approved, the consistency review process remains the main vehicle for coordinating management.

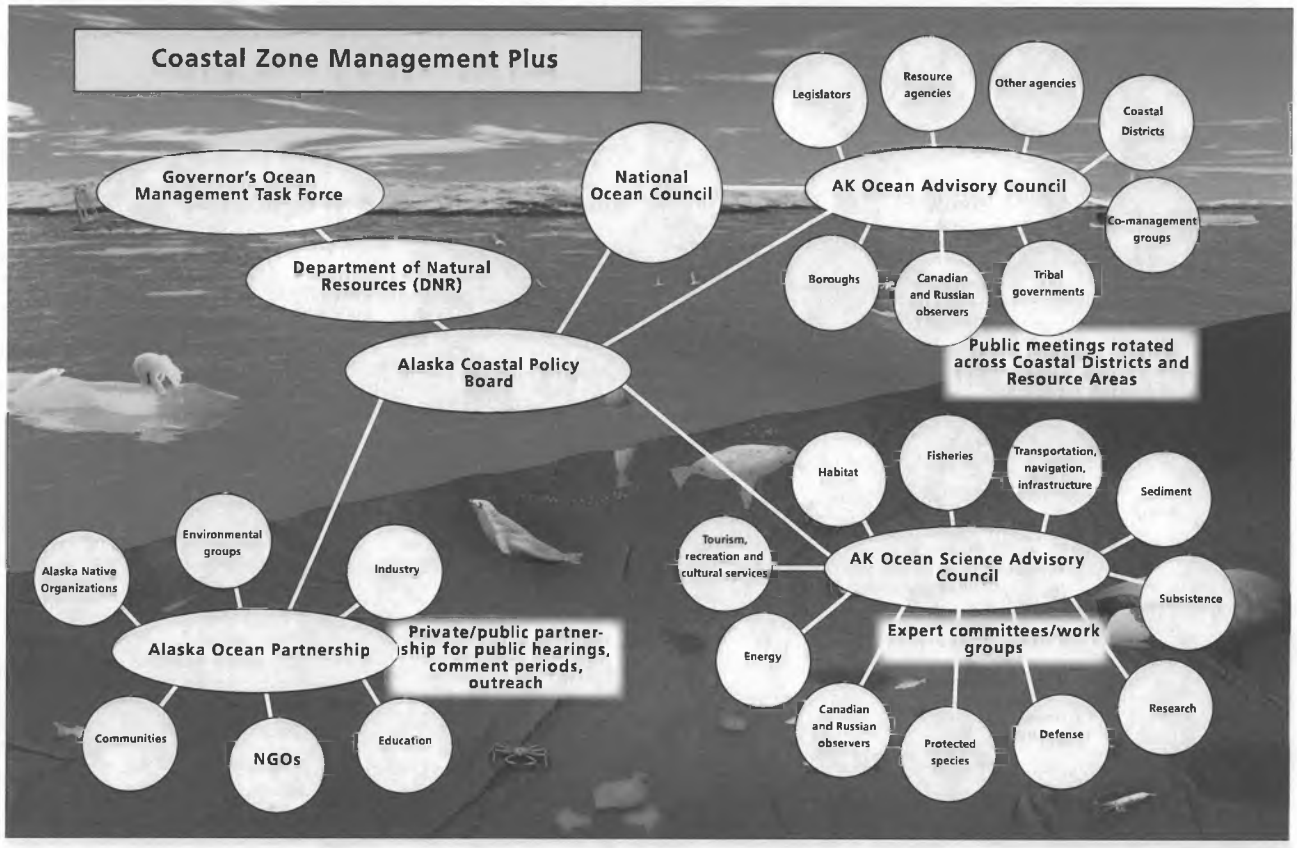
The Alaska Ocean Partnership would hold extensive public input-gathering sessions across the state in open forums, online, and through cross-sectors focus groups to understand the policy preferences of the public and various stakeholder bodies in order to inform the Alaska Ocean Policy Act. Through multi-stakeholder dialogues and outreach, the Partnership builds social capital across sectors and acts as a non-partisan broker of credible science for cooperative ocean management.

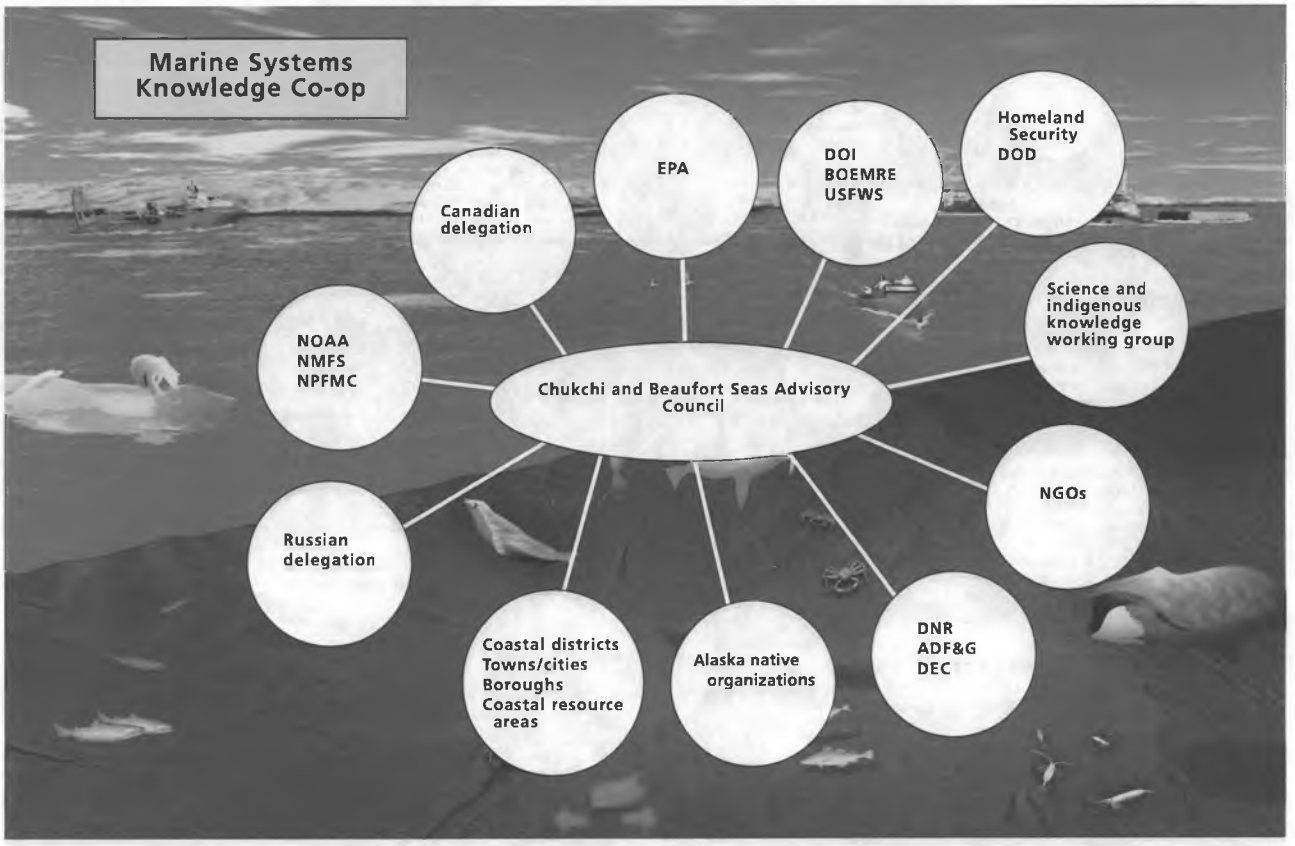
The Alaska Ocean Research Advisory Council would convene expert working groups looking at special management issues related to economic, ecological and socio-cultural uses of the oceans. The working groups and the council as a whole would be tasked with documenting baseline conditions, creating monitoring schemes, and constructing decision support tools.

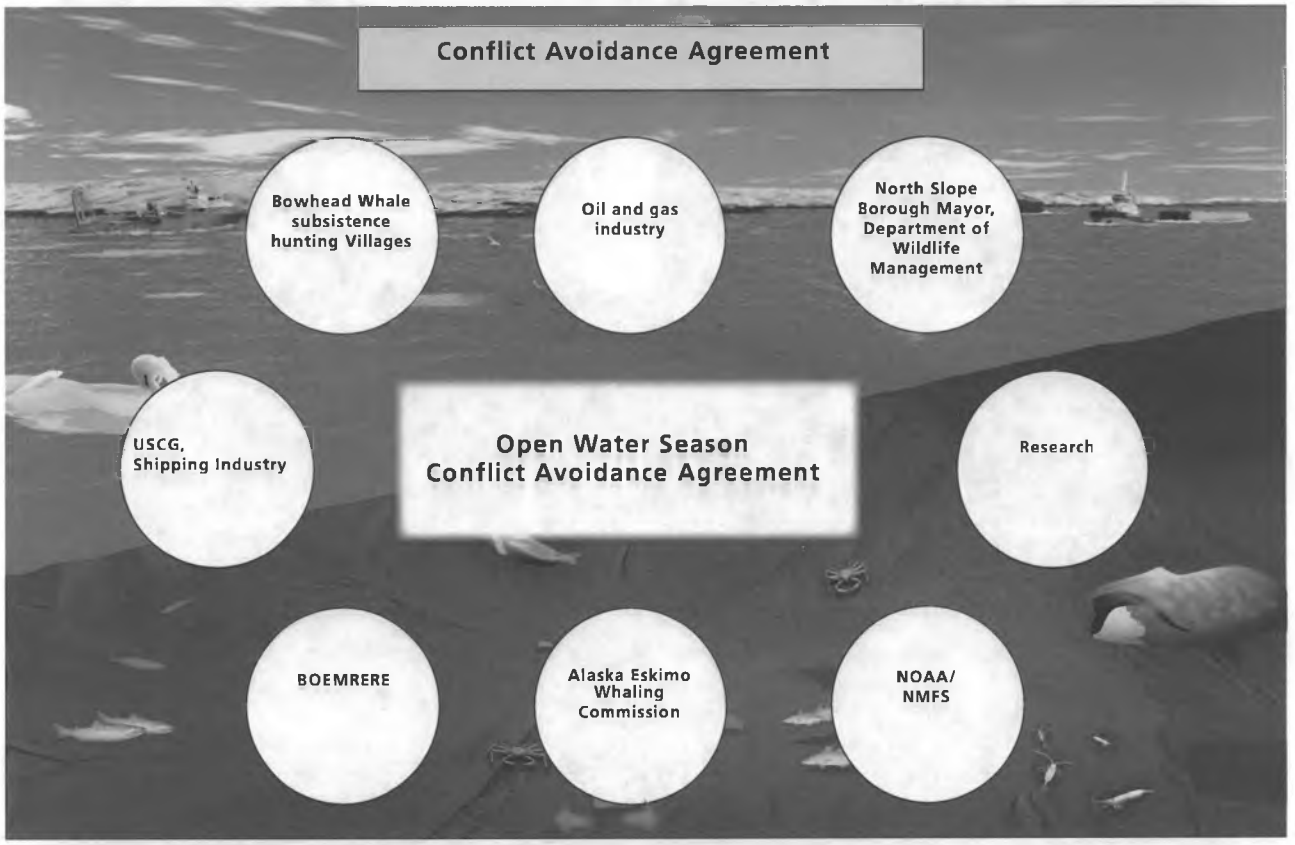
Why collaborate?
Collaboration brings different sectors, stakeholders and knowledge from different sources of expertise to bear on important questions relating to ocean conservation. Together with the Alaska Research Advisory Council and the Alaska Ocean Partnership, the Alaska Ocean Advisory Council builds a stronger knowledge base to conserve resources and sustainably exploit others, better understand the priorities and values of coastal communities, and avoid incompatible activities. By using the planning stage to build consensus on priorities but also the transparency by which activities are deemed to be incompatible, future decision-making is expected to be less contentious.

How are conflicts resolved?
Any conflicts arising during public deliberation on the Alaska Oceans Policy or within the two advisory councils would be solved through consensus, and if not achievable, then by a strong majority vote. A professional mediator could be brought in for seemingly intractable conflicts.


Alaska Ocean Management at Present
Coastal Districts (28)
Federal Agency Effects
DNR
ACMP at DNR
EPA
•CWA
•CAA
DEC
State Resource Agencies
DFG
FERC
USFS
EPA
DOD/ COE
NMFS
USCG
Listed Federal Permits
USFW
Nuclear Regulatory Commission
EPA
NPS
BLM
USFWS
BOEM


Coastal Zone Management Plus
Legislators
Resource agencies
Other agencies
Coastal Districts
Governor's Ocean Management Task Force
National Ocean Council
AK Ocean Advisory Council
Co-management groups
Department of Natural Resources (DNR)
Boroughs
Canadian and Russian observers
Tribal governments
Public meetings rotated across Coastal Districts and Resource Areas
Alaska Coastal Policy Board
Habitat
Fisheries
Transportation, navigation, infrastructure
Sediment
Environmental groups
Alaska Native Organizations
Industry
Tourism, recreation and cultural services
AK Ocean Science Advisory Council
Subsistence
Alaska Ocean Partnership
Private/public partnership for public hearings, comment periods, outreach
Energy
Expert committees/work groups
Research
Canadian and Russian observers
Protected species
Defense
Communities
NGOs
Education


Marine Systems Knowledge Co-op
Canadian delegation
EPA
DOI BOEMRE USFWS
Homeland Security DOD
Science and indigenous knowledge working group
NOAA NMFS NPFMC
Chukchi and Beaufort Seas Advisory Council
NGOs
Russian delegation
Coastal districts Towns/cities Boroughs Coastal resource areas
Alaska native organizations
DNR ADF&G DEC


Conflict Avoidance Agreement
Bowhead Whale subsistence hunting Villages
Oil and gas industry
North Slope Borough Mayor, Department of Wildlife Management
USCG, Shipping Industry
Open Water Season Conflict Avoidance Agreement
Research
BOEMRERE
Alaska Eskimo Whaling Commission
NOAA/ NMFS

Arctic Deepwater Port Charette
May 16-17, 2011

An Arctic Deepwater Port charette was co-convened by the US Army Corps of Engineers and the Alaska Department of Transportation and Public Facilities on May 16-17, with approximately 35 people representing state, federal, and university interest in attendance. The purpose of the workshop was to scope out the criteria, potential locations, and rationale for a deep draft Arctic port in Alaska. The workshop reflected on the November 2009 and January 2011 Alaska Regional Ports workshops as background for what existing port needs were identified and where future deepwater ports could be sited.

Introductory messages by Colonel Koenig and Commissioner Luiken set the cooperative and collaborative approach of this charette by having both the state and federal government invested in the process. The findings would also provide the needed information for Senator Begich in furthering his package of Arctic bills.

The key elements of the workshop were broken out into sessions of 6 tables with rotating members to discuss and itemize aspects of:

Define Arctic Geography:

Defining the Arctic area of consideration, with many alternatives offered of the area south of the Bering straits. Everyone agreed that North of the Bering Straits was Arctic. It was noted that Nunivak Island needed to be included to the southeast and that Provideniya, Russia offered an international Arctic Port adjoining the area of discussion. With the new SAR mission, Provideniya could be an important bilateral or multi-lateral consideration in defining the geographic realm of an Arctic Port.

Consensus was that the Aleutian Islands Pacific great circle route was generally not to be considered for an Arctic deepwater port, although the point was made that transshipment of goods could be staged from both Dutch Harbor and Adak as deepwater ports on the great circle route.

Arctic Vessel Parameters:

Vessel parameters included the breadth of vessels presently using the Arctic, including the large bulk carriers employed at Red Dog Mine, the large gas liquid concentrates tanker that transited the Bering Straits in 2010, and the small cruise ships that are transiting the Northwest Passage. Research vessels, oil exploration vessels, and other public and military vessels were identified, although the vast majority of the traffic would be for summer, open water use only. The role of tugs and barges for supplying arctic communities was noted as a significant activity that would benefit from increased deepwater port access to improve lightering into the Arctic rivers and shallow coastal areas.

The offshore operations for oil and gas development and the nature of vessels and equipment employed raised the question of whether an Arctic Port would be needed, when the vessels could maintain an Arctic offshore operation without a dependence on a land based facility. The use of gravel islands in Prudhoe Bay was noted.

Port Siting Criteria:

An exercise of the 6 tables identifying 9 primary criteria for siting of an Arctic Port was conducted. These Siting Criteria were: national security, environment, economic development, infrastructure, life safety, sustainability, land ownership, spill response, socioeconomics. While consensus was not arrived at for the individual priorities, general consensus showed that the environmental (physical) conditions at the site were key for both the planning and operation of the site, as well as determining the environmental impacts. This information included weather, ice, mapping and ability for seasonal versus year round use, as well as the distribution of fauna and traditional use patterns. A significant amount of data and models exist that can help define the environmental conditions and consideration for development.

Of these criteria, different interpretations of criteria terms stimulated discussions as to the importance of "life safety" when linked to "national security "and "spill response" or "sustainability" when linked to "economic development, environment, or socioeconomics".

National security, search and rescue, and marine pollution response were rated low priorities by several as wherever a port is built; the respective entities will use it, but will not have the money to invest in the initial development. Creating a national interest would be key for federal investment.

A list of potential sites was developed with options for a matrix of what the site conditions and environmental factors may show, as well as the fit to the key elements prioritized in site selection. 9 sites were easily identified. It was generally agreed that one large port would not be developed, but numerous small sites would be eventually developed with purposes of importing materials, goods and supplies, exporting of natural resources and development or rock and gravel sources.

Potential sites noted in discussions were:

- Merkoryuk on Nunivak Island,
- St. Michaels in Norton Sound above the Yukon River mouth
- Cape Darby for rock and gravel
- Cape Nome for rock and gravel
- Nome with deepening existing port
- Teller and Port Clarence, as deep water shelter south of Bering Straits
- Cape Blossom in Kotzebue Sound
- Delong Mountain Transportation System for the Red Dog mine
- Prudhoe Bay

In addition, the bilateral use of Provideniya, Russia was noted as a marginally functional port at the entrance to the Bering Straits, but relevant for search and rescue under the new Arctic Council SAR Agreement.

The potential for offshore lightering with moorings to improve the efficiency of river transport for support of villages and in development of natural resources and particularly mines well removed from tidewater.

In addition, encouragement was offered by Congressman Young to think "out of the box" and recognize that "saving to prosperity" did not build wealth, but building things and developing resources through investment built wealth.

Steve Borell, Alaska Miners Association presented the development of Arctic minerals and the value of defining a transportation system for transporting minerals from the mine site to tidewater. He detailed his previous studies into a railroad from the Ambler and Northwest Arctic to tidewater in Norton Sound. The essential and cost effective role of rail service from mineral deposits has been proven in remote locations worldwide and could again prove itself in Alaska's Arctic. The challenges of reaching deepwater remain, with Cape Darby in northern Norton Sound offering a conceivable location. Steve concluded that the resources are available, the seasonality of shipments provides a challenge, but the warming of the Arctic and diminished ice cover is allowing for a larger shipping season.

The Charette concluded with thoughts on how to move forward. These included:

- Convene a steering committee to move forward on the findings of this charette and the previous two regional port workshops.
- Plan an industry focused ports meeting to add private development and investment sectors to discuss past studies and identify sites for future studies.
- Review environmental data and model projections for Arctic regions on seasonality.
- Identify projects (low-hanging fruit) that can be developed into a pilot project, including offshore mooring buoys at a resource or lightering location.

A press release has been prepared by ADOTPF and posted at http://www.dot.state.ak.us/comm/pressbox/arch_2011/PR11-2528.shtml.

Materials and reports from the workshop will be posted and join the results from the 2011 Regional Ports Workshop.

Arctic Fisheries

- Fishing moratorium
- Need for research and baseline data collection to inform future decision making

Shipping

- Vessel monitoring and tracking
- What are international search and rescue capabilities?
- What are the Coast Guard's capabilities for search and rescue?
- What are local and state capabilities for search and rescue?
- International shipping rules and agreements
- Navigation aides
- National Security

(These are proposed ideas forwarded by task force members to begin the discussion)

2. Set and finalize hearing schedule:

Bethel

International Forum Girdwood NWTF invited June 20-21st

Kotzebue and Nome: July 5-7th in conjunction with Trade Fair

Unalaska: August 24-26th with the legislative fly-in

Final Recommendations Meeting: September in Anchorage

(4) Conduct hearings in the Arctic & Sub-Arctic regions of Alaska to fulfill its purpose.

The task force will provide final recommendations to the Legislature by January 30, 2012.

Arctic Governance

- Who is making decisions and how does the NWTF get heard
- Laws of the Sea
- Boundaries Disputes
- International agreements for shipping, search and rescue, oil and gas activities and spill response
- What does multi-jurisdictional cooperation in the Arctic look like?
- How does the State of Alaska and its people be heard and involved
- International research agreements and sharing of information
- How does the Arctic Council fit in

Oil and Gas Development and Research

- Proposed development
- Spill response capabilities and technology
- What are Coast Guard capabilities to respond to oil spill?
- What are industries capabilities to respond?
- What are local capabilities to respond?
- Ecosystem research and baseline data

Arctic Infrastructure Investment and Long Term Planning

- What investments need to be made
- Who should be making the investments

The Alaska State Legislature created the Alaska Northern Waters Task Force (ANWTF) in 2010 to assess development of state and federal northern waters.

The Alaska Northern Waters Task Force is comprised of legislators, leaders from Arctic communities, and representatives of key federal and state agencies. Members of the task force are Representative Reggie Joule, Chair; Senator Bert Stedman, Vice-Chair; Representative Bob Herron; Senator Lyman Hoffman; Dept. of Environmental Conservation Commissioner Larry Hartig; North Slope Borough Mayor Edward Itta; Unalaska City Manager Chris Hladick; Nome Mayor Denise Michels; NANA Corp. Vice-President Chuck Green; and Alaska Marine Conservation Council Chair Dave Kubiak. Alternates include Senator Donald Olson; Representative Bryce Edgmon; Richard Glenn from Arctic Slope Regional Corporation and Cora Campbell, Commissioner of Fish & Game.

The task force has held meetings in Anchorage and Barrow to bring together Alaskans and Arctic stakeholders

The duties of the task force are:

(1) Assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) Facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) Identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

October 12, 2011 – The following draft outline is intended to serve as basis for: a) a white paper or letter detailing the State of Alaska's view on Arctic shipping to the CMTS (Committee on the Marine Transportation System) as they work to fulfill a Congressional mandate to help design a shipping regime for the Arctic Ocean, b) potential testimony to the U.S. House Transportation Committee on November 15, 2011, where Lt. Gov. Treadwell has been requested to speak about Arctic Council work on Arctic shipping and the State's view on icebreakers (invitation letter forthcoming), c) potential written testimony to the U.S. Senate Energy Committee (hearing on November 19 or 20, invitation forthcoming, per call from Committee staff 10/11/11).

I. **Introduction – Change is here:** Arctic shipping is coming quickly, because of changes in technology, changes in global markets for natural resources, and changes in Arctic environmental conditions. This year's traffic may total 18 Northern Sea Route voyages of major cargoes.

- **a. Changes in technology:**
  - i. Double ended ships are more efficient icebreakers.
- **b. Changes in global markets for natural resources:**
  - i. European producers are seeking Asian markets.
  - ii. Iron ore in Norway is being shipped to markets in Asia
  - iii. Our own Red Dog Mine lead and zinc serves markets in Asia Europe, and North America and could, theoretically, provide a back haul cargo to Europe on ships traveling the Northern Sea Route.
  - iv. Arctic shipping may provide access to other resources, such as Northwest Alaska coal or North Slope propane.
  - v. Offshore oil exploration in 6 of the 8 Arctic countries is expanding ice operations.
- **c. Changes in Arctic environmental conditions:**
  - i. 2011 was second lowest Arctic ice minimum in recorded history.
  - ii. Navigation through ice cover is much easier with less multi-year ice.

II. **Challenges and opportunities:** the State of Alaska sees these changes in the Arctic as both a challenge and an opportunity.

- **a. One challenge is the current double standard in Arctic shipping in the Bering Sea:**
  - i. Ships engaged in oil and gas exploration or delivering to U.S. national ports are more likely subject to strong regulation by the USCG, EPA and NOAA, but international shipping is less subject to these regulations.
  - ii. We face the prospect of increasing international ship traffic through the Bering Strait with minimal requirements to prepare for oil spills, maintain air quality, or requirements to care for wildlife and subsistence needs.
  - iii. Article 234 Law of the Sea may rectify this situation if the U.S. ratifies. Arctic Council efforts could also help rectify.
- b. **U.S. Arctic policy calls for a shipping regime that is "safe, secure, and reliable."**
  - i. Alaska's efforts towards this goal:
    1. Western Alaska Port Study with Army Corps of Engineers
    2. Marine Pilot Board review of ship safety
    3. State comments on Bering Strait traffic study and co-sponsorship of Aleutian risk-assessment study

4. Potential state financial support for USCG forward basing, hangar/port facilities
5. State financial support for AIS (Automatic Identification System) network placed on Alaska's coast and maintained by Marine Exchange of Alaska
6. Statewide Digital Mapping Initiative supports coastal mapping
7. State sponsored feasibility study for container shipping between Adak and Iceland (2006)
8. Statewide broadband study may identify ways to improve communications capabilities for Arctic operations

ii. Federal government efforts we are watching closely:
1. CMTS charged by 2010 Coast Guard Authorization Act to develop integrated picture of Arctic shipping regime
2. Ocean policy review
3. USCG high latitude study
4. US Navy Arctic road map
5. NOAA bathymetric work in Bering Strait
6. Port Study with Corp of Engineers
7. White House Arctic Policy Implementation Group

iii. International efforts pursued by federal and state governments jointly through Arctic Council process:
1. Implementation of 2009 AMSA recommendations
   a. Arctic nations seek enforceable standards for ship construction through the International Maritime Organization's proposed adoption of the Mandatory Polar Code
   b. Arctic Council's Search and Rescue agreement; implementation exercise in October 2011
   c. Expected oil spill response agreement; negotiations begin in Norway October 2011
   d. Arctic Council's PAME (Protection of the Arctic Marine Environment) working group's proposed ballast water moratorium in Arctic Ocean
   e. Arctic Council's SDWG (Sustainable Development Working Group) Arctic transportation infrastructure study is pending before Senior Arctic Officials
2. U.S.-led efforts to provide notices to mariners in Arctic Ocean
3. U.S. National Ice Center/NOAA/Navy/USGC ice forecasting
4. Weather forecasting improvement sought with greater cooperation with Russia

III. What's missing?

a. Icebreakers:

i. Governor Sean Parnell's testimony to the U.S. Senate Subcommittee on Homeland Security Appropriations, 8/20/09:

> "Melting sea ice and increased military and commercial activity require a greater Coast Guard presence. The Coast Guard needs to move north and improve its capability — our heavy ice-class

icebreakers are on their last legs. To provide homeland security the Coast Guard must have new Arctic-class icebreakers equipped for search and rescue missions, border protection, law enforcement, fisheries enforcement, infrastructure and environmental protection."

1. No action by Congress or Executive branch for new icebreaker capacity
2. Prime Minister Vladimir Putin announced on 9/23/11 that Russia will be building 9 new icebreakers to work toward their goal of making Northern Sea Route as important to commerce as the Suez Canal.

ii. Rep. Young, Sen. Begich announced on 10/11/11 introduction of legislation authorizing Coast Guard to lease and operate two new icebreakers.

b. There have been no substantive U.S. discussions about creating an international commercial regime similar to St. Lawrence Seaway model, whereby two nations commit to infrastructure, safety, and marketing for a joint seaway.

c. There has been no Senate ratification of the Law of the Sea, which guarantees freedom of navigation and allows regulation of ice-covered seas.

IV. U.S. must understand …

a. This is a huge opportunity, and a long time coming.

i. 500 year search for Northwest Passage
ii. 40% distance savings
iii. Good for global environment – use less fuel
iv. Good for global economy – market efficiencies

b. How will U.S. respond to this opportunity?

Joint agreement with Russia on oil spill prevention or pending infrastructure? Joint investment with other Arctic nations?

c. Alaska can help to responsibly take advantage of the opportunities on behalf of the nation

i. Encouraging discussions
ii. On the front lines
    1. Closely watching Korea's plans to ship LNG directly via the Mackenzie Delta
    2. Aleutian ports forming relationship with global shipping community
    3. With Russian energy traveling past, will this allow less expensive energy for Western Alaska?

d. This is an issue of national security:

i. U.S. must have an Arctic presence.
ii. We must have the same USCG protection in the Arctic as in the rest of the nation.
iii. Energy potential:
    1. "Do we want to leave it to the Russians to mind the store?"
    2. Decrease dependency on foreign imports to U.S.

Aug. 3, 4, 5th - Arctic Summit / Kotzebue

50-60 people

Stacey & - signature page - what number

DOC / Anchorage →
Jim Kendall / BOEMRE / Alaska (new guy)

CZM is at beginning -

National CZM workshop - Washington D.C.
9 priorities each has a SAP -
Changing conditions in the Arctic - own strategic action plan =
Ocean acidification -
Improve coordination on Arctic issues local, State, Federal, & international economic development that is responsible & sustainable. Societal benefits =

Asst Sec Tilene, Shane Mukluyak Ground Annual Resource Assist Draft SAP Draft II

Ocean Act Tilene, Coordinator, Rev 1

David Hamson AITC 8 - Blatant racism from State / Duty of feds to indigenous people, off topic where are the tribes? Wrong time of year to take testimony - gathering time - tribes should be at the table on DOC.
Disenfranchised so don't show up -
Increase to rural areas / tribal people on policy boards -

Doug Vincent Berg / State Dept F & Game
State: fishing & bil in e economy
largest private sector employer 60% of US fish
OCS key to states & nations economic security
Clearly defined outcomes & timelines not clear
Evolving Proces
Healthy, resilient, sustainable
wants bill passed by Congres questions authority of NOI Pres.
Policies from ground up / Partnership
Questions legality -
Congressional Actions
Arctic Infrastructure - more resources not rules
Arctic boundaries -
Arctic High Seas Fisheries Agreement w/ other nations
Ratify Laws of Seas / other countries claiming land
Bottom up approach - slow down
Carl Wasley / Yupik / Bering Sea
Bountiful resources / stewardship key / for future generations / lack of infrastructure / must involve tribes
CG needs resources / tools
CZM feeling - local knowledge - admin against

failed policies of exclusion by state
Traditional science aspect to include
Best available science. Canada has
walked on balancing science.
Amy Snyder / Alaska Marine Conservation
Council / 700 members / leadership applaud /
unique habitats → sustainable environmental
stewardship - recognize changing conditions
Act quickly proactive.
Ocean Acidification - Applaud as priority
worried about sound / sonar from Navy
precautionary movement.
Nicos Passos - Enviro sociologist - research
funding / tribal govt involved / fish
allocations / govt to govt consultation
enviro justice / Traditional science best available
fish / resource ban up North until no neg
impacts - no tribal representation on NOC
CZM - failed more input coastal com
Dave Harbor & Doug Vincent-Lang / questions
authority of exec Order / Assumes current regs /
process isn't working / SAP is harmful not
from Congress. Congress should solve / FIAT
Jeff Jones &

Andrew Hardstick / Alaska Conservancy /
Plus recognizing Arctic as a stand alone SAP. Beef up reasons why Arctic is a priority / detail geographic scope
Connection b/w Arctic waters and on shore - more detail conservation & stewardship - identify & protect sensitive areas - promote holistic & long term research & data collection strategy for comp. research
seek out & use traditional knowledge
Improve inter-agency coordination

Rachele Donelle / PEW / Bering Sea / revisit comments from scoping period / Arctic SP should have over arching policy - guide map
Emphasis science / ecosystem / trad knowledge / meaningful voice for communities & incorporate / implement ideas.
Ian (Accent) Seaklife Center / make process easily accessible / jargon bearactic & full of scientific jargon / can not clearly explained caused confusion - need to clear up misnomers / work w/ existing National Parkers Increase Ocean literacy

NO C/R to Deep Water Horizon
No C/A to Natl Oceans Endument

Natl Preparedness to wildlife very limited need to work on this - build response capability / Add to Arctic Strategic Plan

AOGA Kate Williams / oppose additional layers for development / pro development / need oil for pipeline - critical / Develope OCS / Question legal authority to congress clearinghouse for research sound science →
resources for infrastructure
forecast models / data driven
Maryanna Hall - RDC / improve coordination of existing policies not add more
Lawson Bringham supports Pres. Integrated & holistic approach to Arctic / Surveys of indigenous uses / one use must account for integrated uses
Infrastructure needed - stewardship requires infrastructure for economic & environmental steward ship.
Arctic Observing System →
Bering Strait region / talk to them - seems forgotten in SAP focus on North

Judy Kitka

Law of the Sea ratify

Spill oil on water to test clean up/ controlled environ/ Norway

Need new models/regs for the Arctic

Alternative compliance / Need money — shared $ efforts

Kara Olson / St. George Island

2.5 mil birds — support EBM / CZM yes

tribal involvement yes / show case implementation of plan

EXECUTIVE OFFICE OF THE PRESIDENT
NATIONAL OCEAN COUNCIL
WASHINGTON, D.C. 20503

December 20, 2010

The Honorable Reggie Joule
Alaska State Legislature
P.O. Box 673
Kotzebue, AK 99752

Dear Representative Joule,

Thank you for your October 26, 2010, letter concerning the recently established National Ocean Council (Council). We appreciate the creation of the Alaska Northern Waters Task Force (NWTF) and the duties it has taken on.

As you know, on July 19, 2010, President Obama signed Executive Order 13547 adopting the *Final Recommendations of the Interagency Ocean Policy Task Force* (Final Recommendations) and directed Federal agencies to take appropriate steps to implement them. As described in the Final Recommendations, the Council's Governance Coordinating Committee (GCC) will consist of eighteen members from states, Federally-recognized tribes, and local government.

The Council has formally requested nominations for the GCC from States, state and local governmental organizations, Federally-recognized tribes, and regional and national tribal organizations. The Alaska Governor's Office has provided nominations for the Alaska representative to the GCC. The Council has also received nominations from the National Conference of State Legislators (NCSL) for the State legislative representative to the GCC. The Council will consider these nominations over the next several weeks along with the nominations received for other GCC seats.

The GCC members will serve one- or two-year terms. While the nomination solicitation process for the first term of GCC membership has closed, there is opportunity for the NWTF to provide input to the Alaska Governor's Office and NCSL on nominees for future terms.

We appreciate your interest in and support for the Council and the National Policy for stewardship of the ocean, our coasts, and the Great Lakes.

Sincerely,

Sherburne B. Abbott
Associate Director for Environment
Office of Science and Technology Policy
Co-Chair, National Ocean Council Deputy Committee

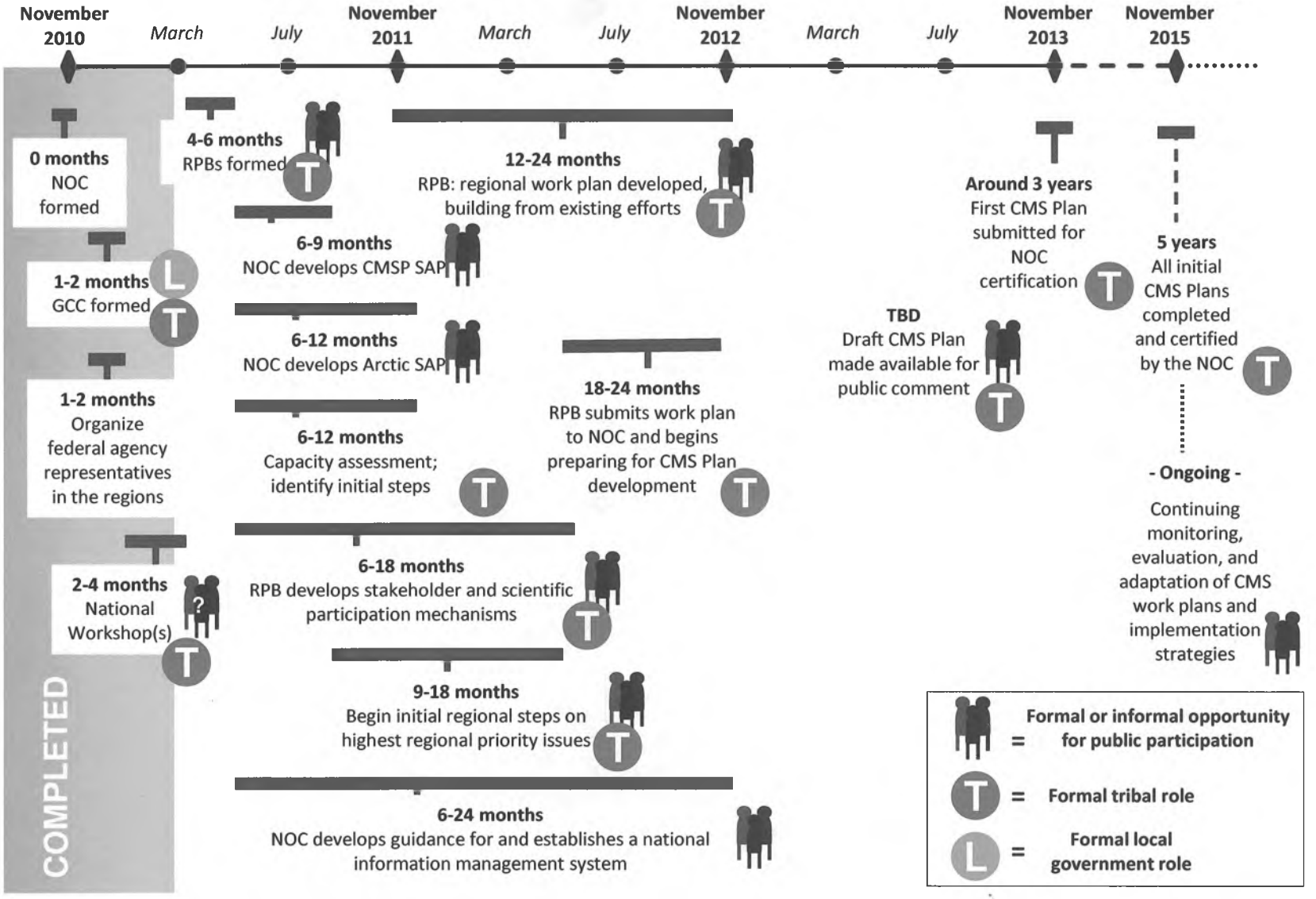
Michael Boots
Associate Director for Land and Water Ecosystems
Council on Environmental Quality
Co-Chair, National Ocean Council Deputy Committee

2

Arctic Council Information and Documents

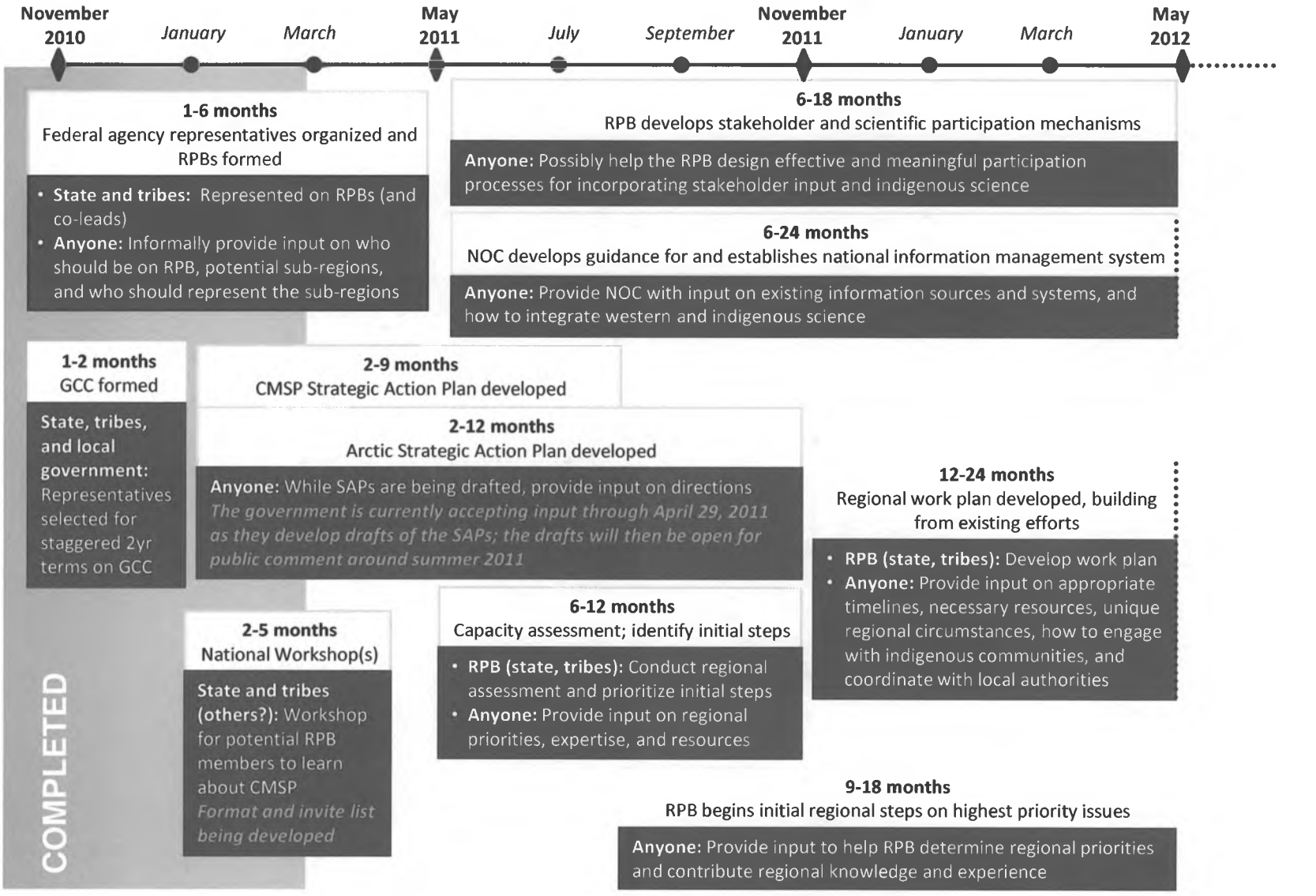
5-YEAR CMSP TIMELINE (AS OUTLINED IN THE FRAMEWORK)

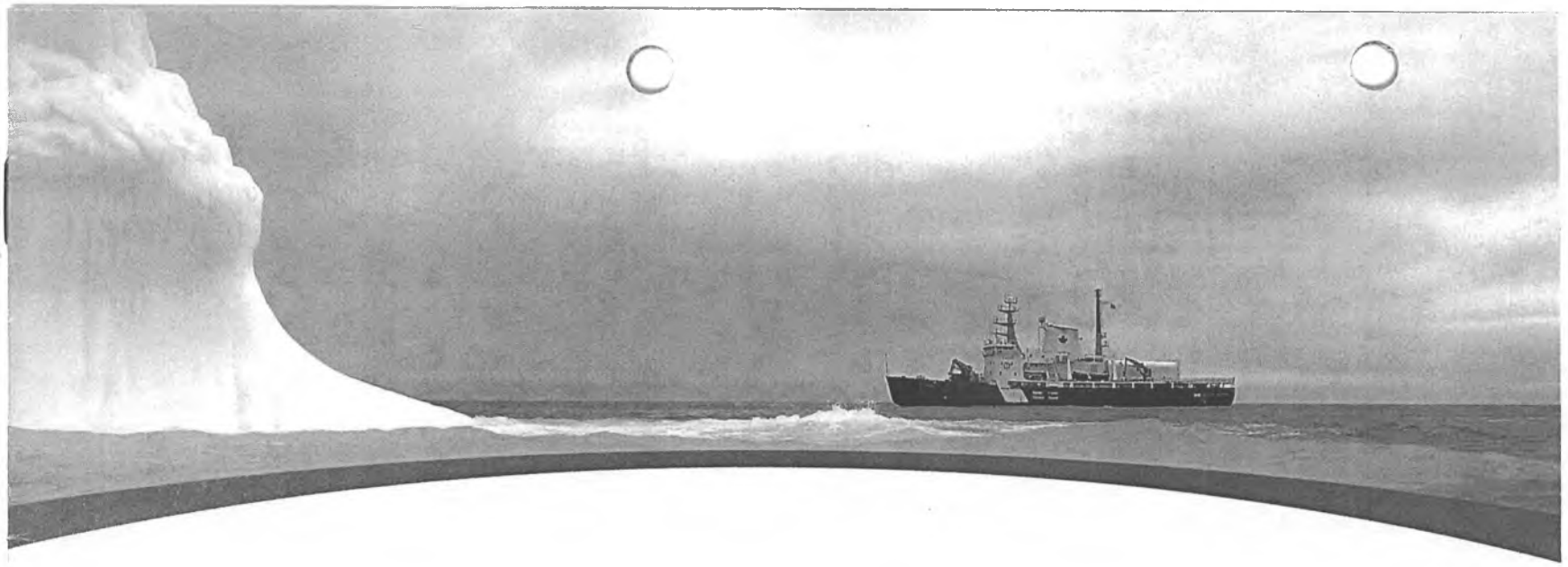
ENVIRONMENTAL LAW INSTITUTE
DRAFT - MARCH 2011



18-MONTH CMSP TIMELINE (AS MODIFIED BY ONGOING PROCESSES)

ENVIRONMENTAL LAW INSTITUTE
DRAFT - MARCH 2011





STATEMENT ON CANADA'S ARCTIC FOREIGN POLICY

Canada's vision for the Arctic is of a stable, rules-based region with clearly defined boundaries, dynamic economic growth and trade, vibrant Northern communities, and healthy and productive ecosystems.

The international dimension of Canada's NORTHERN STRATEGY

Government of Canada / Gouvernement du Canada

Canada

CANADA'S ARCTIC FOREIGN POLICY

provides the international platform from which to project our national interests in the world across all four pillars of the Northern Strategy: EXERCISING OUR SOVEREIGNTY, PROMOTING ECONOMIC AND SOCIAL DEVELOPMENT, PROTECTING THE ARCTIC ENVIRONMENT, AND IMPROVING AND DEVOLVING GOVERNANCE. We will pursue our interests at the international level through leadership and stewardship.

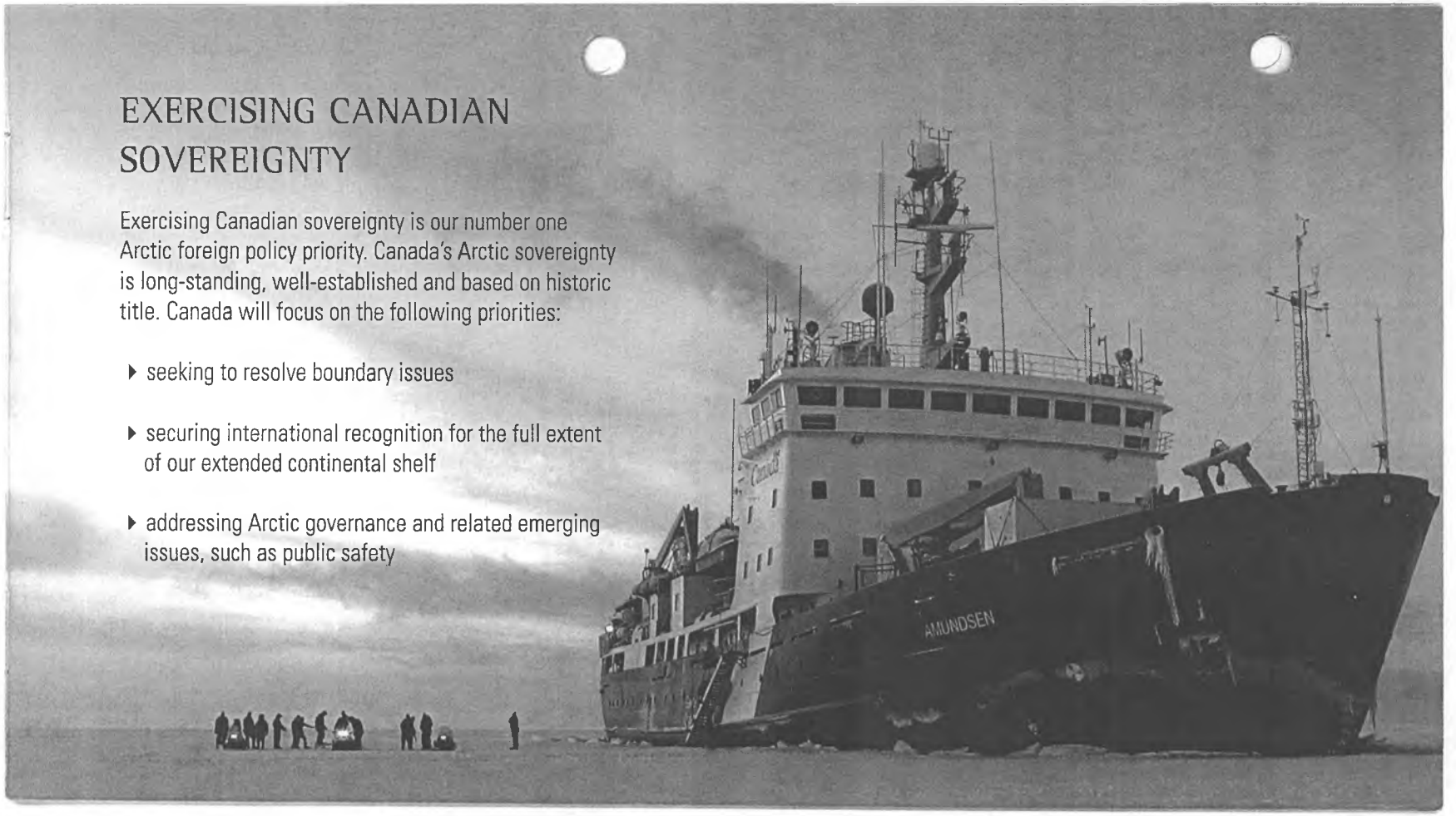
OUR APPROACH

- Canada will show leadership and work with others to demonstrate responsible stewardship to build a region responsive to Canadian interests and values, secure in the knowledge that the North is our home and our destiny.
- Canada will maintain control of our Arctic lands and waters and will respond when others take actions that affect our national interests.
- Canada will never waver from our commitment to protect our North. Cooperation, diplomacy, and respect for international law will remain hallmarks of Canada's approach.

EXERCISING CANADIAN SOVEREIGNTY

Exercising Canadian sovereignty is our number one Arctic foreign policy priority. Canada's Arctic sovereignty is long-standing, well-established and based on historic title. Canada will focus on the following priorities:

- seeking to resolve boundary issues
- securing international recognition for the full extent of our extended continental shelf
- addressing Arctic governance and related emerging issues, such as public safety



PROMOTING ECONOMIC AND SOCIAL DEVELOPMENT

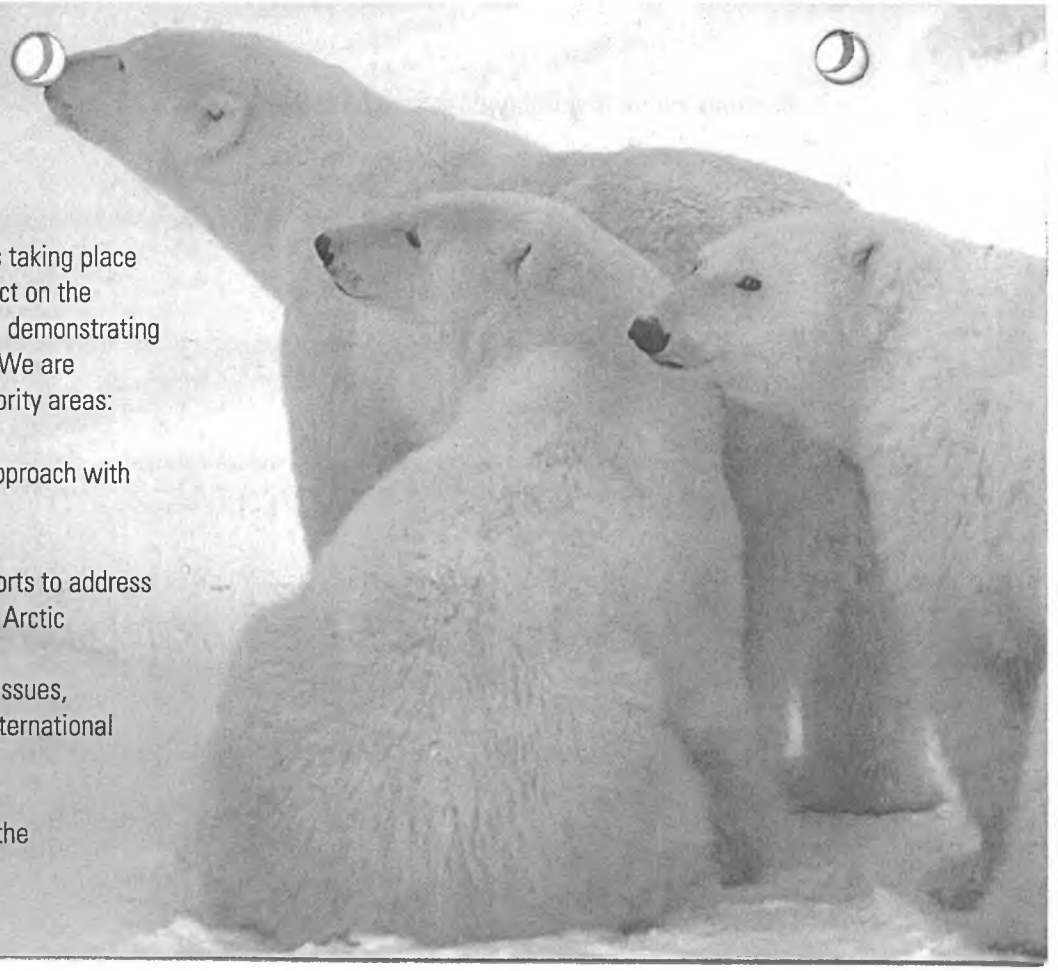
The people of the North are at the heart of Canada's Arctic foreign policy. Canada will actively promote Northern economic and social development internationally on three key fronts:

- taking steps to create the appropriate international conditions for sustainable development in the Arctic region
- seeking trade and investment opportunities that benefit Northerners and all Canadians
- encouraging a greater understanding of the human dimension of the Arctic to improve the lives of Northerners

PROTECTING THE ARCTIC ENVIRONMENT

The Arctic environment is being affected by events taking place far outside the Arctic but having a significant impact on the region's unique and fragile environment. Canada is demonstrating stewardship in this magnificent ecological region. We are pursuing action internationally in the following priority areas:

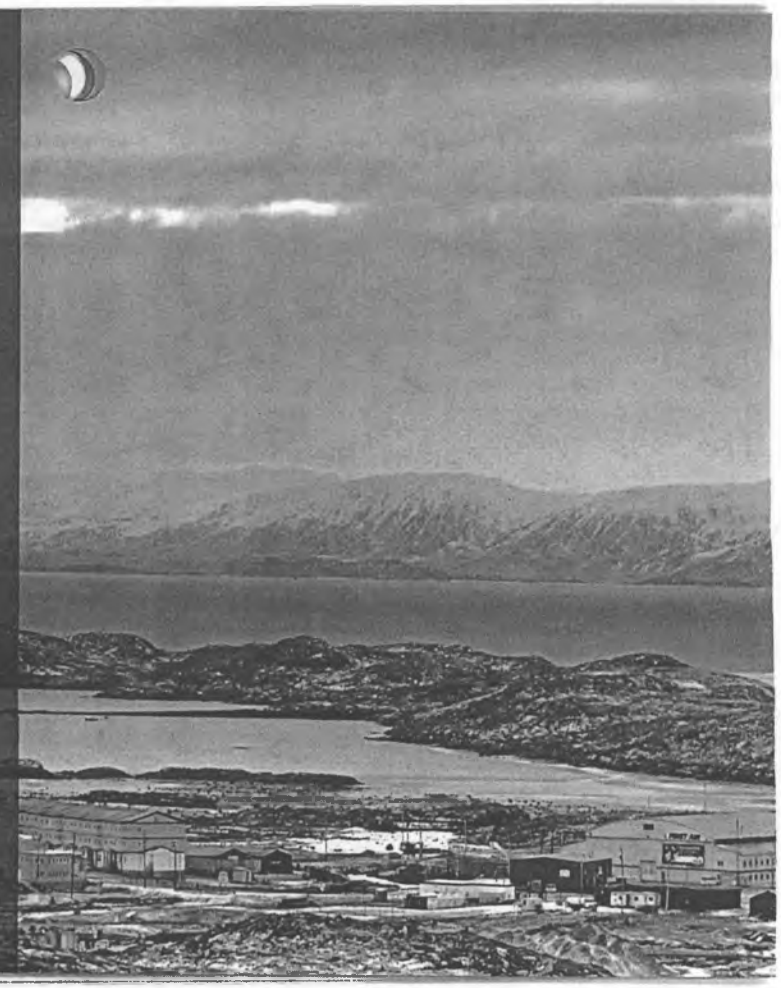
- promoting an ecosystem-based management approach with our Arctic neighbours and others
- contributing to and supporting international efforts to address the causes and effects of climate change in the Arctic
- enhancing efforts on a range of environmental issues, including the promotion and strengthening of international standards
- strengthening Arctic science and the legacy of the International Polar Year



IMPROVING AND DEVOLVING GOVERNANCE

The Government of Canada is committed to providing Canadian Northerners with more control over their economic and political destiny. Canada's Arctic foreign policy bolsters our domestic efforts toward strong governance in the North in the following three ways:

- providing opportunities for Northerners to actively participate in shaping Canadian foreign policy on Arctic issues
- continuing to support the participation of Indigenous Permanent Participant organizations at the Arctic Council
- providing Canadian youth with opportunities to participate in the circumpolar dialogue



OUR STRATEGY

The rapid pace of change and growing importance of the Arctic requires that we strengthen our capacity to deliver on Canada's priorities on the international scene. Facing the region's challenges and seizing its opportunities often requires finding ways to work with others: through bilateral relations with neighbours in the Arctic, through regional mechanisms like the Arctic Council and through other multilateral institutions.

Enhancing key bilateral relationships

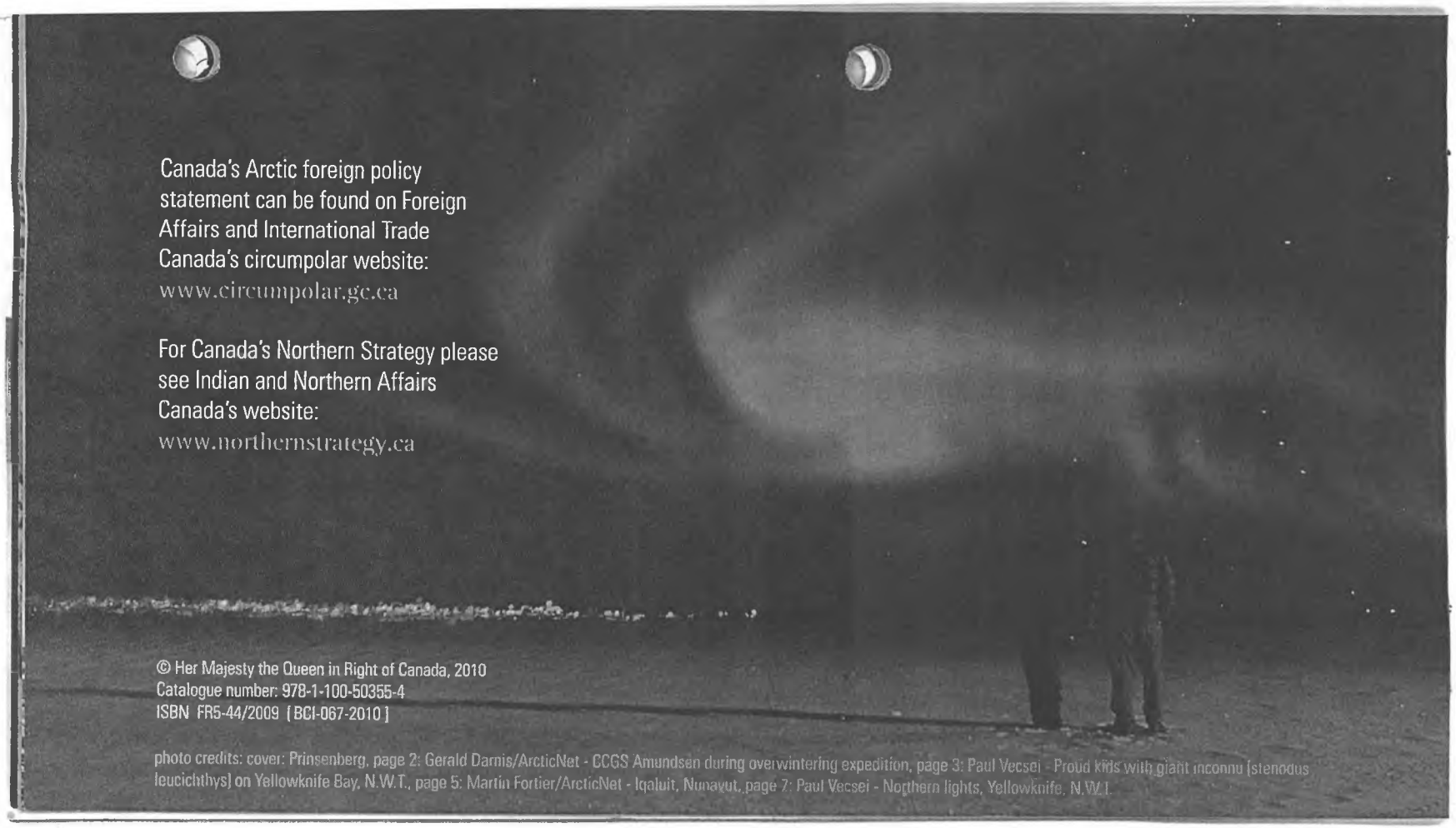
Canada will pursue a more strategic engagement with the U.S., our premier partner in the Arctic, and will work closely with Denmark, Finland, Iceland, Norway, Russia, Sweden, and in priority areas. The Arctic has also attracted the interest of non-Arctic states and entities. The key foundation for collaboration will be acceptance of and respect for Arctic states' sovereignty and the perspectives and knowledge of Northerners.

Pursuing a strengthened Arctic Council

The Arctic Council is the leading forum for cooperation on Arctic issues. Canada's key priorities for strengthening the Council include pursuing a greater policy dialogue, ensuring that research continues to focus on key emerging issues, and engaging with other member states to address the structural needs of the organization.

Working through multilateral institutions

Canada will work through all relevant multilateral institutions toward global solutions for issues such as polar shipping regulations, climate change and mercury emissions.



Canada's Arctic foreign policy statement can be found on Foreign Affairs and International Trade Canada's circumpolar website:
www.circumpolar.gc.ca

For Canada's Northern Strategy please see Indian and Northern Affairs Canada's website:
www.northernstrategy.ca

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Government of Canada
Canadian Consulate

Gouvernement du Canada
Consulat du Canada

Allison Biastock
Political, Economic Relations and Public Affairs Officer

310 K Street, Suite 220, Anchorage, AK 99501
Tel.: (907) 264-6719 Cell: (907) 441-9152 Fax: (907) 264-6713
allison.biastock@international.gc.ca
www.anchorage.gc.ca

Canada

Government of Canada
Canadian Consulate

Gouvernement du Canada
Consulat du Canada

Nancy Hemsath
Arctic Advocacy Officer

310 K Street, Suite 220, Anchorage, AK 99501
Tel.: (907) 264-6728 Cell: (907) 441-4181 Fax: (907) 264-6713
nancy.hemsath@international.gc.ca
www.anchorage.gc.ca

Canada

Spotlight on Canada-U.S. Collaboration:
Arctic Marine Shipping and the Environment

SUMMARY OF PROCEEDINGS

February 24, 2011

... an increasingly busy Arctic calls for a rapid response to some of the uncertainties that exist. It is important that policy makers and administrators – in Alaska, Canada and the United States – recognize and understand those challenges.

The Institute of the North, in partnership with the Consulate of Canada, hosted its inaugural Arctic Policy Forum on February 24, 2011. Setting the stage for a quarterly event, the evening reception provided a networking opportunity for Alaskans to connect around Arctic issues. Future events will feature multiple perspectives intended to develop in attendees a common understanding of Arctic issues.

This first forum featured Consul Jennifer Loten of the Consulate of Canada in Anchorage who highlighted Canada's Arctic Foreign Policy. This international platform will allow Canada to demonstrate responsible stewardship in the Arctic and comprises four pillars: exercising sovereignty, promoting economic and social development, protecting the Arctic environment, and improving and devolving governance. Watch the video of her presentation at www.institutenorth.org.

The following day, the Institute of the North coordinated a symposium hosted by the Government of Canada and focused on Arctic marine shipping and the environment, and highlighting opportunities for U.S. – Canada collaboration. Recommendations from the Arctic Marine Shipping Assessment (AMSA) formed the backdrop as experts from Alaska and Canada shared some of the latest information from work across the Arctic. Panel discussions provided an excellent analysis of the gaps in Northern infrastructure and how to address them; circumpolar environmental response capacity, including coastal planning and environmental management; and vessel tracking systems.

The symposium opened with a compelling overview by Alaska Lt. Gov. Mead Treadwell of why the Arctic – and collaboration and leadership in the region – matters, and that message was reinforced by speakers throughout the day. Not only is the

Lunchtime Keynote on Public Diplomacy and Collaboration: Hot Ideas for a Cool Climate

- Education: creating new curricula
- Field trips to the Arctic for thought leaders across boundaries
- Slogan, logo, creative event
- Arctic World Games
- Global commons in the Arctic needs to be communicated
- International Arctic Corps – comprising international scientist, business leaders, grad students
- Arctic Chamber of Commerce
- International Arctic Prize
- Arctic Development Book for the private equity community
- Increased outreach for the Arctic Council

Community input is a valuable component of responsible, relevant public policy.

Arctic home to the peoples and communities living there but it has a profound impact on the economies of its nations, many of which rely on natural resource development. At the same time, an increasingly busy Arctic calls for a rapid response to some of the uncertainties that exist. It is important that policy makers and administrators – in Alaska, Canada and the United States – recognize and understand those challenges.

AMSA was the first Arctic Council document to require consent from all eight of its nation members: U.S., Canada, Russian Federation, Norway, Finland, Sweden, Iceland and Denmark through Greenland and the Faroe Islands. The report was foundational in that it provided a baseline for data on Arctic marine traffic, as well as recommendations of areas for focus and governance. AMSA emphasized the necessity for Arctic infrastructure and understanding the use and challenges as Arctic shipping increases. Following the 2009 report, subsequent discussion and work have contributed toward a roadmap to address the recommendations. The Arctic Council has recognized the importance of AMSA findings by committing to two additional years to continue implementation.

Another partnership to note is that of the Pacific Northwest Economic Region (PNWER) and its recent formation of an Arctic Caucus. PNWER recognizes the value of the U.S. – Canada economic partnership, particularly of its Northern regions, which have large geographic areas with small populations and rich natural resources. Alaska and Northern Canada are essential to a successful Arctic and the sub-regional work being conducted through PNWER helps ensure that success. The State of Alaska's formation of the Northern Waters Task Force complements these efforts.

In developing infrastructure, it is important to plan for the long term and involve communities early and throughout the plan. Community input is a valuable component of responsible, relevant public policy. Infrastructure is a broad term that may include government services, such as icebreakers or search and rescue; private services, such as salvage; or information, such as weather, ice, and safe navigation

In addressing gaps, policy makers should recognize that Information, Skills, Systems and Assets (ISSA) are essential to implementing AMSA negotiated recommendations.

products. The infrastructure deficit noted in AMSA is of concern to Northern communities, both in their ability to develop strong economies and vibrant communities, and in their ability to respond in case of crisis. In addressing gaps, policy makers should recognize that Information, Skills, Systems and Assets (ISSA) are essential to implementing AMSA negotiated recommendations.

Commonly articulated between all panels was the importance of the planning process and the necessity for cohesion in closing the gaps. The U.S. and Canada share common ecosystems objectives for the Arctic region – prevention, preparedness, response and recovery – yet each nation has a different approach in shaping policy. Panelists highlighted examples such as Canada's Beaufort Region Environmental Assessment and the Beaufort Sea Partnership; and tools like the U.S. Environmental Response Management Application. Cross border collaboration through the CanUS North Exercise in 2010 and the resulting CanUS North Joint Plan was spotlighted as a link through which to coordinate response information and technology. The readiness exists; however, the resources remain limited and one speaker called for cohesion between U.S. and Canadian investments to fill the gaps without overlaps.

The readiness exists; however, the resources remain limited...

Current and future polar orbiting ice observing satellite imagery will allow efficiency in monitoring Arctic shipping and may foster investment. With increased traffic, tracking vessels can improve safe and environmentally sound operations. One U.S. speaker pointed to the Bering Strait as "Alaska's Gibraltar"– a major transit and potential chokepoint for traffic into and out of the North Pacific Arctic – and spoke of the need for Arctic domain awareness. By contrast, Canada's 1970 Arctic Water Pollution Policy Act was extended into mandatory registration for ships with the 2010 implementation of NORDREG through which the Canadian Coast Guard ensures that ships in the Canadian Arctic meet AWPPA regulatory requirements.

It was clear from the active engagement throughout the day that the symposium was unique in offering the opportunity for policy and science to co-mingle. And while there was considerable discussion around the US and Canada's well managed disputes, the forum demonstrated that there is value in detailed exchanges on these questions outside of the decision-making arena.

Canada was pleased to sponsor the inaugural forum and looks forward to participating in future events.

The Arctic Policy Forum is a quarterly event convened by the Institute of the North, designed to connect policy makers and administrators, academics, community members and other stakeholders in Alaska to one another and to new and emerging policy issues in the Arctic. These respond to the Institute of the North's mission to act as an advocate for Alaska in Arctic infrastructure and policy.

Hosted by

INSTITUTE OF THE NORTH

Sponsored by

Government of Canada / Gouvernement du Canada / Canada

Visit www.institutenorth.org to see presentations from the Arctic Policy Forum, as well as video of speakers.
Contact Nils Andreassen at 907 771-2448 or nandreassen@institutenorth.org to learn more about the Institute's Arctic program.

Consulate of Canada Consulat du Canada

June 16, 2011

Rep. Reggie Joule
State Capitol
Juneau, AK 99801

Dear Representative Joule

The Arctic is fundamental to Canada's national identity, and Canada is strongly engaged in the Arctic, both internationally and here in North America. In 2008, Prime Minister Stephen Harper released Canada's Northern Strategy, a document outlining Canada's domestic priorities for the Arctic including enhancing economic development, public safety and environmental protection. Conscious that we cannot accomplish our goals for the Arctic in isolation, and understanding the critical role our arctic neighbours play in the evolving Arctic, Canada released its Arctic Foreign Policy in 2010. Recognizing our historic relationship and the close bond our nations enjoy, this document explicitly recognizes the United States as Canada's premier partner in the Arctic.

Alaskans and Canadians have inhabited the Arctic for millennia, and share not only a border but knowledge of opportunities and challenges associated with the region. Canada and Alaska have collaborated to address challenges and to achieve shared objectives in the Arctic, from marine search and rescue missions and arctic science to trans-border road maintenance. This partnership has yielded benefits across the region and on both sides of the border.

As the Arctic gains prominence on the international stage, Canada and the U.S. are poised to expand their partnerships to advance shared interests. Together, Canada and the U.S. can exercise leadership by promoting environmental stewardship, strengthening arctic science, and encouraging a greater understanding of the human dimension of the Arctic.

As part of our ongoing advocacy efforts in Alaska, the Government of Canada has produced a brief publication highlighting U.S. and Canada's collaboration in the Arctic. This flier will serve as a reference for the many existing partnerships that enhance the ability of Canada and the U.S. to effectively govern and serve as stewards of the North.

I hope you will take a few moments to review the flier and learn more about the dynamic and historic relationship that links Alaska and its Arctic neighbour to the east. Should you have any questions regarding the content of this flier or other Canada/U.S. issues, please contact the Consulate of Canada in Anchorage.

Sincerely yours,

Jennifer Loten
Consul
Consulate of Canada, Anchorage

encl.

Canada

Government of Canada
Canadian Consulate

Gouvernement du Canada
Consulat du Canada

Allison Biastock
Political, Economic Relations and Public Affairs Officer

310 K Street, Suite 220, Anchorage, AK 99501
Tel.: (907) 264-6719 Cell: (907) 441-9152 Fax: (907) 264-6713
allison.biastock@international.gc.ca
www.anchorage.gc.ca

Canada

Government of Canada
Canadian Consulate

Gouvernement du Canada
Consulat du Canada

Nancy Hemsath
Arctic Advocacy Officer

310 K Street, Suite 220, Anchorage, AK 99501
Tel.: (907) 264-6728 Cell: (907) 441-4181 Fax: (907) 264-6713
nancy.hemsath@international.gc.ca
www.anchorage.gc.ca

Canada

CANADA-U.S. COLLABORATION IN THE ARCTIC

Canada and the United States have long collaborated in the Arctic as neighbors and friends. In the harsh environment of the Arctic, the two nations break sea ice for each other, fight forest fires, perform search and rescue, build transportation and technological infrastructure, and maintain a sophisticated system of early warning to reinforce continental security. As stated in Canada's Arctic Foreign Policy, the United States is Canada's premier partner in the Arctic.

With the unique conditions in the Arctic and the limited infrastructure available, coordination and cooperation between Canada and the United States are vital in achieving mutual goals. Collaboration in the realms of science, technology, environmental protection, infrastructure, and surveillance is underwritten by myriad agreements that together create a sound framework for the economic development and security of the Arctic, consistent with the objectives laid out in Canada's Northern Strategy Statement of July 2009 and United States National Arctic Policy.

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▶ Transportation

Transportation challenges include great distances between communities, limited air and highway connections, weather conditions, status of the ice pack/river ice for marine travel, and the high cost of road construction and maintenance.

Canada–U.S. Highway Collaboration

The United States, Alaska and Yukon governments have signed formal agreements to build and maintain highway linkages which, in some cases, have included absorbing the costs for work done in the other's jurisdiction. These bilateral and sub-federal agreements keep roads passable, paved, plowed, and patrolled for those who travel in the Arctic.

The Government of Yukon and the Alaska Department of Transportation and Public Facilities collaborate on highway engineering and operational issues and share technology and experience with respect to constructing and maintaining highway infrastructure in a northern environment.

The Government of Yukon also collaborates with the Alaska University Transportation Center (AUTC) on permafrost research related to highways, including the Beaver Creek Permafrost Test Site on the Alaska Highway.

Canada–U.S. Arctic Marine Collaboration

An estimated 6,000 ships navigate the Arctic Ocean annually, with roughly 120 ice-free days. The United States Coast Guard reported a total of 122 vessels traveling in United States waters of the Arctic and 278 vessels traveling in the Bering Strait in 2009.

Transport Canada works with the United States Coast Guard to share information about vessel risk, on-vessel incidents, shipping activity, and design criteria. The International Maritime Organization is currently updating the *Guidelines for Ships Operating in Arctic Ice-covered Waters*, under which both Canadian and United States jurisdictions are expected to operate.

Joint Military Operations

The *Canada-United States Civil Assistance Plan* provides a framework for Canada Command and United States Northern Command (USNORTHCOM) to operate binationally.

U.S. Northern Command

USNORTHCOM operations areas include air, land, and sea approaches across the continental United States, Alaska, Canada, and Mexico, as well as offshore to approximately 500 nautical miles. Headquartered in Colorado, the USNORTHCOM Commander is also the North American Aerospace Defense Command (NORAD) Commander and is appointed by and responsible to both the United States President and the Canadian Prime Minister. The Command Center coordinates a worldwide system of sensors designed to provide intelligence on any aerospace threat.

Canada Command

Canada Command, headquartered in Ottawa, Ontario, is responsible for all domestic and continental Canadian Forces operations. The Command also coordinates military support to Canadian civil and law enforcement authorities.

NORAD

In the 1950s, the United States and Canada constructed the "DEW Line," a network of 58 stations along the 69th parallel north to detect an attack over the Arctic.

NORAD was founded in 1958 as a binational command between the governments of Canada and the United States. It is the most significant joint military activity between Canada and the United States in the Arctic. Through outstanding binational cooperation, NORAD has proven itself effective in its roles of watching, warning, and responding. NORAD plays a important role in the defense of Canada and the United States by evolving to meet the changing threat.

In 2006, a new agreement included a maritime warning mission that entails a shared awareness and understanding of the activities conducted in United States and Canadian maritime approaches, maritime areas and inland waterways. NORAD shares information across borders and, in the case of a threat, initiates response by the appropriate national commands or agencies.

NORAD's forces consist of the Alaskan NORAD Region, Canadian NORAD Region, and Continental NORAD Region.

Alaskan NORAD Region (ANR)

The Alaskan NORAD Region (ANR) conducts aerospace control within Alaska and 200 miles offshore. ANR is active 24 hours a day and has the capability to intercept, escort, divert, direct landings and use force if necessary. ANR also assists in the detection and monitoring of aircraft suspected of illegal drug trafficking.

The ANR Region Operations Control Center is located at Joint Base Elmendorf Richardson in Anchorage. It is operated binationally by United States Air Force, United States Air National Guard, and Canadian Forces personnel.

Protecting the Arctic

In 2007, ANR was named NORAD's outstanding unit, receiving the Partridge-Slemon Award. In the same year, an ongoing operation demonstrating ANR's vigilance and readiness to defend North American air sovereignty was initiated. Fighters from the Alaskan NORAD Region and Canadian NORAD Region are launched in response to aircraft that enter North America's Air Defense Identification Zone. While aircraft do not generally violate United States or Canadian airspace, NORAD-integrated air defense assets in Alaska and Canada are able to detect and intercept aircraft, including Russian heavy bombers carrying out training exercises near the coasts of Alaska and Canada.

Joint Task Force North (JTFN)

As part of its partnership to enhance North American security in response to the events of September 11, 2001, Canada and the United States worked together to develop independent Canadian and US military organizations called Joint Task Force North (JTFN). These units function independently in Canada and the United States, under Canada Command in Canada and in the United States under USNORTHCOM. Under these separate commands, each JTF provides support to domestic law enforcement agencies in the identification and interdiction of threats, including international terrorism, narcotics trafficking, and illegal alien smuggling. Each country's JTFN also works closely with NORAD.

Joint Task Force Alaska (JTF-AK)

Joint Task Force Alaska (JTF-AK), headquartered at Joint Base Elmendorf Richardson in Anchorage, consists of soldiers, sailors, airmen, United States Coast Guardsmen and United States Department of Defense civilian specialists. JTF-AK works with the United States Department of Defense and other federal agencies to evaluate events and locations throughout Alaska for their potential vulnerability as targets for aggression. JTF-AK also provides intelligence to military commands and civilian agencies throughout Alaska and the United States to aid in homeland security awareness and planning. JTF-AK's civil support mission includes disaster relief operations in response to fires, hurricanes, floods and earthquakes.

States Navy and the United States Coast Guard participated in the military exercise portion of Operation NANOOK 2010, Exercise NATSIQ, in order to increase interoperability, exercise a collective response and build the combined capability of the Arctic nations to operate together.

Canadian Joint Task Force North (JTF-North)

Canadian Joint Task Force North (JTF-North), headquartered in Yellowknife, Northwest Territories, exercises Canadian sovereignty and security through routine and contingency operations in the North. It contributes to the growth and development of ...thern residents through the Junior ...adian Ranger and Cadet programs, ...nds Canada's capacity to respond rapidly and effectively to safety and security emergencies, and assists with environmental stewardship.

Combined Efforts

Operational-level engagement between the Joint Task Forces in Canada and the United States ranges from regular communication, to reciprocal visits and briefings on Arctic issues, to combined exercises. They also keep each other informed on search and rescue and disaster response operations taking place in their areas of operation and share information on Arctic marine traffic.

Operation NANOOK 2010

In August 2010, the ...adian Forces held the ...h annual Operation NANOOK in Resolute Bay, Nunavut. The United

Canadian Rangers

Canadian Rangers are part-time reservists who provide a military presence in Canada's remote, isolated and coastal communities. They bring local expertise, guidance and advice to the Canadian Forces during operations and exercises. In sharing their traditional knowledge of the land and environment, the Rangers are a major contributor to the training and effectiveness of the Canadian military in the Arctic.

At the invitation of USNORTHCOM/ NORAD, a group of Canadian Rangers and staff traveled to Colorado in 2009 to deliver a briefing at NORAD headquarters as part of its Aboriginal Awareness week.

Coast Guards

The Canadian Coast Guard Central and Arctic Region is headquartered in Sarnia, Ontario, and maintains a working partnership with the 17th United States Coast Guard district, headquartered in Juneau, Alaska. The two coast guards conduct joint exercises, operations, planning and delivery of services, and participate in the annual Canada-United States Coast Guard Summit. The two forces perform icebreaking for each other when requested. They also work together on a variety of public safety, law enforcement, search and rescue, research, and environmental preparedness and response activities.

Joint Canada - United States Extended Continental Shelf Surveys

Canada and the United States cooperate on scientific and technical work needed to map the outer limits of the continental shelf beyond 200 nautical miles in the western Arctic Ocean. The surveys require significant planning by scientists and officials from Canada's Extended Continental Shelf Program and the United States Extended Continental Shelf Task Force. The research trips have been used to support other scientific endeavors such as ice, seal and seabird surveys and research on sea-ice coverage, water salinity, and micro-organisms.

▶ Public Safety

Border Patrols and Law Enforcement

Following the events of September 11, 2001, the United States and Canadian governments focused attention on customs enhancements and plans to increase the security and efficiency of border processes. In December 2001, the *Canada-United States Smart Border Declaration* established specific measures to identify and address security risks with minimal impact on the movement of legitimate goods and services across the border. The United States and Canadian agencies responsible for border security maintain close communications.

The Royal Canadian Mounted Police (RCMP) delivers police and law enforcement services in Canada, including local community services and federal enforcement. RCMP personnel work in their areas of specialization with Alaska State Troopers, Homeland Security, border enforcement, and the FBI.

Canada-United States Cross-Border Forum

Established in 1997, the Canada-United States Cross-Border Forum brings together provincial, state, and local partners. Numerous law enforcement sub-groups (intelligence, border enforcement, organized crime, prosecutions, interoperability, and mass marketing fraud) are active throughout the year. The Forum has improved Canada-United States law enforcement cooperation and information-sharing to reduce terrorism and organized crime.

Arctic Security Working Group (ASWG)

Jointly chaired by Public Safety Canada and Joint Task Force North Yellowknife, ASWG brings together Canadian domestic agencies, as well as provincial and territorial administrators to share mainly unclassified information relating to the Arctic and to collaborate on emergency management and security. United States officials also participate.

Disaster and Emergency Response

Alaska, Oregon, Idaho, Washington, British Columbia and Yukon created the *Pacific Northwest Emergency Management Arrangement* to allow for cross-border mutual aid in times of disaster or emergency. The treaty addresses cross-border planning and exercises, emergency operations and support centers, damage and impact assessment, disaster recovery administration, community outreach, search and rescue, medical assistance, debris clearance, resources and donation management, and security.

Yukon River Flood of 2009

Canada-United States emergency response collaboration was tested in May 2009 when an unusually warm spring thaw caused flooding along the Yukon River, destroying the Alaska community of Eagle. Canada gave the United States hydrological information that enabled Alaska to warn Eagle residents to prepare an evacuation. After the disaster, Canadians from Dawson City were among the first responders in Eagle, volunteering for clean-up and staying throughout the summer to help repair the extensive damage.

Environment and Resource Management

Canada and Alaska have many thousands of square miles of national parks and refuges that share a border. Glacier Bay National Park, Wrangell St. Elias National Park, Tatshenshini-Alsek Wilderness Park, and Kluane National Park form the largest internationally protected area in the world – a UNESCO World Heritage Site. Along the Arctic coast, the Arctic National Wildlife Refuge is an extension of Canada's Ivvavik and Vuntut National Parks.

Joint efforts to monitor the environment and resource development are an increasingly important element of the Canada-United States collaboration in the Arctic.

▶ Regional Relations

Indigenous and Northern Issues

In March 2010, the Department of Indian and Northern Affairs Canada and the United States Department of the Interior signed a Memorandum of Understanding with a goal of improving the quality of life of Indigenous groups in both countries. A joint work plan will focus on economic development, policy and legislation experience, preservation of Indigenous cultures, education, emergency preparedness, and law enforcement.

Yukon River Inter-Tribal Watershed Council

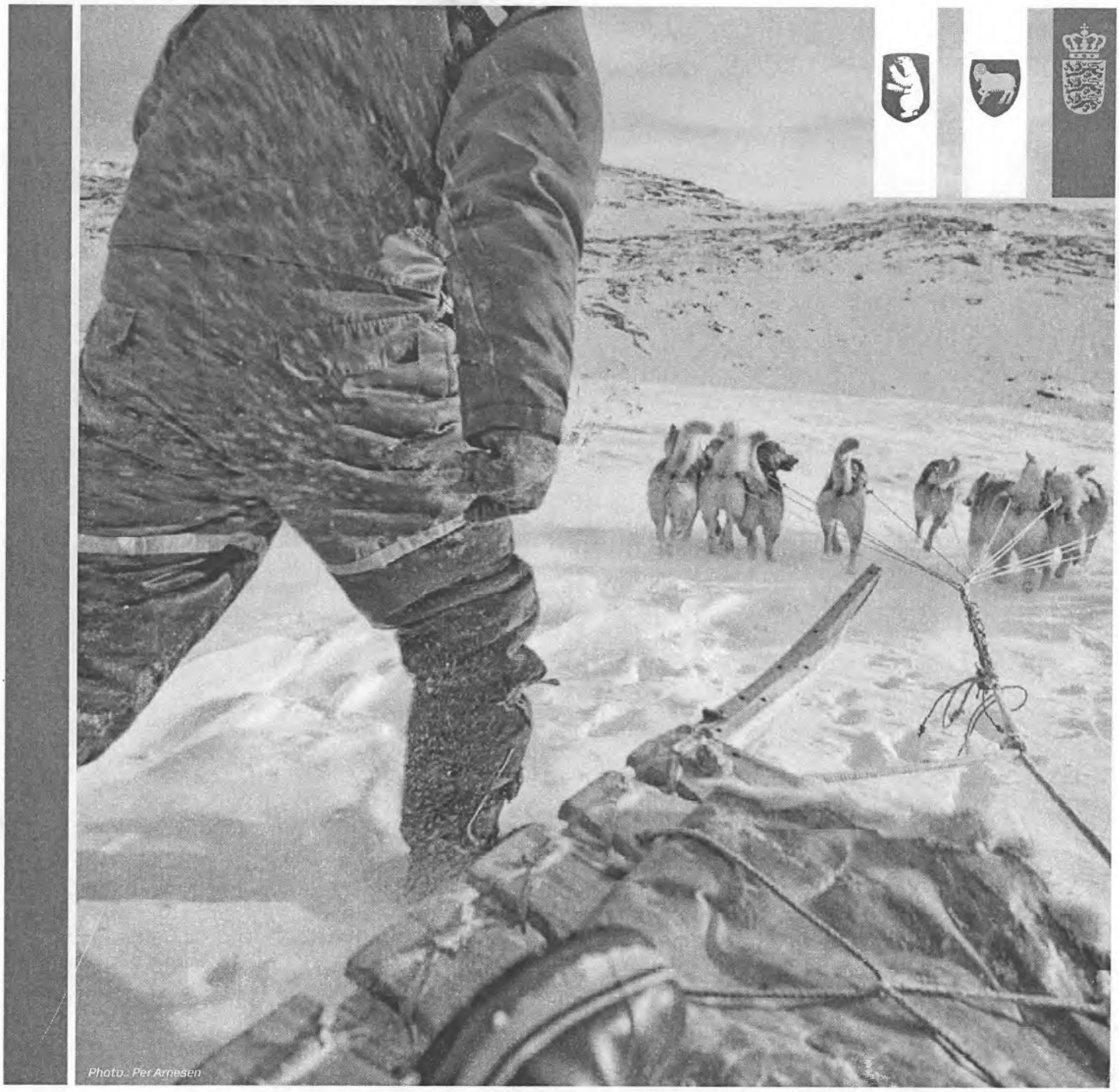
The Yukon River Inter-Tribal Watershed Council (YRITWC) consists of 70 aboriginal groups and tribes from Canada and the United States dedicated to the protection and preservation of the Yukon River watershed. The YRITWC facilitates the development and exchange of information, coordinates efforts between Indigenous peoples and tribes, undertakes research, and provides training, education and awareness programs to promote the health of the watershed and its Indigenous peoples.

State of Alaska/Yukon Government Cooperation

The governments of Alaska and Yukon have a number of joint agreements regarding natural resources and transportation. The tourism programs *Joint Yukon Alaska* and *Tourism North* were also established to facilitate and encourage travel to the Arctic region.

Denmark, Greenland and the Faroe Islands:

Kingdom of Denmark
Strategy for the Arctic 2011–2020



Denmark, Greenland and the Faroe Islands:

Kingdom of Denmark
Strategy for the Arctic 2011–2020

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Preface

The Kingdom of Denmark is centrally located in the Arctic. The three parts of the Realm – Denmark, Greenland and the Faroe Islands – share a number of values and interests and all have a responsibility in and for the Arctic region. The Arctic makes up an essential part of the common cultural heritage, and is home to part of the Kingdom's population.

The Kingdom and its populations have over several hundred years developed modern and sustainable societies based on democratic principles. The development has affected all sectors of society - from education, health and research to the environment, trade and shipping. At the same time, huge and sweeping changes are taking place today in the Arctic. Due to climate change and technological developments, vast economic potential is becoming more accessible.

It is our common objective that the Arctic and its current potential must be developed to promote sustainable growth and social sustainability. This development must take place firstly to the benefit of the inhabitants of the Arctic and go hand in hand in safeguarding the Arctic's environment.

With new opportunities come new challenges. The Arctic has to be managed internationally on the basis of international principles of law to ensure a peaceful, secure and collaborative Arctic.

The purpose of this strategy is, on the basis of an already strong engagement in the Arctic, to reinforce the foundation for appropriate cooperation on the many new opportunities and challenges that the Arctic is facing.

The Kingdom is already a vigorous and important actor in the strategically vital international cooperation on the future of the Arctic and in that connection attaches great importance to creating transparency in and understanding for cooperation.

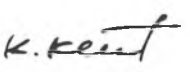
In the Kingdom's strategy for the Arctic 2011-2020, the Government, the Government of the Faroes and the Government of Greenland have set out the most important opportunities and challenges as we see them today and in the near future. On that basis we have defined our common political objectives for the Arctic.

We will – through close cooperation in the Kingdom and with our international partners - work towards the common overall goal of creating a peaceful, prosperous and sustainable future for the Arctic.

For the Government of Denmark
Lene Espersen

For the Government of the Faroes
Kaj Leo Holm Johannesen

For the Government of Greenland
Kuupik Kleist



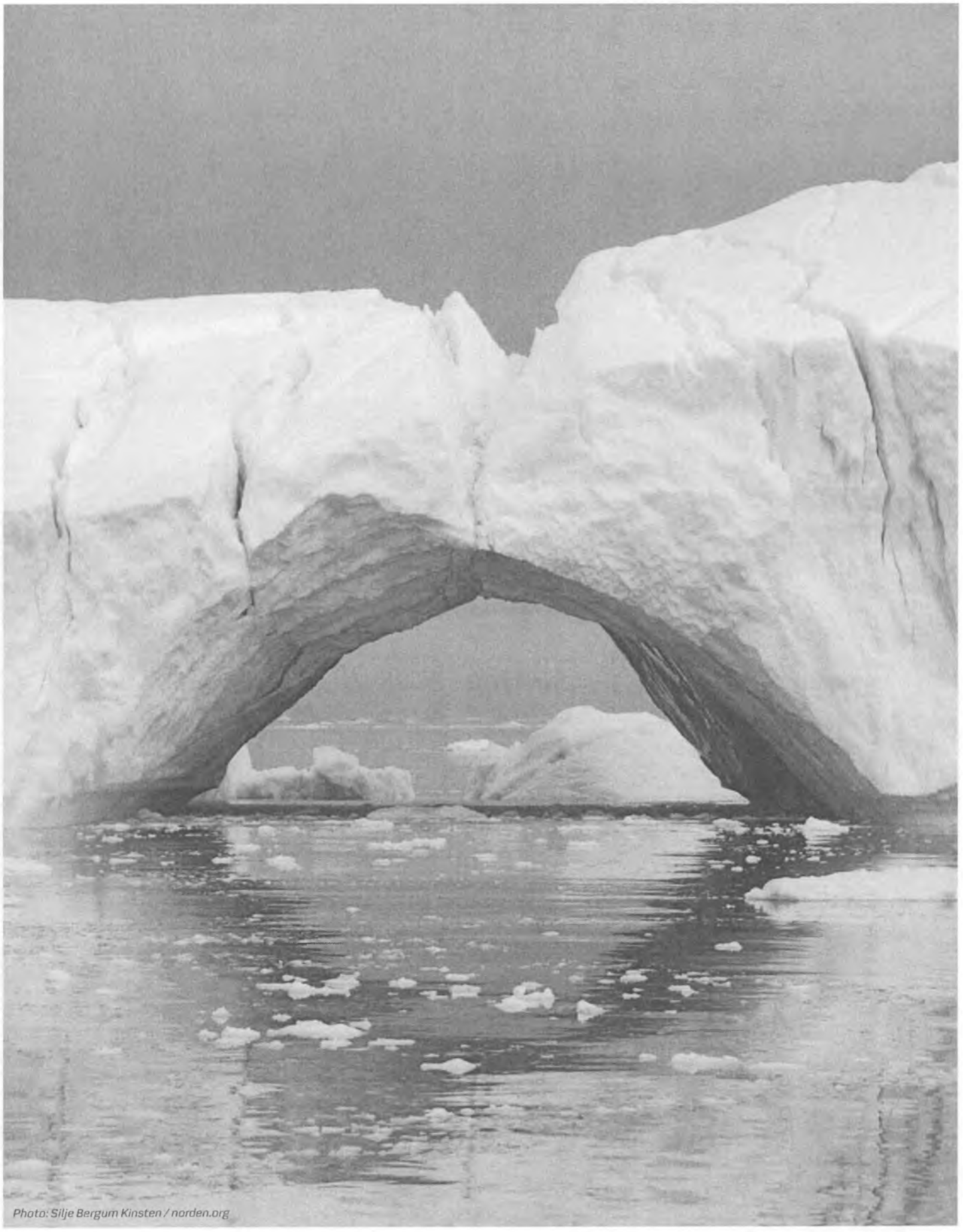


Photo: Silje Bergum Kinsten / norden.org

1. Introduction

1.1. A REGION IS OPENING UP

One of the most significant global issues over the past 10 years is the vast changes in the Arctic region. The world has again turned its attention to the Arctic, this time mainly because of the climate effects in the Arctic, the economic potential of the region, and the geopolitical implications of changes in the Arctic. The political, economic and social development is already underway, including the flourishing of advanced democratic societies, and the future of the Arctic will be radically different from the reality we know today.

Warming in the Arctic is occurring faster than anywhere else on the planet, and the average temperature in the Arctic has surpassed all previous measurements in the first decade of the 21st century. Sea ice has been shrinking, and the melting of Greenland's ice sheet and other Arctic ice caps will contribute more and more to the rise in global sea levels. Climate change has major implications for the global, regional and local climatic and environmental conditions and requires decisive global action.

The Arctic and the global community are presented with both new challenges and new opportunities.

Climate change poses new challenges to the peoples of the Arctic and puts pressure on the natural environment. Warming will especially change the basis of the Arctic inhabitants' lifestyles and the indigenous Arctic peoples' culture. Moreover, the harvesting of living resources plays a pivotal role in the Arctic, and changes for example in fish stock productivity and distribution is of great importance to the economy. Glaciers in the Arctic and the Greenland ice sheet increasingly contribute to the global rise in sea levels, and changes and dynamics in Arctic systems are crucial to global climate trends. Thus, they are of particular significance for the adaptation to climate change on a global scale and thereby also for the entire Kingdom. Increased economic activity and renewed geopolitical interest in the Arctic results in a number of key challenges to ensuring a stable, peaceful and secure region characterized by dialogue, negotiation and cooperation.

Climate change and technological developments are also opening new possibilities for the Arctic. Among them is increased access to the exploitation of oil, gas and minerals, but also new shipping routes which can reduce costs and CO_2 emissions by freight between the continents. It is estimated that the Arctic may contain up to 30% of the world's undiscovered gas resources and about 10% of undiscovered oil resources, and that ships sailing between East Asia and Western Europe could save more than 40% in transportation time and fuel costs by navigating the northern sea lanes north of Siberia rather than the southern route through the Suez Canal. Furthermore, climate change could provide access to new fishing grounds in the Arctic where rising sea temperatures can pull fisheries towards the North. Commercial opportunities in the Arctic are enormous, not least for the Greenland, Faroese and Danish industries, which to a great extent already possess the skills that will be far more in demand with the development of the Arctic region.

Overall we can expect a multi-faceted boom in activities in the Arctic over the coming decades. New opportunities and challenges must be handled proactively - with care, with long-term accountability and with respect for the Arctic societies, the rights of Arctic indigenous peoples, the

FACTS ABOUT THE ARCTIC

The Arctic covers more than a sixth of the Earth's total land mass plus the Arctic Ocean which the Arctic coastal states border. Unlike Antarctica, which also has relatively low temperatures year round, the Arctic region is populated by people, including more than 30 different indigenous peoples such as the Inuit who originate from the Thule culture. The Arctic has a unique wildlife, largely associated with the sea, including marine mammals such as seals, whales and walruses.

Arctic climate and the environment. The basis for the future of the Arctic is being created now, and the Kingdom must play a key role in the future international cooperation that lies ahead.

1.2. JOINT STRATEGY FOR THE ARCTIC

The Kingdom consists of three parts - Denmark, the Faroe Islands and Greenland - and, by virtue of Greenland, is centrally located as a coastal state in the Arctic. This involves specific rights and obligations in the region. Today, both the Faroe Islands and Greenland have extensive self-government and the division of legislative and administrative powers between the Kingdom's three parts requires good cooperation and a joint strategy to meet the opportunities and challenges in the Arctic.

The Faroe Islands and Greenland have had home rule since 1948 and 1979, respectively. Home rule arrangements have been continuously modernised, most recently by the Takeover Act on Power of Matters and Fields of Responsibillity and the Act on Faroes Foreign Policy Powers of 2005 in the Faroe Islands and the Greenland Self-Government Act of 2009. Considerable parts of the separation of powers that are central in an Arctic context are matters that fall within the exclusive powers of the respective Faroese and the Greenland authorities. The Kingdom thus comprises significant political diversity and also accommodates cultural differences.

The Kingdom's Arctic strategy intends no change in the power-sharing that exists between Denmark, the Faroe Islands and Greenland, including responsibility for policy areas taken over and their funding. Regardless of these individual distinctions, the Kingdom has a common interest in addressing the challenges and utilising the opportunities arising from the Arctic region's rapidly changing conditions and growing interest from the world. One of the areas Greenland has taken over is mineral resources. Decisions on development, exploration and exploitation of resources in Greenland are taken by the Greenland authorities. However, revenues from mineral activities will benefit both the Greenland and Danish people, given that cf. Self-Government Act for Greenland there will be a reduction of the annual block grant in line with possible revenues from mineral resources.

A strategy for the Arctic region is first and foremost a strategy for a development that benefits the inhabitants of the Arctic - involving common interests relating to for example international agreements, and regional and global issues. Such a development incorporates a fundamental respect for the Arctic peoples' rights to utilise and develop their own resources as well as respect for the indigenous Arctic culture, traditions and lifestyles and the promotion of their rights. Denmark and Greenland's cooperation on Arctic indigenous peoples dates back to 1973 when the Arctic Peoples' Conference at Christiansborg Palace in Copenhagen became a launching point for the international organising of indigenous peoples.

Cooperation between Denmark and Greenland helps in creating new opportunities for the Arctic indigenous peoples. Greenland's self-government model, natural resource management, climate policy, environmental policy and preservation of its cultural heritage is a model of inspiration for many of the world's indigenous peoples. This situation constitutes an essential element in the Kingdom's international efforts to promote indigenous rights and aspirations. Denmark and Greenland will continue constructive cooperation to strengthen indigenous peoples' rights to control their own development and their own political, economic, social and cultural situation.

It is a central goal of Greenland, the Faroe Islands and Denmark that decisions regarding management and utilisation of resources and protection of the environment are taken in accordance with international obligations, and are based on the best scientific advice that supports healthy, productive and self-sustaining communities. Based on good collaboration within the Kingdom, policies and mechanisms must be organised in close cooperation with other Arctic nations and other stakeholders with an interest in the Arctic.

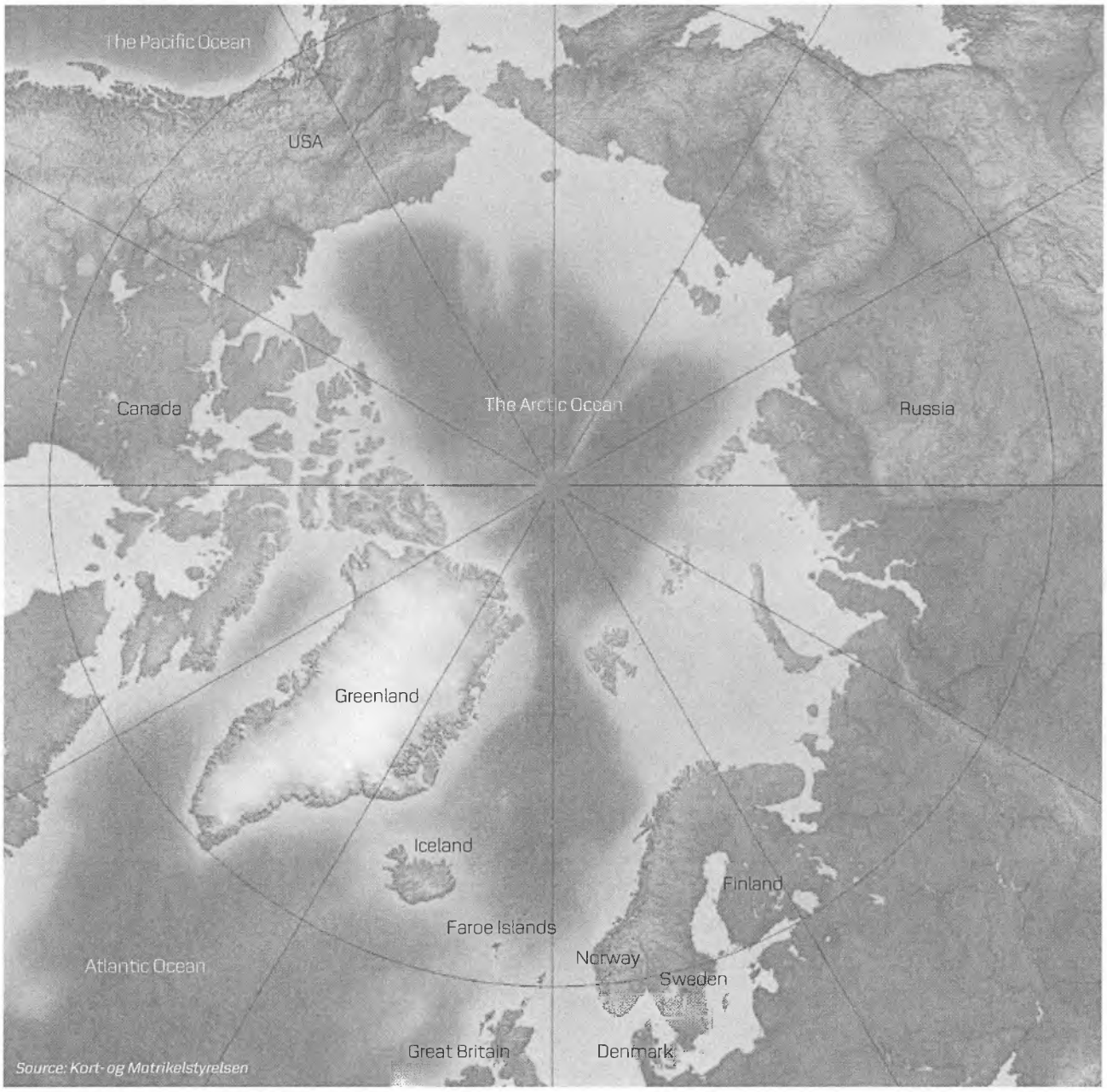
The premise of this strategy stems internationally from the Arctic Council Declarations and the Ilulissat Declaration of 2008, in which the coastal states of the Arctic Ocean committed themselves politically to giving negotiation and cooperation pride of place in handling disputes, challenges and opportunities in the Arctic, and thus hopefully once and for all dispelling the myth of a race to the North Pole.

The Kingdom's approach to security policy in the Arctic is based on an overall goal of preventing conflicts and avoiding the militarization of the Arctic, and actively helping to preserve the Arctic as a region characterized by trust, cooperation and mutually beneficial partnerships.

In an equal partnership between the three parts of the Danish Realm, the Kingdom will work overall for:

TERMINOLOGY

The strategy uses the terms "The Kingdom" and "Danish Realm" for both the formal relations between Denmark, Greenland and the Faroe Islands and in a broader and more informal sense. Naalakkersuisut is, pursuant to the Self-Government Act of Greenland, the name of the Government of Greenland.



- A peaceful, secure and safe Arctic
- with self-sustaining growth and development
- with respect for the Arctic's fragile climate, environment and nature
- in close cooperation with our international partners.

The Greenlandic-Danish report, "Arctic in a time of change", of May 2008 and targets contained herein remains an important basis for the Kingdom's various activities in the Arctic.

The purpose of this strategy is to focus attention on the Kingdom's strategic priorities for future development in the Arctic towards 2020. The aim is to strengthen the Kingdom's status as global player in the Arctic.

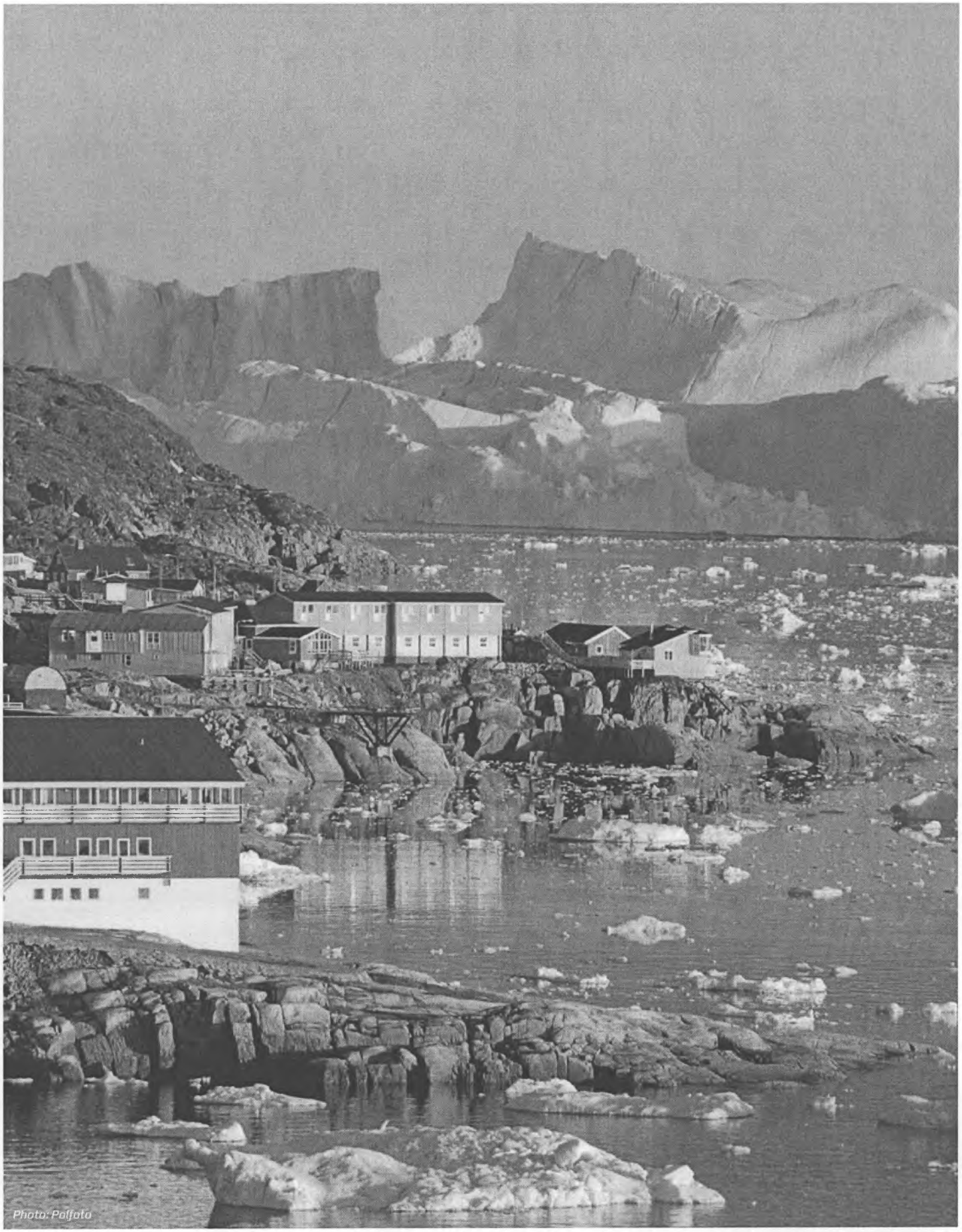


Photo: Polfoto

2. A peaceful, secure and safe Arctic

- International law and established forums of cooperation provide a sound basis for conflict resolution and constructive cooperation in the development of the Arctic. The Kingdom must help in shaping the future of cooperation on joint challenges and new opportunities in the Arctic.
- Maritime safety is a fundamental priority. The extreme Arctic conditions require preventive measures including training and ship safety, as well as regional cooperation on search and rescue.
- The Danish Armed Forces undertake important tasks in the Arctic including the enforcement of sovereignty, and attach in this respect great importance to confidence building and cooperation with Arctic partner countries.

Climate change and rising global demand for oil and gas have resulted in a sharp rise in international interest in the Arctic, and the coastal states of the Arctic Ocean have increased their endeavours to ensure their rights to the greater part of the as yet unexplored Arctic subsoil. At the same time, the prospect is that for a large part of the year, it will be possible to navigate both the Northeast Passage and the Northwest Passage. The rising strategic interest and activity in the Arctic region necessitates a continued prioritising of a well-functioning international legal framework for peaceful cooperation, a special need for enhanced maritime safety, and persistent focus on maintaining the Arctic as a region characterised by peace and cooperation.

2.1. BASIS FOR PEACEFUL COOPERATION AND WITH EMPHASIS ON THE UN'S CONVENTION ON THE LAW OF THE SEA

The growing international interest in the Arctic has led to increased focus on legal controls in the area. However, the Arctic is not a legal vacuum. The Arctic has been inhabited for thousands of years, in contrast to the Antarctic which is uninhabited. Regions in the Arctic under national jurisdiction are governed by the coastal states legislation. The Arctic is also subject to a number of international laws, in particular the UN Convention on the Law of the Sea in1982 (UNCLOS), which contains detailed regulation of for example navigational rights and management of resources.
In recognition of the significant changes that the Arctic faces, Denmark and Greenland arranged a conference in Ilulissat in May 2008 for the five coastal states of the Arctic Ocean. Its aim was to confirm the responsibility of the five coastal states for managing the development of the Arctic. The conference resulted in the Ilulissat Declaration in which the five coastal states of the Arctic Ocean undertook to enshrine close cooperation in developing the Arctic into international law. The five coastal states' cooperation covers areas such as sea rescue, continental shelf claims and environmental protection.

Even though the existing regulation in international law, particularly the UN Convention on the Law of the Sea, lays a solid foundation for coastal states' cooperation

on the development of the Arctic, there may be a continuous need for more detailed regulating of certain sectors. An example is the agreement on search and rescue adopted at the Arctic Council Foreign Ministers' Meeting in May 2011 in Nuuk.

The UN Convention on the Law of the Sea 1982 is the global international legal instrument in relation to the sea around the Arctic, in that the Convention defines states' rights and responsibilities in relation to their use of the oceans. Denmark ratified the Law of the Sea Convention on behalf of the Kingdom on 16 November 2004 and to date the Convention has been ratified by 161 states. Of the five coastal states of the Arctic Ocean, only the U.S. is not (yet) a party to UNCLOS, though part of the Convention is an expression of customary law and therefore binding on countries not party to the Convention. Moreover, the United States, by Presidential Directive of 9 January 2009 specially approved the Convention as a means of resolving border issues concerning the continental shelf in the Arctic.

Under the UN's Convention on the Law of the Sea, coastal states have the right to create an exclusive economic zone. In this zone, the coastal state has exclusive right to explore and exploit natural resources of the sea as well as the seabed and its subsoil, and any other economic exploitation. The coastal state may also exercise environmental jurisdiction in the zone. The exclusive economic zone can extend to a maximum of 200 nautical miles (approx. 370 km). Denmark and Greenland have an exclusive economic zone while an exclusive economic zone has not yet been declared in the Faroese fisheries territory.

Under article 76 of the UN's Convention on the Law of the Sea, a coastal state has the possibility of extending its continental shelf beyond 200 nautical miles if within 10 years of the Convention coming into force for the state concerned, it can document to the Commission on the Limits of the Continental Shelf (CLCS) established pursuant to the Convention, that a number of scientific criteria are met. The coastal state will then have the right to living and non-living resources on and under the seabed beyond 200 nautical miles, subject to an obligation to make payments or contributions to the International Seabed Authority pursuant to Convention Article 82.

The Kingdom thus has a deadline of 16 December 2014 to submit data and other material to the CLCS as a basis for the extension of the continental shelf beyond 200 nautical miles. The time limit can however be exceeded in special cases under a decision made by the convention partners in 2008, as long as preliminary information is submitted to CLCS before the deadline expires.

To document the claim on the continental shelf the Danish Realm has launched a continental shelf project that is based in the Ministry of Science, Technology and Innovation and is run in cooperation with the Government of the Faroes and the Government of Greenland, the Prime Minister's Office, the Ministry of Foreign Affairs, and the Ministry of Finance. The project includes the participation of the Danish, Faroese and Greenland authorities and scientific institutions, and is charged with identifying areas where the rights to new seabed claims can be made, and to collect, interpret and document the data necessary to submit a claim to the CLCS. The Kingdom has submitted documentation to the CLCS for claims relating to two areas near the Faroe Islands and by 2014 plans to submit documentation on three areas near Greenland, including an area north of Greenland which, among others, covers the North Pole.

The budget for the continental shelf project until 2014 is app. DKK 350 million spread over 12 years. The actual work of the project is a collaboration between Jarðfeingi (Faroe Directorate of Geology and Energy), the Danish Maritime Safety Administration, DTU Space (Institute for Space Research and Technology), National Survey and Cadastre and the Geological Survey of Denmark and Greenland (GEUS). Jarðfeingi, together with GEUS, is project manager for the Faroese Continental Shelf Project (half funded by the Faroe Islands) while GEUS is the project manager for the Greenland part where the Bureau of Minerals and Petroleum in Nuuk and ASIAQ (Greenland's Survey) take part.

The continental shelf project is very much an example of a project that is feasible

ILULISSAT DECLARATION

The Ilulissat Declaration is a landmark political declaration on the Arctic's future. It was adopted in Ilulissat, Greenland on 28 May 2008 by ministers from the five coastal states of the Arctic Ocean - Denmark / Greenland, Canada, Norway, Russia and the U.S. The Ilulissat Declaration sends a strong political signal that the five coastal states will act responsibly concerning future development in the Arctic Ocean. The states have a political commitment to resolving disputes and overlapping claims through negotiation. The five countries also confirmed that they will strengthen their cooperation in important areas. This applies to both broad cooperation that in particular takes place in the Arctic Council and the UN's International Maritime Organization (IMO), and to the practical everyday cooperation on issues such as search and rescue, environmental protection and navigational safety.

due to all parties', including both the Faroe Islands and Greenland's, willingness and ability to cooperate and the will to achieve the project's targets. Furthermore, the project is an example of how different institutions can cooperate across the Kingdom and benefit from one another. The continental shelf project also has exemplary research cooperation with other countries, such as the Swedish Polar Research Secretariat with which it has carried out many data collection expeditions with the Swedish ice-breaker Oden. The project also has fruitful research-based cooperation with Canada and Russia.

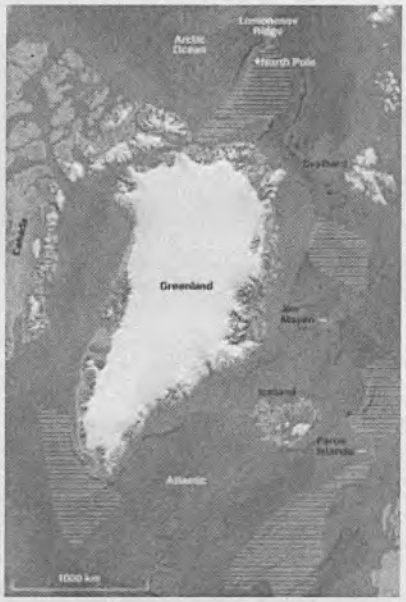
The Kingdom's claims on the continental shelf will in some areas overlap with other country's continental shelf claims. There is close collaboration with other coastal states in the Arctic Ocean to solve unresolved boundary issues beyond 200 nautical miles. As highlighted in the Ilulissat Declaration, unresolved boundary issues in the Arctic will be resolved in accordance with international law.

Besides maritime boundary issues, the Kingdom has an unresolved issue relating to the sovereignty of Hans Island (Hans Ø) as both the Kingdom and Canada claim sovereignty over the island. In September 2005, Denmark/Greenland and Canada made a joint statement on Hans Island, and frequent consultations on the island are in progress. Pending a permanent solution to the issue, the dispute will be handled professionally as would be expected between two neighbouring countries and close allies.

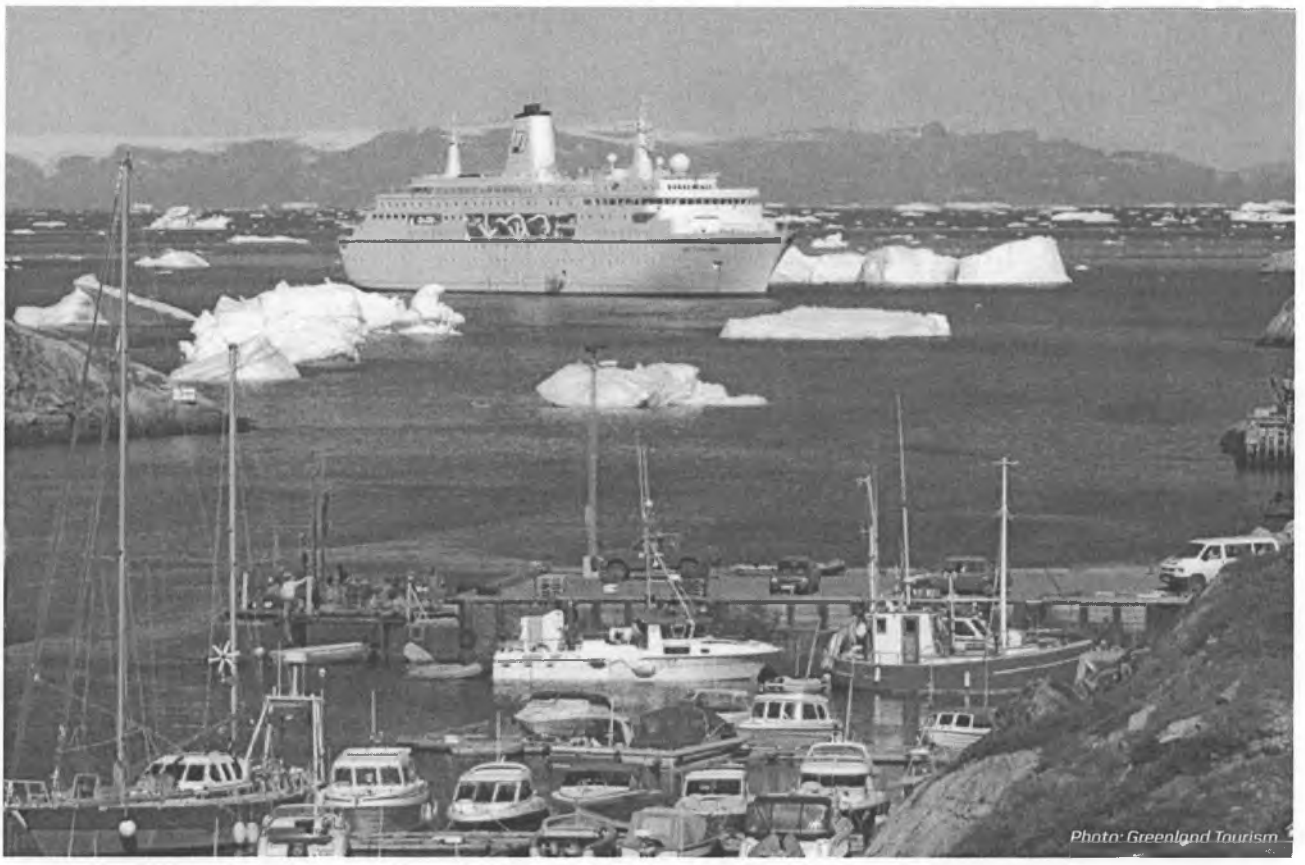
- The Kingdom will work for peaceful cooperation between the coastal states of the Arctic Ocean in accordance with the Ilulissat Declaration.
- The Kingdom will advance concrete international legal regulation of the Arctic in areas where needed.
- The Kingdom will seek to resolve outstanding unresolved boundary issues and actively work to reduce the processing time of the Commission on the Limits of the Continental Shelf and thereby ensure greater assurance of coastal states' continental shelf claims in the Arctic.
- The Kingdom will continue work on the Continental Shelf Project in order to promote its claim pursuant to the UN's Convention on the Law of the Sea.

THE CONTINENTAL SHELF PROJECT IN PRACTICE

Since 2006 the Danish Realm has conducted a series of expeditions in the Arctic Ocean as part of the continental shelf project. A factor common to the expeditions is close cooperation with other countries. Canada, Russia and the U.S. have also been conducting scientific studies in the Arctic Ocean these years in preparation for an extension of their respective continental shelves. The expeditions "LORITA" (2006), "LOMBAG" and "LOMGRAV" (2009), for example, were based on Canadian logistics. LOMROG I and II expeditions in 2007 and 2009 were carried out with the Swedish icebreaker Oden, in cooperation with Sweden and Canada. In 2007, the expedition was for a period supported by a Russian nuclear icebreaker. Another factor these expeditions have in common is that in addition to the collection of data relevant to the continental shelf project, emphasis is also placed on scientific output and follow-up research in other fields. Thus, ice cores have been collected, ice thickness measured, samples of DNA and bacteria collected, geology, oceanography, plankton ecology all studied, and the accumulation of mercury measured. All collections are conducted in cooperation with Danish, Greenland, Swedish and American research institutions and have led to increased knowledge of the Arctic Ocean's plate tectonics, palaeoclimatology, physical oceanography and ecosystems. Further expeditions are planned under the auspices of the Continental Shelf Project in 2011 and / or 2012.



Source: Ministry of Science, Technology and Innovation / www.a76.dk



2.2. ENHANCED MARITIME SAFETY

Navigation in the Arctic is increasing, including in the waters around Greenland and the Faroe Islands. Less ice coverage, especially in the summer months, has led to a significant growth in maritime traffic, including cruise ships to areas of Greenland which until a few years ago were not possible to navigate. In 2010, 43 cruise ships berthed in Greenland ports, compared with 32 in 2009. Furthermore, shipping trade in Faroese waters has increased considerably. Shipping in Faroese waters has risen by 5-6 times from 2008-2010 and 40-50 sizeable cruise ships now call at Faroese ports each year.

Shipping operators are exploring new areas still further north as ice conditions permit. Meanwhile, prices of raw materials and not least a long-term expectation of a shortage of oil and natural gas have led to increased trade in the exploration and exploitation of natural resources. The melting of sea ice in the summer also allows for new shipping routes through the Northeast and the Northwest Passage which could ultimately yield significant savings in transportation time by the maritime transport of goods between Europe and Asia. It is believed that the waters around Greenland and the Faroe Islands will experience a significant increase in maritime traffic in the coming years.

The increasing maritime activity is closely linked with economic development in the Arctic. For the sake of the fragile environment in the Arctic, it is important to build sustainable growth. For shipping, which is a global industry, this means that internationally high safety standards must be established for ships navigating in the Arctic. Furthermore, in terms of shipping policy, it is important that the Kingdom is working to promote shipping in the Arctic under high standards where international regulation ensures that ships are competing within a uniform framework.

Because of the extreme conditions in sparsely populated Arctic regions, prevention of marine vessel accidents is crucial in the Arctic. Regardless of climate changes, it will still be necessary to take account of ice, low temperatures, extreme weather and the risk of grounding. It is therefore vital that ships are built and equipped so they can operate under these conditions. Despite increasing intensity, marine traffic

will still be spread over a vast geographical area far from ports. Therefore, ships should first and foremost use their own rescue equipment if an accident should occur, until the resources offered by the authorities responsible in the area can be deployed to assist. Therefore, preventive measures must be set in place that allow for the continued and increased navigation in the Arctic, while at the same time effectively preventing and minimising marine accidents and mitigating damage to the environment and nature.

It is important to implement preventive safety measures, not least for the cruise ships that sail with many passengers, and often with limited local knowledge. Here, experience shows that other ***cruise ships*** in the vicinity are crucial to saving lives. The Kingdom is working to promote cooperation on maritime safety in all key forums, particularly in the International Maritime Organisation (IMO), where binding rules for navigation in the Arctic are drawn up, but also through enhanced cooperation in the Arctic Council.

To increase the safety of ships navigating in Arctic waters, Denmark has introduced improved port State control of cruise ships planning to sail to Greenland. Moreover, other countries have been urged to do the same when these ships enter their ports before sailing to the Arctic. Furthermore, the Ministry of Economic and Business Affairs has entered into an agreement with the Government of Greenland (Naalakkersuisut) on the establishment of a liaison committee in order to ensure that a high safety level of navigation in Greenland waters is sustained and developed, whether this takes the form of international shipping or in the form of domestic navigation to and from Greenland ports. The liaison committee will prepare a joint plan in 2011 to ensure this.

Increased maritime traffic also places greater demands on ***infrastructure*** as marine vessels require support in the form of a sound infrastructure. The Government of Greenland has focused on this challenge with the establishment in 2009 of a Transportation Commission and in the coming years will address requirements in this area, based on the recommendations in the commission's report in 2011.

Updating nautical charts will be an important factor under the auspices of the Danish Realm. In the future, ships will increasingly use electronic nautical charts and make use of satellite-based navigation systems such as GPS which impose stricter requirements on the accuracy of charts. In particular, a thorough knowledge of water depth is necessary to navigate safely at sea. In 2009 an agreement was made between the Minister of Environment and the Government of Greenland about a renewal of the nautical charts for Greenland, which means that the charts for most of Southwest Greenland (from Cape Farewell to Uummannaq) - the busiest Greenland waters - will be corrected and digitized no later than 2018. Due to the vast sea areas, large areas of the Greenland waters will be unsurveyed beyond 2018 while still greater areas become accessible to shipping as the ice melts. For reasons of safety at sea the Kingdom will furthermore continue to prioritize the work of the International Hydrographic Organization (IHO), such as in the regional commission on the Arctic which was established in 2010.

Similarly maritime safety is supported by ensuring the availability of reliable information on weather, sea conditions and ice. The Greenland Ice Services at the Danish Meteorological Institute was established in 1959 as one result of the shipwreck of M / S "Hans Hedtoft". The Service's main task so far has been to map the ice conditions in the Cape Farewell area for the safe navigation of cargo ships between Greenland and Denmark. Because of changing climatic conditions and altered distribution of sea ice in Greenland waters, the navigational pattern of ships has changed dramatically. Combined with the growth of cruise ship activity and oil exploration, there is a need for intensified ice and weather warning alerts further north in both West and East Greenland. It will therefore be a priority that the existing Ice Services be adapted to the increased requirements for observation, forecasting and dissemination of ice conditions in Greenland waters.

Furthermore, enhanced surveillance of maritime traffic in the Arctic will contribute to improved prevention of accidents and coordination of the rescue efforts. It also provides greater opportunity to intervene before an accident can occur. Currently, ships sailing to Greenland must report to the so-called GREENPOS reporting system, which requires ships in Greenland waters to continuously report their position to the Greenland Command. Larger ships already send their positions via the satellite-based LRIT (Long Range Identification and Tracking) system. Surveillance is expected to be improved, for example by using new technology with satellite reception of ships' AIS signals (Automatic Identification System) as almost all larger ships are equipped with AIS.

The Faroese Maritime Authority follows international developments and handles Faroese interests in the IMO because of its status as an associate member of IMO. With the introduction of AIS and LRIT, which are based on IMO mandatory requirements, it has been possible to improve the monitoring of foreign and Faroese vessels in Faroese waters. In addition to this, cooperation has been established between Denmark, Greenland, the Faroe Islands, Norway and Britain for the mutual exchange of AIS data in the North Atlantic region.

Over a number of years, both the Faroe Islands and Greenland have entirely or in part been responsible for the monitoring of the marine environment and pollution control in territorial waters. Furthermore, the Faroe Islands has responsibility for search and rescue services. In light of increased activity in the region further knowledge and exchange of findings and cooperation will be needed to solve these tasks.

- The Kingdom will promote cooperation with other Arctic states and other key countries with significant maritime interests in major marine policy issues concerning the Arctic, such as maritime safety. Cooperation with other Arctic states must support a sustainable maritime growth, for example by establishing a better knowledge base on navigation in the Arctic.

- The Kingdom will reinforce concrete preventive measures to improve safety of navigation in the Arctic. In particular this involves endeavours, in cooperation with the other Arctic States, for adoption by the IMO of a mandatory Polar Code to ensure high safety levels in Greenland waters, regardless of the ships' nationality and for a requirement that crews have the requisite skills for navigation in Arctic waters.

- To work for the inclusion of requirements in the polar code under IMO auspices that cruise ships coordinate their navigations with the emergency services, including other cruise ships, which could come to the rescue if a maritime incident occurs. The Kingdom will work in the Arctic Council to gather knowledge of cruise lines' own safety standards for navigation in order to promote "best practices" for the navigation of cruise ships in the Arctic, and also consider the need for increased focus on port State control prior to cruise ships sailing to the Arctic.

- The Kingdom will continue preparing new nautical charts for Greenland to avoid maritime accidents in Greenland waters and to support mineral resource activities. The Kingdom will support the surveying of the Greenland waters and cooperation with other coastal states of the Arctic Ocean within the Arctic Hydrographic Commission. Maritime safety must also be supported by ensuring the availability of reliable information on weather, sea and ice in collaboration with other Arctic states, better information about navigation in Greenland waters and the tightening up of port State control of ships sailing to the Arctic, and finally working for the international dissemination hereof.

- The Kingdom will work to introduce binding global rules and standards for navigation in the Arctic and it is a high priority to reach agreement on a global regulation of shipping via the IMO, cf. Ilulissat Declaration. Should it prove that agreement on global rules cannot be reached, and in view of the especially vulnerable Arctic environment and the unique challenges of security, the Kingdom will consider implementing non-discriminatory regional safety and environmental rules for navigation in the Arctic in consultation with the other Arctic states and taking into account international law, including the Convention on the Law of the Sea provisions regarding navigation in ice covered waters.

- The Kingdom will work to strengthen cooperation with neighbouring countries on monitoring, search and rescue, such as supporting the implementation of the joint Arctic cooperation agreement on strengthening coordination and data-sharing in relation to search and rescue, entered into under the auspices of the Arctic Council in May 2011.

- Given the clear correlation between the rise of maritime activity and economic development in the Arctic, efforts will be strengthened to involve Greenland citizens in tasks within areas of maritime safety, such as surveying, buoying, and search and rescue at sea, perhaps by establishing a voluntary coastal rescue service.

- The Kingdom will examine the need for the establishment of new shipping routes, and implement this to the extent it promotes maritime safety and marine protection. For example, there is particular need to establish recognized routes in Faroese waters for both cruise ships, tankers and other vessels with respect to safety and the environment.

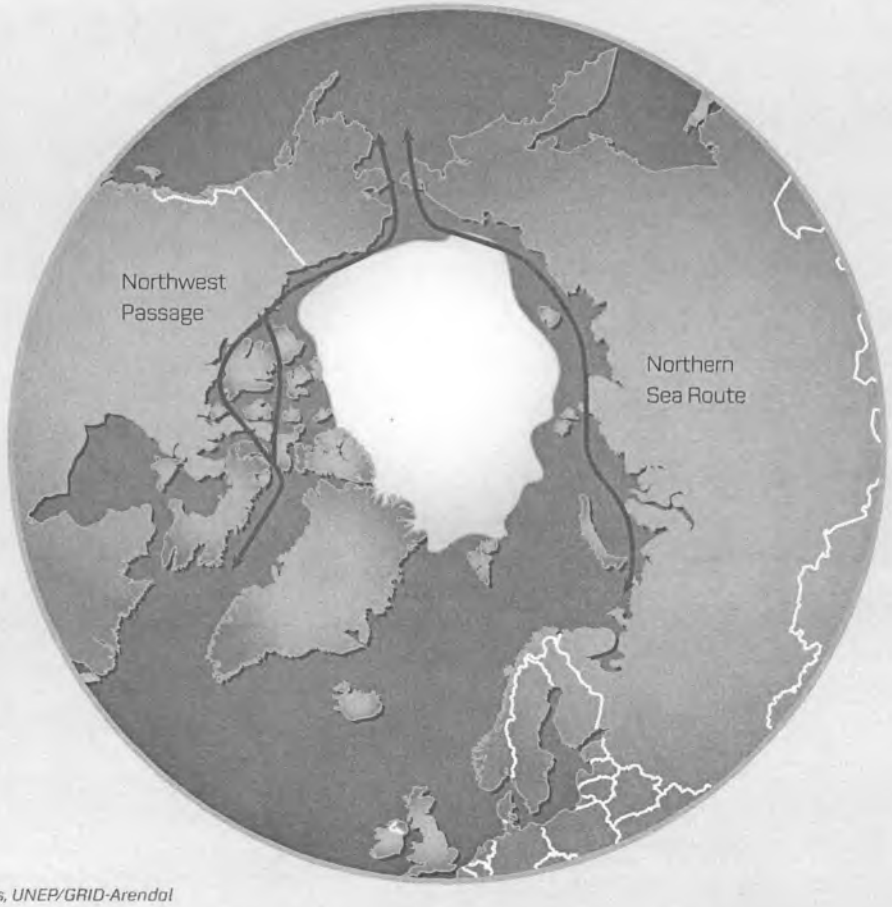
NAVIGATION IN GREENLAND

There are many different maritime activities in Greenland waters. In particular, cruise tourism has increased markedly: From 15,654 passengers in 2004 to 30,271 passengers in 2010. There is also an increasing activity of vessels used for oil exploration and marine studies, just as the shipping of minerals with bulk carriers is expected to rise significantly. Additionally, there is considerable local traffic with fishing vessels, passenger transport, supply of Greenland towns, etc..

THE NEW SHIPPING LANES

The continued melting of ice in the Arctic Ocean is expected over a 10 to 20 year period to result in the opening (at least during parts of the year) of the Northwest Passage over North America and the Northeast Passage over Russia. The economic benefits of these new routes are potentially significant. The opening of the Northwest Passage will reduce the distance from Seattle to Rotterdam by almost 25% compared to the route via the Panama Canal. The possibility of navigating the Northern Sea Route via the Northeast Passage will reduce the distance between Rotterdam and Yokohama by over 40% compared to the route via the Suez Canal. Furthermore, the opening of these alternative routes means that the military and commercial shipping will no longer be dependent on passage through the political unstable Middle East nor the piracy-infested routes through the South China Sea, the Malacca Straits and the Gulf of Aden.

Danish pioneers: In September 2010, the heavy ice class bulk carrier, "Nordic Barents", of the Danish shipping company, Nordic Bulk Carriers, sailed via the Arctic and the Northeast Passage to Asia as the first cargo ship ever to do so. The voyage, with 41,000 tons of iron ore concentrate from Kirkenes in northern Norway to China was around 30% shorter than if the ship had used the traditional route via the Mediterranean and the Indian Ocean and took place in close cooperation with the Norwegian Tschudi Shipping Company and the Russian authorities. In August 2008, the Danish cable ship "Peter Faber", assisted by Canadian pilots, sailed as the first commercial vessel through the Northwest Passage thus saving 15 days on its voyage from Japan to Newfoundland in order to lay cables between Greenland and Canada.



Source: Hugo Ahlenius, UNEP/GRID-Arendal

THE POLAR CODE

The Polar Code will supplement the international maritime safety and environmental conventions which already apply in the Arctic with additional rules on rescue equipment, fire fighting, ice navigation and navigation in uninhabited areas to allow for Arctic conditions. The Polar Code must also allow for the changing requiretments imposed by geography and seasons. The work is taking place at the International Maritime Organisation (IMO) and the rules are expected to come into force in 2013-2014.

AGREEMENT ON AERONAUTICAL AND MARITIME SEARCH AND RESCUE IN THE ARCTIC COUNCIL AND PREPAREDNESS IN GREENLAND

At its meeting of foreign ministers in May 2011, the Arctic Council adopted a mutual agreement on Search and Rescue (SAR), which aims to strengthen coordination of rescue efforts, so in the event of an accident, it is possible to receive rapid assistance from neighbouring countries' emergency services. The Ministry of Economic and Business Affairs, Ministry of Transport and Ministry of Justice have overall responsibility for the SAR response in Greenland. The daily operational management is handled by the Greenland Command, the Air Rescue Service and the Chief of Police office in Greenland.

2.3. EXERCISING OF SOVEREIGNTY AND SURVEILLANCE

The Arctic is and must be a region characterized by peace and cooperation. Even though the working relationship of the Arctic Ocean's coastal states is close, there will be a continuing need to enforce the Kingdom's sovereignty, especially in light of the anticipated increase in activity in the region. While the Kingdom's area in the Arctic is covered by the NATO treaty Article 5 regarding collective defence, the enforcement of sovereignty is fundamentally a responsibility of the Realm's central authorities. Enforcement of sovereignty is exercised by the armed forces through a visible presence in the region where surveillance is central to the task. In addition, the armed forces play an important role in the provision of a range of more civilian-related duties. Within the entire spectrum of tasks, the Kingdom attaches great importance to confidence building and cooperation with Arctic partner countries.

The long-term political agreement on defence (Danish Defence agreement 2010-2014) involves a stronger focus on the tasks of the Danish Armed Forces in the Arctic. The agreement includes four overriding initiatives that must be viewed in light of climate change and increased activity that would foreseeably result in an increase of tasks for the armed forces.

Firstly, the Armed Forces North Atlantic command structure will be streamlined by the amalgamation of the Greenland Command and the Faroe Command into a joint service Arctic Command.

Secondly, the ability of the armed forces to conduct operations in the Arctic environment will be strengthened through the establishment of an Arctic Response Force. The response force would not be established permanently, but designated from existing armed forces and emergency preparedness units with Arctic capacity or the potential to develop one. The range of tasks of the Arctic Response Force is for defined periods and in defined areas anticipated to strengthen the armed forces' enforcement of sovereignty and surveillance, for instance through military exercises. The force could also be deployed in other situations such as in assistance to the Greenlandic society.

Thirdly, a risk analysis of the maritime environment in and around Greenland is to be conducted in the light of an anticipated expansion of traffic and activity in the Arctic.

Fourthly, towards 2014 a comprehensive analysis of the armed force's future tasks in the Arctic is to be carried out, including opportunities and potential for closer cooperation with partner countries in the Arctic concerning surveillance and the like. In this connection it is to be examined whether the Thule Air Base may play a larger role in regard to the tasks performed in and around Greenland by the Danish Armed Forces in cooperation with other partner countries.

The Danish Defence aspires, as other public institutions, to reflect the surrounding community. Indeed, it is a Danish-Greenland hope that citizens of Greenland can be increasingly involved in the tasks of the armed forces and with that, participate in a wide range of training opportunities, whether they be basic training, civil/military specialist and management training programs or customized further education at all levels. The armed forces will thereby also greatly benefit from Greenland local knowledge.

- The armed forces must be visibly present in and around Greenland and the Faroe Islands with regard to the enforcement of sovereignty and surveillance. The North Atlantic command structure is to be streamlined by the establishment of an Arctic Command and an Arctic Response Force is to be designated from existing units.

- The Kingdom will reinforce confidence-building in cooperation with other Arctic states to maintain the Arctic as a region characterized by cooperation and good neighbourliness, just as the Kingdom will continue to play an active role in creating and promoting new collaborative initiatives between countries in the Arctic. The Kingdom will stress the potential for increased cooperation on surveillance.

- The possibilities to enhance cooperation in regard to the armed force's tasks will be looked into, including the involvement of Greenland's citizens in the handling of key tasks of the armed forces in the Arctic. The possibilities for targeted information and recruitment campaigns and the establishment of customized courses will be studied.

KEY TASKS OF THE ARMED FORCES IN THE ARCTIC

Enforcement of state sovereignty is a fundamental task of the armed forces in all parts of the Kingdom. Sovereignty enforcement is the primary task of the Danish Armed Forces in the Arctic and the level of presence in the area is determined accordingly. Units from the army, navy and air force carry out tasks in the Arctic. They undertake surveillance and enforcement of sovereignty of Greenland and Faroese territorial waters and air space, as well as the Greenland exclusive economic zone and the fishing zones to ensure that no systematic violations of territory can take place. Likewise, the Sirius Patrol oversees the National Park in Northeast Greenland and enforces sovereignty there.

As part of its presence, the armed forces is building a habitual picture of activities in the waters around Greenland and the Faroe Islands. The armed forces presence and overview of activities in the Arctic establishes a basis for solving many other tasks , including providing assistance to the Greenland community. Activities in the Arctic are largely related to the ocean as a transportation route and to the utilisation of marine resources.

Climate change in recent years, in particular the melting of ice masses, has resulted in an increase in the navigable areas and the commercial activities that follow in Greenland in the summer from mid-May to mid-October and this trend looks set to continue. In winter, there has not been a corresponding change of activities in the area. How this development will affect the armed forces' tasks is analysed as part of the Defence Agreement 2010-2014.

The armed forces adapts its deployment of vessels, aircraft and other capacities in accordance with the distinct difference in seasonal activity. Because of the enormous dimensions of the Arctic, international cooperation is an important element in resolving the armed forces' tasks in the Arctic.

Challenger CL-604 patrol aircraft

Off shore patrol vessel and patrol vessel

Sledge patrol

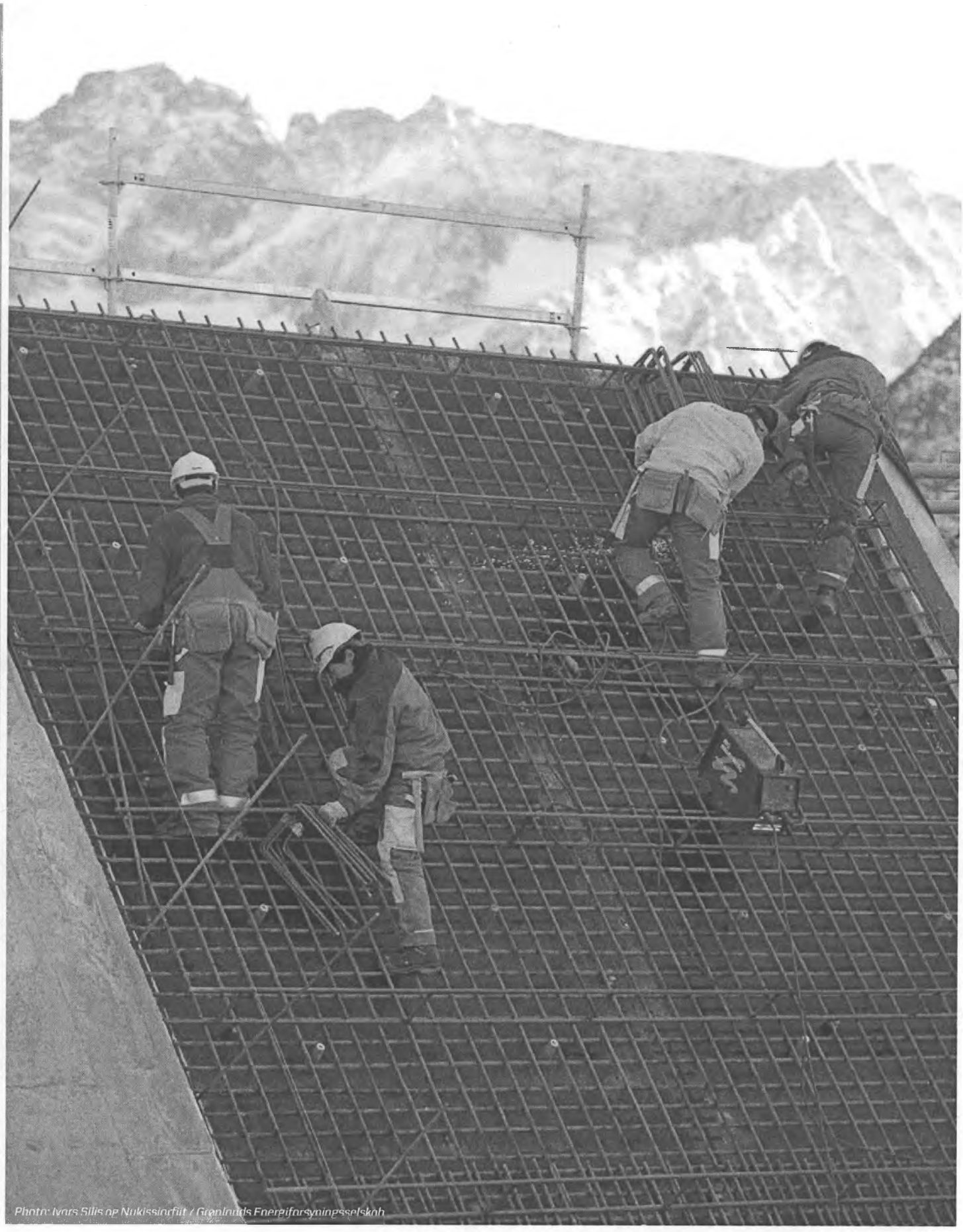


Photo: Ivars Silis og Nukissiorfiit / Grønlands Energiforsyningsselskab

3. Self-sustaining growth and development

- Mineral resources shall be exploited under the highest international standards of safety, health, environment, preparedness and response, and transparency with high returns for society.
- The use of renewable energy sources must be increased significantly.
- Living resources, including fish, shellfish and marine mammals shall be harvested in a sustainable manner based on sound science.
- New opportunities in the Arctic must be exploited in close cooperation with industry, and an optimal regulatory framework will be created for exports and investments.
- The Kingdom's Arctic research will be at the global forefront, and research and training efforts must support the development of industry and society in the Arctic.
- The Kingdom will promote Arctic cooperation on health and social sustainability, including research and best practices in areas of shared challenges.

It will be an overriding political priority for the Kingdom and particularly in Greenland over the next ten years to seize the many opportunities in the Arctic to create more growth and development. The huge economic potential in the Arctic must be realized while appreciating its human impact, i.e. the economic and social integration of the population and with sensitivity to environmental concerns, thereby creating a healthy, productive and self-sustaining community. Greenland is already a fast-changing society and peoples in the Arctic, including the Greenlanders, may have to adapt to even more extensive changes in the future due to climate change, societal developments and the restructuring of industry. Integration into the new opportunities in the Arctic will place great demands on the populations' adaptability and mobility. It will also be a significant challenge for Greenland to develop policies which, apart from the goal of social and societal-related sustainability, deal with the prospect of significant foreign labour migration.

There is a close correlation between on the one hand realising the potential of natural resources, new trade and investment opportunities, and enhanced research and education contributions while on the other promoting health and social sustainability, which are the areas specifically addressed in this chapter. This concerns a number of strategic priorities for the Kingdom in relation to economic and societal development in the Arctic, but also other important areas such as enhanced economic development and diversification of the economy. This applies i.a. to the development of the tourist industry and bolstering the overall development with adequate infrastructure.

Today, ***tourism***, second only to fisheries, is the most important export industry in Greenland, and the tourist industry has potential for growth in the future. This ap-

plies both to land-based tourism and the cruise-liner business. Among the benefits of the latter is that even small towns and villages along the coast can be involved in tourism. The land-based tourism generates by far the greatest revenue but is currently dependent on only a few markets, primarily the Danish. Therefore Greenland's Tourist Board is working on the development of a new national brand that more clearly defines Greenland as an adventure destination focusing on sustainable tourism and which to a greater extent appeals to the global market.

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND GEUS

The Geological Survey of Denmark and Greenland (GEUS) is responsible for the scientific exploration of the geological survey of Denmark and Greenland, including their respective shelf areas. GEUS will conduct research at the highest international level on issues of importance to the exploitation and protection of Denmark and Greenland's geological natural resources. GEUS also carries out mapping, monitoring, data collection, data management and the presentation of these issues. GEUS provides geological advice to public authorities on nature, environment, climate, energy and mineral resource related questions and participates in the authority's regulatory work within these areas. GEUS is a national geological data centre and in that capacity makes data and knowledge available to the authorities, educational institutions, businesses and individuals. GEUS's tasks in relation to Greenland are generally defined in the Self-Government Act and are described in the Mineral Resources Act for Greenland.

Infrastructure is a key element in the development of the Greenland society and to ensure long term sustainable development, the Government of Greenland set up a transportation commission in 2009 for the socio-economic analysis of the entire infrastructure in Greenland. The Commission's recommendations of April 2011 will form an important element in future policy decisions on the evolution of Greenland infrastructure. This will include decisions on the location of ports and airports. These projects will be costly and therefore private funding is seen as a possibility, just as mining projects located near urban areas could be included in potential funding of larger local infrastructure projects.

3.1. HIGH STANDARDS FOR THE EXPLOITATION OF MINERAL RESOURCES

Studies from the U.S. Geological Survey, among others, estimate that there may be enormous, as yet unproven oil and gas resources in the Arctic, just as previously major discoveries were made of gas especially (in Russia) but also oil (in Alaska). Specifically, it is estimated that the Arctic may contain up to 30% of the world's undiscovered gas resources and approx. 10% of the oil resources. Approximately 97% of oil and gas resources are believed to lie within the Arctic States' exclusive economic zones, and are thereby allocated.

In Greenland's case, it is estimated that 31 billion barrels of oil and gas off the coast of Northeast Greenland and 17 billion barrels of oil and gas in areas west of Greenland and east of Canada could be discovered, though the probability is greater for discoveries in Northeast Greenland. Greenland is also rich in mineral deposits, including zinc, copper, nickel, gold, diamonds and platinum group metals, and has substantial deposits of so-called critical metals, including rare earth elements, several of which are important components of high-end technology, including green energy technologies.

The mineral resources sector in Greenland has significantly matured over the last 10-15 years as a result of a long-term and deliberate strategy. After the adoption by Parliament Act No. 7 of 7 December 2009 on mineral resources and activities of relevance hereto, the mineral resources sector was fully taken over by the Greenland Self-Government on 1 January 2010 and is a key element to building growth industries and a self-sustaining economy. In 2008, Greenland had already adopted the Parliament Act No. 6 of 5 December 2008 on Greenland's Mineral Resources Fund, which is inspired by the Norwegian model so that oil and gas revenues also benefit future generations.

The vision is to exploit mineral resources in the Arctic under the best international practices, and in continued close cooperation with relevant authorities of the Danish Realm and international partners. Greenland and the Faroe Islands shall be attractive areas for exploration, and the management of mineral resources must be competent and efficient in ensuring that such mineral resources are explored and exploited under the highest standards of safety, health, environment, emergency preparedness and transparency. The mineral resource industry must be developed while strongly taking into consideration the fragile Arctic environment so it contributes to sound economic development, including the creation of new jobs and a maximum return to society. Mineral resource activities will also be carried out with sufficient preparedness that the public is kept from harm (based on the polluter-pays-principle) and that the Kingdom's international obligations can be met in case of major unscheduled incidents. This should be a model for resource exploitation across the whole of the Arctic.

In the oil and gas sector, licensing rounds have been held biannually since 2002 and alongside rising oil prices in recent years, there has been a breakthrough in the international interest in Greenland's oil potential. An area of more than 200,000 km² offshore South and West Greenland is now covered by 20 exploration and exploitation licenses, and in 2010 seven new exploration licenses were issued in Baffin Bay off the coast of Northwest Greenland. A licensing round for oil exploration off the coast of the northernmost part of East Greenland will be held in 2012/2013. In the coming years in particular, there will be a need to maintain the level of activity offshore of West and Northwest Greenland, while ensuring a broad professional knowledge building in the more inaccessible areas off Northeast Greenland. With respect to oil and gas finds and subsequent production, a number of new challenges and tasks will emerge. As a result, coordination and cooperation with neighbouring Arctic states with similar challenges will be a major priority.

In 2000 the first licenses for exploration of the Faroese shelf were issued. Subsequently there were two licensing rounds in 2005 and 2008. In total, 17 licenses have been issued, of which 12 are currently active with a total of 11 licensees. Of the 7 wells drilled so far, 5 contain hydrocarbons, but finds on a commercial scale have not yet been confirmed. There is still unexplored potential for exploration in structures that could potentially contain large amounts of hydrocarbons. Currently there are two outstanding drilling commitments, of which the first well will be drilled in 2012.

The current relatively modest level of activity has already had favourable effects on the Faroese economy through direct and indirect taxes in connection with drilling and area fees. Another significant benefit is the boost in commercial competencies and employment opportunities which wholly or partly are attributable to exploration activity on the Faroese Continental Shelf. One condition for acquiring a license is that a commitment must be entered into to finance activities that build up local competencies. This enhancement of competence must be commercially oriented though not necessarily be related to the oil industry. The arrangement should be seen as an investment in both the present and future, and already several hundred projects, both large and small, have been carried out. This has created a solid basis for local involvement provided that commercial discoveries are made on the Faroes.

In the ***mineral sector***, exploration in Greenland in recent years has especially targeted gold, zinc, iron, copper, diamonds, rubies and a number of critical metals, including rare earth elements. The prospects are bright that the development of the mineral sector can significantly underpin the development of an economically self-supporting Greenland. The Government of Greenland is expecting that a number of mature projects developed with foreign partners and partial involvement of Danish companies will create over 1,000 new jobs by 2015. Regarding radioactive minerals, the Self Government follows a zero-tolerance policy, which means that it does not permit the exploration and exploitation of deposits that contain radioactive elements, either as a main product, by-product or residue. In 2010 an amendment was made to the standard terms for exploration, which permits the carrying out of feasibility studies, including environmental, health and safety studies of deposits containing radioactive elements.

- Greenland will continue the successful licensing policy and strategy of competitive tenders in the oil and gas sector. Sets of rules will be continually adapted to optimize safety, health, environment and transparency standards through the use and improvement of best available techniques and practices. This will include inspiration from other countries' regulations, not least the Norwegian NORSOK standards.

- Cooperation will be expanded with authorities in similar areas, including Norway and Canada, and participation in relevant international fora such as the Arctic Council's working groups is to be given high priority.

- The Kingdom will work actively in the United Nation's Maritime Organisation (IMO) or other international fora, for the establishment of an international liability and compensation convention and a possible international compensation fund for pollution damage caused by offshore oil exploration and exploitation.

- Terms and conditions for licenses to exploit must be reasonable for both larger and smaller companies, resilient to fluctuating market conditions as well as simple and easy to administrate for companies and authorities.

- Mineral sector activities must be conducted responsibly as regards environmental, health and safety concerns, and an appropriate supervisory body must ensure compliance hereof.

OIL AND GAS ACTIVITIES IN GREENLAND

High standards for activities

In connection with the exploration and exploitation of oil and gas resources regulated by the Greenland Mineral Resources Act, the licensee must ensure that ***safety, environmental and health risks*** are identified, assessed and reduced as much as practically and reasonably possible.

The Bureau of Minerals and Petroleum (BMP) guidelines and terms of approval are based largely on the Norwegian NORSOK standards which determine how the licensee can comply with international best practice in relation to specific operational procedures and practices. The BMP follows strict compliance with international standards, supplemented by an emergency committee broadly composed of authorities of the Danish Realm (including the Danish Armed Forces and the Danish Maritime Authority) and Greenland authorities. The Emergency Committee monitors the precautionary actions taken by the licensee, and is responsible for coordinating the authority's efforts in accident and emergency situations on offshore installations.

Thus, permission is only given for exploration and exploitation activities provided that the Government of Greenland is fully assured that the activities are performed properly in a safe and healthy manner and stringent requirements are made of licensees regarding their own capacity to deal with accidents and emergencies. Under the Mineral Resources Act, the responsibility for clean-up operations and compensation always lies with the party causing damage, whereby a number of stringent requirements are imposed following international standards regarding financial guarantees and insurance for oil and mineral activities.

Before new offshore areas are designated as oil / gas licensing areas, the Government of Greenland sets in motion the preparation of ***strategic environmental impact assessments*** in order to ensure that any oil / gas activities can be implemented on an environmentally sustainable basis. The strategic environmental impact assessments are prepared on a scientific basis by the National Environmental Research Institute and Greenland's Institute of Natural Resources. In connection with an application for the carrying out of concrete oil / gas activities which are likely to have a significant impact on the environment, such as exploration wells, the licensee is required to conduct a specific assessment of the environmental impact (EIA). The EIA report is submitted for public hearing and must be approved by the Government of Greenland before the application to carry out the activity can be approved.

Under the Mineral Resources Act, companies seeking a license for exploitation must also prepare an ***Assessment of Societal Sustainability*** (SSA report). The report must, for example, describe the utilisation of Greenland manpower and enterprises in the project, including how the proportion of Greenland employees and subcontractors can be increased through training and skills development.

Cooperation with Cairn Energy

Scottish Cairn Energy's exploratory drilling for oil in waters west of Qeqertarsuaq and Nuussuaq Peninsula is presently the most advanced project, and collaboration between the company and the authorities has been very positive. The self-government has used Norwegian consultants for the regular monitoring of compliance with stringent safety requirements, and similarly the self-government has established cooperation with the Canadian government in the area. Cairn Energy has also complied with the Greenland authority's demands for financial guarantees in case of an accident, oil spill or a major environmental emergency. Cairn Energy, affected municipalities and Greenland's Self Government have also entered into a cooperation agreement on recruiting Greenland labour in the future, including initiatives which develop relevant courses as part of the self-government's efforts in using the resident workforce and local businesses wherever possible in the future.

Licensees in oil and gas sectors in Greenland

As of 1st January 2011 there were 20 active exclusive right licenses for exploration and exploitation of oil and gas in the sea around Greenland. During 2012-2013 a licensing round will be carried out covering offshore Northeast Greenland. There is great interest from a number of different companies and as of January 2011 the licensees are: NUNAOIL (Greenland), DONG (Denmark), Maersk Oil (Denmark), ExxonMobil (U.S.), Chevron (U.S.), Husky (CAN), Cairn Energy (UK), PA Resources (SVE), ConocoPhillips (U.S.), Shell (NL), Statoil (NOR), GDF Suez (FRA) and Petronas (Malaysia).

OIL ACTIVITIES IN THE FAROE ISLANDS

High standards for activities

The execution of exploration activities in the Faroes takes place with continuous regard for the environment and the existing fishing industry. Safety procedures for example are on par with the Danish, Norwegian and British. This includes requirements for the licensees regarding their technical and economic expertise as a part of their responsibilities. Furthermore, exploration activity must always live up to best practices in the industry and be geared to the circumstances of the specific drilling location. To be updated on developments in safety matters, the Faroe Islands is a member of NSOAF (North Sea Offshore Authorities Forum), an association of offshore safety authorities in countries in Western Europe with an oil industry. As the exploration activity on the Faroese shelf is geographically close to activity in the UK and Norwegian waters, the emergency preparedness is also tied to response equipment on the respective British and Norwegian continental s helves. To a great extent, this places emergency preparedness on the Faroese shelf on a par with that in Norway and the UK.

Authorities' responsibility for oil drilling in the Faroe Islands

The Faroese Ministry of Trade and Industry has overall responsibility for exploration activity in the Faroes. The everyday management is delegated to Jarðfeingi (Faroese Earth and Energy Directorate), which also deals with public sector geological interests, and has an advisory function regarding energy issues.

Umhvørvisstovan (the Environment Agency) is responsible for the Faroese marine environment act and the Faroe Islands Marine Rescue Coordination Centre (MRCC) Torshavn is responsible for coordination regarding incidents offshore.

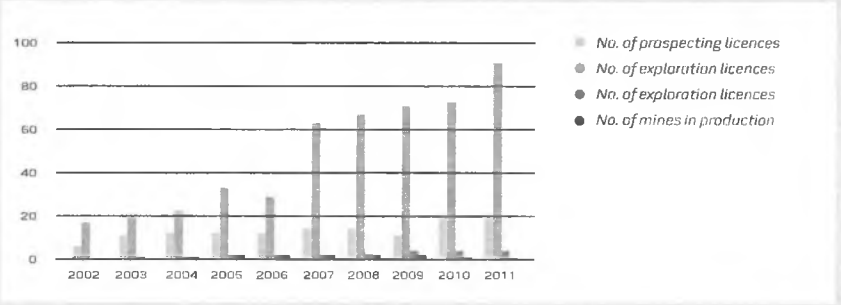
Oil companies active in the Faroe Islands

Atlantic Petroleum (FO), Cieco (Korea), Dana Petroleum (UK), DONG (DK), ENI (ITA), Exxon Mobil (US), Faroe Petroleum (FO), First Oil Expro (UK), OMV (Østrig), Sagex Petroleum (NOR), Statoil (NOR).

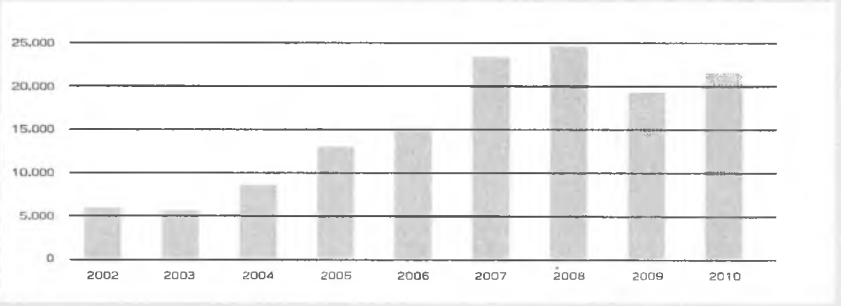
GREENLAND'S STRATEGY FOR MINERALS

The Government of Greenland's strategy and plan of action for exploration and exploitation of hard minerals is described in the sectoral plan "Mineral Strategy 2009". The main objectives of the strategy are that all projects must be implemented socially sustainably, and ensuring that:

1) The society will receive a competitive share of profits gained from mining.
2) Greenland manpower and enterprises are used to the greatest possible extent.
3) All mineral activities are to be conducted properly in terms of safety, health and the environment.
4) The population is ensured participation and knowledge in the development of the mineral sector.
5) The development proceeds with respect to Greenland values.



Development of mineral activities in Greenland



Area (km²) covered by exploration licenses

CRITICAL METALS / RARE EARTH ELEMENTS AND DEPOSITS IN GREENLAND

A raw material/ mineral is considered 'critical' if it is used for purposes for which there are no other satisfactory alternatives. A given mineral resource's criticality is dynamic and is determined by issues of supply, demand and the potential reuse of the resource. New technology can change the requirements. The time span from exploration to the opening of a new mine will generally not be less than 10 years; therefore the mining industry has difficultly in keeping pace with market requirements for new resources. There may be various reasons why it can be difficult to obtain a given commodity, for example:

1) Geological conditions;
2) Technical factors;
3) Social conditions;
4) Political factors, and
5) Economic conditions – i.e., whether or not the raw material is available on the market.

Mining Opportunities in Greenland
Overview of critical minerals (short term) [1]

Mineral	Area	Rating of resource
Antimony	East Greenland	Moderate
Beryllium	South Greenland	Low
Cobalt	-	Low
Fluorspar	East Greenland	Low
Gallium	East Greenland	Moderate
Germanium	-	Unknown
Graphite	West- and East Greenland	Moderate
Indium	-	Low
Lithium	-	Low
Magnesium	-	Low
Manganese	-	Low
Niobium	South Greenland	Large
PGM 2	West- and East Greenland	Large
REE 3	South Greenland	Large
Tantalum	South Greenland	Large
Tellurium	-	Unknown
Tungsten	East Greenland	Moderate

Overview of mineral resources which can be critical in the long term
Known deposits in Greenland [4]

Mineral	Area	Rating of resource
Aluminium	-	Low [5]
Zinc	South, West and North Greenland	Moderate
Nickel	East Greenland	Moderate
Manganese	-	Low
Iron	South, West and North Greenland	Large
Chrome	Southwest Greenland	Moderate
Molybdenum	East Greenland	Large
Vanadium	South and East Greenland	Large
Titan	South and East Greenland	Large
Copper	North and East Greenland	Large
Uranium [6]	South Greenland	Moderate

[1] Estimated by the EU, respectively (Raw Materials Supply Group. EU 2010), U.S. (Minerals, Critical Minerals, and USE economy 2008) and UNEP (Critical Metals for Future Sustainable Technologies and their recycling potential; UNEP 2009), respectively. [2] PGM = Platinum Group Metals. [3] REE = rare earth elements. [4] Estimated by the EU (Raw Materials Supply Group. EU 2010). [5] Can be high with other technology. [6] Greenland currently has zero-tolerance policy on uranium and thorium.

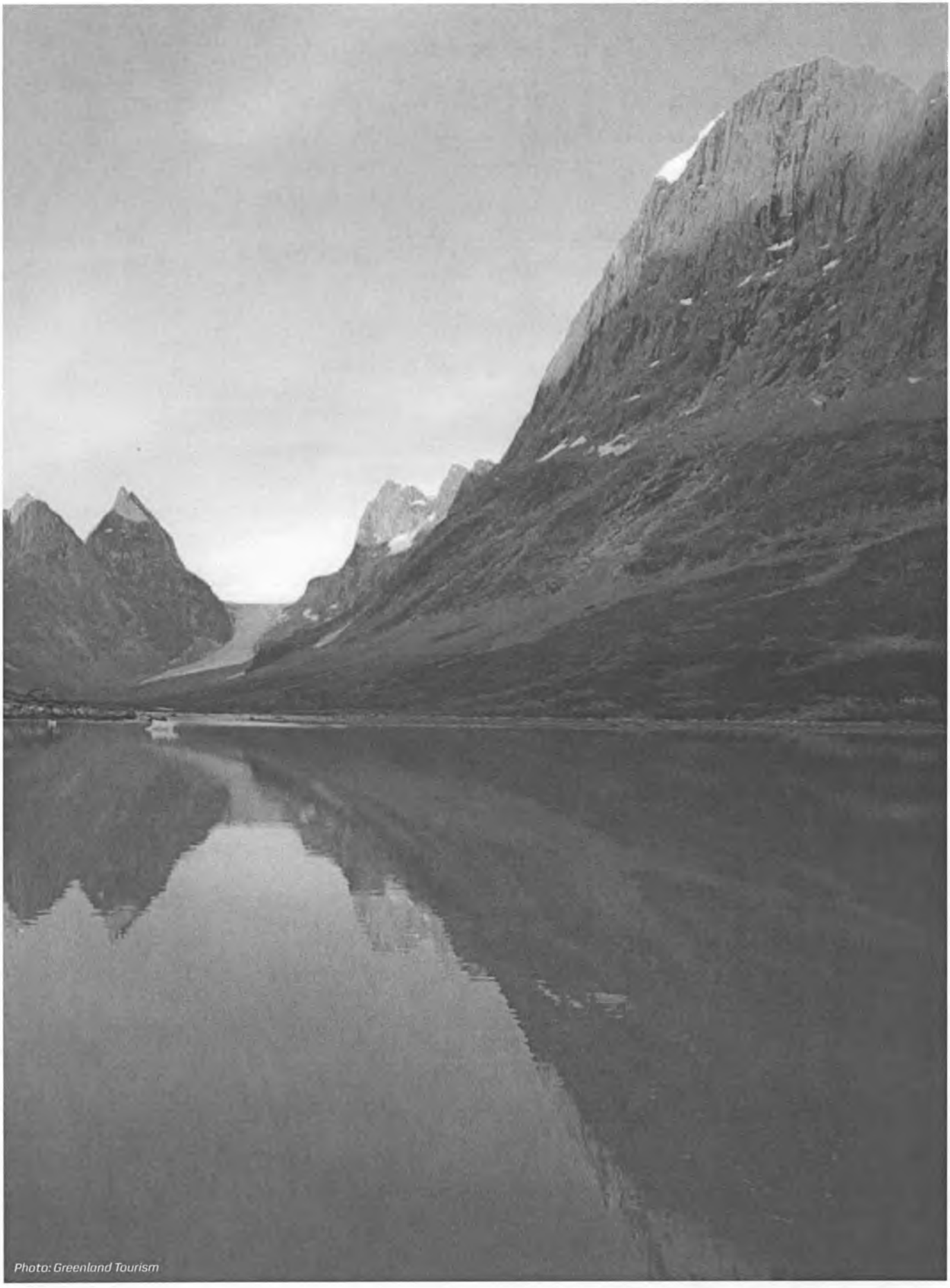


Photo: Greenland Tourism

GREENLAND'S COMMITMENT TO RENEWABLE ENERGY

In 1990, the use of renewable energy in Greenland was almost zero, but since 1993, Greenland's Self-Government has annually invested an average of approx. 1% of GDP in the development of hydropower and other renewable energy sources. Today, renewable energy makes up 60% of the public energy supply via the power supply company, Nukissiorfiit. When the Ilulissat hydroelectric plant comes into operation in 2013 as expected, the proportion will rise to approx. 70%.

The Greenland hydroelectric power plants:

- Buksefjord Power Station at Nuuk (1992/2008) with an output of 45 MW;
- Tasiilaq hydroelectric plant (2005) with an output of 1.2 MW;
- Qorlortorsuaq hydroelectric plant (2008) with an output of 7.2 MW;
- Sisimiut hydroelectric plant (2009) with an output of 15 MW;
- Ilulissat hydroelectric plant (to be inaugurated in 2013) will have an output of 22.5 MW.

Through the annual Greenland Finance Act account for the Support of Research and Development of Renewable Energy a number of concrete projects are supported, including the installation of solar panels and wind turbines, installation of remote readers and the dissemination of renewable energy. Since 1993, an average of 1% of GDP has been invested annually on the development and establishment of hydropower.

3.2. EXPLOITATION OF RENEWABLE ENERGY POTENTIAL

The Kingdom will pursue ambitious and active energy and climate policies. The energy policy objectives of Greenland, Denmark and the Faroe Islands respectively are to create security of supply, to reduce emissions of greenhouse gases and air pollution while creating a basis for commercial development. A shared ambition is to significantly increase the harnessing of renewable energy sources. Denmark's commitment to renewable energy targets under the EU is 30% by 2020. Greenland will increase its share of renewable energy to 60% of total energy production by 2020. The Faroe Islands will increase the use of renewable energy, including the target of 75% of electricity production based on renewable energy by 2020.

Greenland has a tremendous natural potential for renewable energy, which among other things can be utilised for the development of emerging industry. An example is the designing, in collaboration with the American company, Alcoa, of an aluminium smelting plant in Maniitsoq which will be operated solely by hydropower. Increasing focus in Greenland is placed on small-scale solutions for renewable energy to be used in smaller towns and settlements where there is currently no access to hydropower. The Government of Greenland provides support for developing renewable energy projects, including micro hydropower plants, and solar and wind power projects that aim at a green and self-sufficient Greenland energy supply. Furthermore, the utilisation of renewable energy in the transport sector is being explored. The development of renewable energy sources is a key issue in Greenland's international cooperation.

- Denmark, Greenland and the Faroe Islands will increase the share of renewable energy sources in the energy supply in order to increase the security of supply, reduce emissions of greenhouse gases and air pollution, and thus create the basis for enhanced commercial development and knowledge sharing through training and participation in projects.
- The Government of Greenland will continue to promote the utilisation of renewable energy in Greenland. In the smaller towns and settlements, the development of local energy solutions based on renewable energy must be supported. The Government of Greenland will also promote Greenland's potential to house industrial production based on renewable energy.

Photo: Ivars Silis and Nukissiorfiit

3.3. SUSTAINABLE EXPLOITATION OF LIVING RESOURCES

The Arctic regions are unique ecosystems that represent important values biologically and socially. The natural resources have shaped the development of Arctic fishing and hunting cultures and traditions, and the utilization of fish and marine mammals has always formed the bedrock of Arctic societies and economies. Historically, supply-related and cultural considerations are fundamental to the Arctic population's relationship to the exploitation of living resources, whether fish or marine mammals. The exploitation of living marine resources is one of the essential economic factors in both Greenland and the Faroe Islands.

The structure, function, diversity and integrity of the ecosystem in the Arctic are crucial to the productivity. The Arctic must therefore be managed so as to ensure a healthy marine ecosystem with economically sustainable species and stocks. Ecosystem-based management means that management of the ecosystem is based on a holistic approach where all parts of the ecosystem and all impacts, including those from human activities, are taken into account in management. The management of living marine resources in the Arctic must ensure a high return within the ecosystem's capacity, ensure minimal impact on the ecosystem, and guarantee respect for the ecosystem's capacity for future production of living resources.

Greenland and the Faroe Islands' ***fishery*** takes place mainly in the North Atlantic, the Denmark Strait and the David Strait. Greenland's fishery is based on a quota system whose aim is to ensure a sustainable exploitation of certain stocks. Therefore, an annual "Total Allowable Catch" (TAC) of the principal species is stipulated, based on biological advice and respecting socio-economic concerns, commercial interests and international obligations. The biological advice is provided by the Greenland Institute of Natural Resources and a number of regional organizations, particularly the ICES and NAFO.

Faroese fishing of pelagic stocks and fishing in other waters under bilateral and multilateral agreements is mainly based on quota systems, while for groundfish fisheries around the Faroe Islands there is a special system of fishing days and areas which are closed as required. Besides their own expertise, the Faroese also draw on international advice, particularly ICES. Greenland and the Faroe Islands each have agreements with one another and also with the EU, Norway and Russia, and the Faroe Islands furthermore with Iceland. The Faroe Islands, though also Greenland, shares fishery stocks with close neighbours and exports of fish and fish products form a large part of the economy of both countries. The Faroe Islands' export of fish and fish products represents approx. 90% of total exports and for Greenland, approx. 85% of total exports.

The Greenland fishery industry is facing a structural challenge of adjustment, including the need of larger and more modern vessels and the need for future regulation of the industry in relation to ownership provisions and access to capital. This restructuring process will also cause an outflow of labour to other industries and make demands on social policy. Greenland's Self-Government has initiated a project concerning the consequences of climate change on the fishing and hunting industry with a view to identifying opportunities for adaptation that manage the challenges while exploiting new opportunities. The adaptation of industry and retraining initiatives in for example the fisheries industry, might be one element of a new phase of partnership between Greenland and Europe.

A key element in fishery management is control and enforcement. Control operations are undertaken by the Greenland and Faroese authorities who monitor that both Greenland and Faroese, and relevant international fishery regulations are complied with by all vessels in their respective waters, as well as by Greenland and Faroese vessels operating internationally. The inspection of vessels and catches at sea is undertaken by the Danish Armed Forces and the Faroe Islands Fisheries Inspection ***Fiskiveiðieftirlitið***. Furthermore, regional cooperation on inspections remains a priority.

General increases of temperature in the Arctic and rapid melting of ice can make new areas of the Arctic Ocean potentially attractive for fishing. This presents new challenges with regards to national and international regulation of these areas due to insufficient data about them. In addition, illegal, unreported and unregulated fishing is a serious threat to marine ecosystems which has considerable implications for conservation and rational management of marine resources. It is a huge task for small communities with large ecosystems to provide adequate expertise for the management and control of fishery. In the Arctic, there is relatively limited knowledge of fish stocks and fishery opportunities, which means that the precautionary principle should be applied to protect the environment and fishery resources.

Hunting is an integral part of the Arctic community and a sustainable exploitation of hunting resources is important for the local economy and for cultural self-identity. The best possible basis for decisions should be ensured in the exploitation of these resources nationally and internationally. Similarly, it is essential that hunters have confidence in the basis for decision-making so that limitations on hunting are observed. The Greenland seal-hunting industry is currently under pressure partly because the European and North American markets for sealskin have

KEY ORGANIZATIONS AND OTHERS IN THE FISHERY AND HUNTING SECTOR

- ICES - International Council for the Exploration of the Sea: International organization that is responsible for coordinating and promoting marine research in the North Atlantic and adjacent seas, the Baltic and North Sea. The organization has 20 member states, including Denmark, with the Faroe Islands and Greenland.
- NAMMCO - North Atlantic Marine Mammal Commission: Regional management organization for marine mammals with Norway, Iceland, the Faroe Islands and Greenland as members. NAMMCO has observer status in the Arctic Council.
- NAFO - Northwest Atlantic Fisheries Organization: Regional fisheries management organization that provides science-based advice, as well as managing and regulating fishing in the Northwest Atlantic. NAFO consists of 12 members at present, including Denmark in respect of the Faroe Islands and Greenland.
- NEAFC - Northeast Atlantic Fisheries Commission: Regional fisheries organization that provides science-based advice and manages and regulates fishery beyond 200 miles in the North Atlantic and up to the North Pole. NEAFC currently consists of 5 members, including Denmark in respect of the Faroe Islands and Greenland.
- IWC - International Whaling Commission: International Management Organisation which regulates hunting of large whales. Denmark, the Faroe Islands and Greenland are members. Greenland allocates quotas on large whales by means of the so-called "Aboriginal Subsistence Whaling quota"

virtually collapsed after pressure by special interest groups on consumers. Internationally, there is very limited understanding for the catch of marine mammals. This is also true of the Greenland catch of large whales, which is regulated by the International Whaling Commission in accordance with the exemption that applies to indigenous peoples.

- All living resources must be developed and exploited sustainably based on an ecosystem management that ensures a high return in the long term, and is in compliance with international obligations, while at the same time the Arctic communities' rights are defended in support of the fishing and hunting industry. Management must be based on scientific advice that is founded on the collection, processing and analysis of data, including from hunters and industry.

- The Kingdom will work internationally for the Arctic indigenous peoples' right to conduct hunting and to sell products from seal hunting, as long as it is based on sustainable principles.

- Denmark, Greenland and the Faroe Islands will work to ensure that the utilisation of living resources, including marine mammals, is founded upon an ecosystem-based management model that places emphasis on scientific foundation and sustainability.

- Work continuously to ensure regular scientifically based monitoring of living resources in the Arctic with the involvement of its citizens. The precautionary principle should apply in cases where there is a lack of adequate knowledge about development in previously ice-covered areas.

- Effective management and control regimes must be pursued to counter illegal, unreported and unregulated fishery and hunting, and also work for international agreements on potentially attractive Arctic high seas not yet covered by the conservation and management systems. The parts of the Danish Realm will work to ensure that in general fishery does not commence where a conservation and management system is not available.

- The parts of the Danish Realm will work to strengthen international cooperation on scientifically based management of shared fish stocks and fishery in international waters with a view to promoting consensus on sustainable management plans and allocation formulas for the benefit of all relevant parties.

- The parts of the Danish Realm will work towards the introduction of a special regional form of control for a prudent fishery in large ecosystems in sparsely populated areas where there is no historical data and where it is particularly challenging to collect data and carry out control. Methods must be developed for sustainable management in situations of scientific uncertainty, whereby models are developed that support a learning management system based on the precautionary principle.

WHALING

Denmark is in a rather unique situation when it comes to whaling, since the Kingdom's three parts - Denmark, the Faroe Islands and Greenland - each have their own whaling policy. This particular situation is similar to the U.S. and Russia, which also distinguish between population groups that rely on whaling and the rest of the territory. The Faroe Islands and Greenland's maritime policy is based on the principle of being able to live off marine resources in a sustainable way, whether it be fish, seals or whales. Each part of the Danish Realm is empowered to regulate the exploitation of whale resources in their own waters - though some whale species are subject to decisions to which the Kingdom is bound under the framework of the International Whaling Commission (IWC). The entire Danish Realm is thus bound by the IWC's current ban on commercial hunting of large whales.

In the Faroe Islands and in Greenland there is general support for a principled policy and the political priority is to ensure the populations' right to hunt. In the Danish part of the realm, many people are fundamentally hesitant about whaling and whaling is not practised in Danish waters, although there is understanding for the situation of Greenland and the Faroe Islands. In Danish waters, EU rules apply, i.e. a total ban on whaling. In Greenland, the hunting of small as well as large whales is operated in connection to the society's food supply. Large whales are covered by the IWC's regulatory powers. As a member of the IWC, the Kingdom therefore seeks, at intervals, to obtain backing in the IWC for quotas of relevant species of whales in Greenland. The Faroe Islands has previously operated commercial hunting of large whales, but has for many years only operated non-commercial hunting of small whales, mostly pilot whales, which are not subject to the IWC. The Faroe Islands, however, continues to see sustainable commercial whaling as a right and supports the right of other nations in this respect.

3.4. STRONGER INTEGRATION IN INTERNATIONAL TRADE

New opportunities for economic development in the Arctic are leading to increasing interest from international investors in the area. The Government of Greenland has set itself clear targets to attract more foreign investors, and to ensure that the exploitation of Greenland's natural resources in the future will constitute a major source of revenue for the Greenland society. The new trading opportunities can contribute to the diversification of Greenland's economy and create the basis for economic sustainability and prosperity. For the Faroe Islands in particular, the opening of the Northeast Passage will unfold new opportunities as a result of increased navigation. The Government of the Faroes has decided to set up a working group to assess the Faroese strategic opportunities associated with increased enterprise in the Arctic and North Atlantic area.

The heightened international interest requires the creation of attractive regulatory frameworks for investments. Therefore, Greenland is working to conform to international trade rules and obligations and create a healthy investment environment. This will not only strengthen Greenland as an attractive investment destination, but also give Greenland more opportunities to penetrate new markets. By virtue of the Kingdom of Denmark's membership, Greenland and the Faeroe Islands come under the World Trade Organisation. Since the end of 2005, Greenland has worked continuously to bring Greenland law into compliance with WTO rules. Due to its OCT status (Overseas Countries and Territories) Greenland goods have duty-free access to the EU. The Faroe Islands has duty-free access to the EU for the majority of its goods pursuant to an agreement on mutual tariff exemption in 1991, renewed in 1996. Faroe trade with the EFTA countries, Norway and Switzerland (and Liechtenstein), is covered by free trade agreements concluded in the early 1990s. As regards Iceland, the Faroe Islands entered into a more comprehensive economic cooperation agreement in 2005 (Hoyvík Agreement).

Many Arctic regions are favourably located in relation to the world's two largest markets (the EU and U.S.), especially Greenland. The opportunities for a closer association to the surrounding markets must gradually be expanded as the extent of sea ice decreases. Trading requires infrastructure, and it is essential that the infrastructure be developed to support growing trade. In Greenland, the Transportation Commission has analysed the future needs for adapting the infrastructure and its recommendations of April 2011 will form a weighty element in the basis for decisions on the development of Greenland's infrastructure.

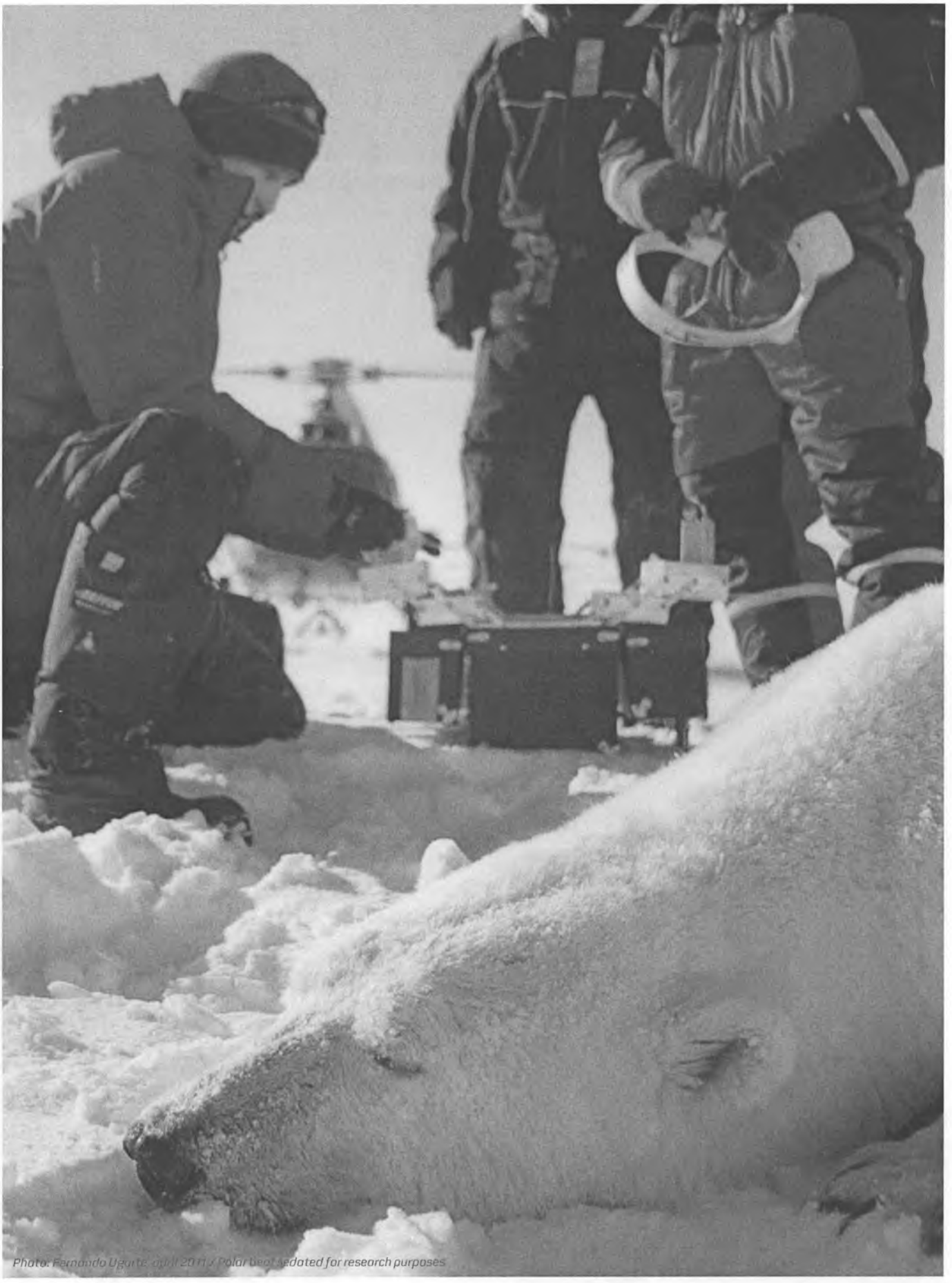


Photo: Fernando Ugarte, april 2011 / Polar bear sedated for research purposes

- A close collaboration with the business community must be ensured regarding the increased opportunities in the Arctic. The markets for Greenland and Faroese export goods are to be expanded, and internal and external barriers to exports removed.

- Inside the Kingdom's individual customs territories, the closest possible alignment must be ensured with international trade regulations and obligations, in particular the WTO's regulations.

- Cooperation must be strengthened concerning Greenland adaptation, as deemed appropriate, to the bilateral trade agreements which Denmark enters into via the EU, and the Kingdom will work to maintain - and wherever possible expand - preferential access for products from Greenland and the Faroe Islands in the EU and third countries, including entering into agreements on reciprocal free trade between the Faroe Islands and new third countries.

- Trade relations with the outside world must be managed through an ongoing infrastructure development.

3.5. KNOWLEDGE-BASED GROWTH AND DEVELOPMENT

Greenland now plays a prominent role in international research because of the unique opportunities to study processes of global importance, including the planet's geological history, natural climate variations and global warming. Interest in Arctic research has been increasing rapidly in recent years, which has resulted in major national and international research programs and increased Arctic research funds from among others the Nordic Council of Ministers and the EU. Nordic, European and wider international research and educational cooperation will also be given high priority in the future.

Global warming affects the Arctic directly, including the Greenland ice sheet, sea ice and ocean currents, which in turn have far-reaching implications for global climate trends. Meanwhile, climate change also has direct consequences for the Arctic in terms of changing circumstances for the fishing and hunting industry, the potential for mining and exploitation of hydrocarbon resources, and also navigational options for tourism and transport.

Greenland offers so many unique opportunities for research in nature, geography, biology as well as the interplay between nature and humans. It is vital that research into and monitoring of the ice sheet and research on climate and environmental processes in the Arctic are disseminated and used internationally. It is also essential that research findings are of practical use by Arctic peoples in supporting the rapid cultural, social, economic and industrial development that other peoples have had generations to adapt to. Therefore, Arctic research findings must clearly be promoted to the benefit of the Arctic populations, not least the Arctic indigenous peoples. Here, social science and health research will play a key role.

The Faroe Islands lies at the gateway to the Arctic. Nearly 90% of the total oceanic heat transfer towards the Arctic flows through this area, and the heat brought into the Arctic keeps large marine areas free of ice and far warmer than they would otherwise have been. This is the basis for the huge pelagic fish stocks that feed in the area , keeping surrounding land masses warmer than the global average at this latitude. In the Arctic and subarctic oceans, the water cools and then most sinks and returns to the world's oceans as a cold deep-water current that transports carbon dioxide, oxygen and heat from the atmosphere into the deep water masses, which are a prerequisite for all deep-water fauna. This interconnected system of ocean currents is essential to the relationship between the oceans, the global climate and not least the Arctic, but it is driven by sensitive mechanisms that can easily be weakened as the Arctic warms. The international scientific community has put considerable resources into charting patterns of ocean currents, following their changes and working out methods to predict their development and future impact on climate, living resources and humans. The Kingdom will seek to play an active and leading role in the continuation of this research effort.

There is a long tradition in the Danish Realm for Arctic research and close cooperation in meeting challenges. Danish, Greenland and Faroese universities, and research and scientific centres take part in numerous international research projects within a broad spectrum of paleoclimatic studies, research into Arctic ecosystems, oceanography, glaciology, geophysics, geology, social sciences and health sciences, and similarly a number of monitoring programs and Arctic research stations conduct an essential monitoring of climate impacts on the Arctic.

In addition, a joint research initiative by the Danish-Greenland-Faroese Continental Shelf Project provides data collection on the seabed and opportunities for follow-up research in other fields.

Research into Arctic technology, which mainly takes place at the Arctic Technology Centre in Sisimut West Greenland in cooperation with the Technical University of Denmark (DTU), is another area with potential, including requirements for the use of renewable energy in power systems and the development of Arctic infrastructure.

In 2009, the Ministry of Science and the Government of Greenland set up an interdisciplinary climate research centre in Nuuk. The centre works in partnership with

the Commission for Scientific Research in Greenland (KVUG), the Greenland Institute of Natural Resources and the University of Greenland. The centre focuses on basic research about the Arctic climate and the effects of climate change including the need for mitigation and adaptation strategies, and currently has approx. 80 Greenland, Danish and international researchers affiliated on a permanent or flexible basis.

Nordic, European and wider international research and education cooperation is to be given high priority. For example, Danish and Greenland researchers are participating in the top Nordic research initiative on climate, environment and energy, which is one of the Nordic Council of Ministers' globalization initiatives. The Kingdom also supports the running of the University of the Arctic - an association of circumpolar universities that offers a rich variety of courses relevant to Arctic students. Bilaterally, education, language and research constitute key elements in Joint Committee cooperation between Greenland, Denmark and the U.S. - and Greenland is increasingly taking part in promising bilateral research and education partnerships, as for example with Canada.

Research and education are closely connected - and must be tightly linked with economic and industrial development. For instance, in January 2011, the Government of Greenland set up a new mineral resources school by reorganising the Mining and Construction School in Sisimut. The mineral resources school will function as a knowledge centre for the entire mining resource sector and develop training within the oil industry. The Government of Greenland also has ongoing initiatives where research is used for the training of the population. Among other things, a summer school in Kangerlussuaq has been launched in cooperation with the United States under its auspices, where foreign scholars teach pupils at secondary level in scientific research topics. Finally, as part of the existing partnership agreement with the EU, Greenland receives about 25 million Euros annually in budget support for the education sector, in particular targeting the special educational drive where the societal needs are greatest.

It will remain a key priority to support the future economic and social sustainability with educational initiatives. Besides the mineral resource sector, initiatives concerning new opportunities and challenges in the maritime sector will also be central.

- The Kingdom will maintain its leading position internationally in a number of research fields concerning the Arctic, and will promote national and international Arctic research.

- The Kingdom will work to promote the participation of Danish, Greenland and Faroese academic and scientific institutions in international research and monitoring activities. This includes the quantification of global and regional impacts of climate change in the Arctic, such as how Arctic ecosystems, sea ice and ice sheets respond to climate change and also the consequences and importance of climate change for the populations and communities in and outside the Arctic.

- Research and monitoring in the Arctic puts a strain on resources and logistics and therefore international cooperation on such projects must continue to be encouraged, as well as pursuing flexible administration that facilitates access to the regions and minimizes administrative burdens on projects.

- Research in the Arctic must also help to support the cultural, social, economic and commercial development. Knowledge and data must be built up even more, firmly embedded, and also used in the Arctic where research partnerships in for example natural resources and broader social science fields will be prioritized. The extensive research by foreign researchers must be disseminated to a greater extent to relevant institutions and communities.

- Within the Kingdom, cooperation between research institutions must constantly be consolidated and developed, and researchers have to be familiar with available options for funding of Arctic research. Continuity and stability in the research environment must be assured, for example, by the recruitment of young researchers.

- Greenland targets that by 2020, at least 2 / 3 of school leavers will have gained training leading to formal qualifications, and the Government of Greenland will prioritise supplementary further education as new requirements arise. In particular, the Self-Government will develop education and training in the mineral resources area, so Greenland will increasingly be able to offer relevant and qualified manpower in the offshore and mineral industry.

- Possibilities will be considered for closer involvement of Greenland's citizens in the armed force's education and training and tasks in the Arctic, including customized programs in Greenland with emphasis on the maritime domain.

- International training and exchange cooperation will be a strategic priority for Greenland, particularly with the U.S. and Canada as well as the EU, where a new phase in the partnership could involve further adaptation to trade and industry and / or retraining initiatives.

INFORMATION A PREREQUISITE FOR PROGRESS - BUILDING UP OF GEOGRAPHICAL INFRASTRUCTURE

The establishment of a well-developed infrastructure of geographical information is important for the development of the Arctic. Compiling geographical information and obtaining a complete picture of what is happening at a given location (maps, charts, records, etc.) is very important to the carrying out of the authorities' activities and for people's access to information. The building up of a geographical infrastructure is based on the principles that data must only be produced once and that all additional data should be collected and maintained and made available in the most effective manner. To manage this, the Greenland self-government has set up NunaGIS. The objective of NunaGIS is to gather all essential information across Greenland in a digital atlas, and link this information to a data and organizational infrastructure, also called SDI (Spatial Data Infrastructure). Work is being done internationally to establish a common geographical infrastructure for the entire Arctic region by building an Arctic SDI where basic topographical data from all the Arctic countries can be assembled, displayed and linked with other information on the climate, wildlife, vegetation etc.

TOPOGRAPHICAL MAPPING

There is an agreement between the National Survey and Cadastre (KMS) and Greenland's Self-Government to jointly find a method to establish data for the topographical mapping of Greenland at 1:100.000 and maintain these maps in a simple manner. Since it is a vast land area to be covered, traditional methods that have been used for mapping in Denmark are in some cases are too costly, and therefore new technologies for mapping, including use of satellite images, need to be explored. There is also agreement between Umhvørvisstovan (Environmental Office) in the Faroe Islands and KMS that there must be an updating and modernization of the topographical map, so that new data from the Faroese authorities can be combined with existing topographical maps of the Faroe Islands.

NEEM ICE CORE DRILLING

North Greenland Eemian Ice Drilling, NEEM (2007 - 2011) is an international research project coordinated by the Centre for Ice and Climate, a scientific research project at the Niels Bohr Institute at Copenhagen University, funded by the Danish National Research Foundation. The goal of NEEM drilling in Northwestern Greenland is to retrieve an ice core reaching back through the last interglacial period, the Eemian, which ended about 115,000 years ago. The climate in Greenland was warmer during the Eemian period than it is today, and is therefore considered as an analogue for the future climate which is expected to be warmer because of global warming. Ice cores from the Eemian period may thus contribute to understanding climate dynamics in the future. Previous drilling in other parts of the Greenland ice sheet (e.g., DYE-3, GRIP, GRIP2 and NGRIP) have also aimed at acquiring knowledge about past climate changes, but none of the ice cores obtained from previous drills have contained a complete uninterrupted series of Eemian ice layers. On 27 July 2010 NEEM reached bedrock at a depth of 2537.36 m. The researchers expect that the lowest meter of the ice core will be rich in DNA and pollen and thus be able to give insights into vegetation that existed in Greenland during the last interglacial period and perhaps earlier. Further analysis of the approx. 2.5 km-long ice core will be undertaken by the Centre for Ice and Climate in collaboration with international research groups.

CLIMATE RESEARCH CENTRE'S COLLABORATION WITH CANADA

In 2010 Greenland's Climate Research Centre began collaborating with the University of Manitoba, Canada where the head of the Climate Research Centre was awarded the post of Canada Excellence Research Chair in Arctic Geomicrobiology and Climate Change. Thus, a new and extensive Greenland-Danish-Canadian climate research collaboration was launched which is bringing together a number of the world's leading scientists in climate research in the Arctic. In addition, in early 2011 steps were taken to establish a new "Centre for Arctic Research" at Aarhus University with close ties to Greenland's Climate Research Centre, which creates the basis for a highly integrated and coordinated climate research collaboration between Denmark, Greenland and Canada around much of the Arctic region. The new collaboration will be structured in a new joint research partnership, the 'Arctic Science Partnership', with the participation of Greenland's Climate Research Centre, the University of Manitoba and the University of Aarhus. Overall, this provides unique opportunities for comprehensive research, educational cooperation and synergy between the three centres.

SUMMER SCHOOL IN KANGERLUSSUAQ AND THE ARCTIC STATION

In July 2011 the first summer school in Kangerlussuaq is going to be held for high school students from Greenland, Denmark and USA. The summer school is taking place under the auspices of the trilateral "Joint Committee" cooperation between Greenland, Denmark and USA. Greenland is providing facilities; the manager is Danish, while the teachers are American scientists who freely devote 2-4 days to train the students in scientific disciplines. The purpose of the summer school is to arouse interest in science among young people, to improve their language skills and to give the Greenland students the opportunity to make contact with Americans and Danes of the same age and learn about educational opportunities in the U.S. and Denmark. The project is targeting two of the three priority areas which the Joint Committee has agreed upon in 2010-2011, namely to improve access for Greenland's students to U.S. institutions of learning and to improve English skills in secondary schools in Greenland.

In July 2000, and 2001, so-called pre-research schools were held for high school students at the Arctic Station on Disko Island in West Greenland, where researchers covered a wide range of scientific topics. The purpose of the schools at the field station was to motivate students to pursue science in higher education. The result was extremely positive and several students subsequently chose higher education courses in geology and biology. Pre-research schools at the Arctic Station will resume in 2012.

Photo: Helle Astrid Kjær / NEEM ice core drilling project, www.neem.ku.dk

3.6. ARCTIC COOPERATION ON HEALTH AND SOCIAL COHERENCE

It is a shared core value in Denmark, Greenland and the Faroe Islands to promote the population's health and also prevent and treat illness, suffering and disability with respect for the individual, his/her integrity and independence. The parts of the Danish Realm prioritize preventative and public information efforts to improve diet, increase the number of physically active people, reduce smoking and harmful alcohol consumption and also to maintain focus on risk groups to combat the increase in lifestyle diseases. Furthermore, the parts of the Danish Realm prioritise the monitoring of the population's state of health.

Greenland today is facing a dual challenge from both old patterns of disease characterized by relatively high infant mortality, accidents, and acute and chronic infectious diseases such as tuberculosis, as well as a new Western pattern of disease dominated by chronic and lifestyle-related diseases.

In the field of environmental medicine, Greenland faces the challenge of the long-range trans-boundary pollution, which increasingly impacts on traditional food resources and the population's health, just as the training of professionals as well as recruitment and retention of health professionals is a continuing challenge.

In 2011 Greenland has launched a health reform which is expected to be fully implemented in 2013. Through the regionalization of the healthcare system, the health reform will lead to greater and more equitable access to healthcare for the population, improved financial management and better opportunities for recruitment and retention of health professionals. The health reform is underpinned by the telemedicine network which was developed with the help of Alaskan and Norwegian inspiration.

The Danish Realm supports cooperation which can improve people's living conditions and health in a sustainable way, including knowledge-exchange and the increased use of new technological capabilities, both within the Kingdom and Nordic cooperation and in cooperation with existing and new partners in the rest of the Arctic. This applies generally, but also focusing especially on vulnerable sections of the population, including children and the elderly, and also the mentally ill. The Danish Realm will continue jointly to review healthcare policy and other health-related challenges, including specialized treatments, among other things as a follow-up to the Danish-Greenlandic agreement in September 1998 on the continuation and expansion of cooperation in the health area. The Danish Realm also supports Arctic research cooperation concerning the development of best practices, public health and health-related consequences of pollution.

Some Arctic communities are also facing difficult social issues. To deal with adverse social trends, the emphasis on social coherence and integration is central to development in the Arctic. Denmark and Greenland are cooperating closely on projects and knowledge-exchange in the social sector. Greenland is also sharing its experience on family matters and gender equality with, among others, the Nunavut region of Canada. Furthermore, the Nordic Council of Ministers has been focusing on changes in the Arctic from a gender perspective.

- The Kingdom will continue to develop cooperation in the health area, including emergency and specialist treatments within the Kingdom – and in the case of Greenland also with Iceland - and training and recruitment within the Kingdom and through Nordic and Arctic cooperation.

- The cooperation between Arctic partners on common challenges should be further developed, especially based on a Greenland context. Enhanced Arctic cooperation could include, research, evaluation and also exchange of "good / best practices" regarding infectious diseases, public health, telemedicine, a culturally attuned health service and environmental medicine.

- It will be a priority to increase cooperation in the Nordic and Arctic arena on public health preparedness concerning disaster situations and other urgent challenges to public health.

- In cooperation with the international research and scientific communities, the Kingdom will continue to focus on monitoring the state of public health, as well as the effect of climate change and global pollution on public health and social conditions in Greenland. Greenland has a special responsibility for advice and internal dissemination of the monitoring and research findings generated in the Kingdom and internationally.

- The Kingdom will promote Arctic cooperation and knowledge sharing on social coherence, including the participation of the population in new opportunities in the Arctic, and their involvement in international debates on the future of the Arctic.

TOWARDS CLOSER COOPERATION ON ARCTIC HEALTH

The first Arctic Health Ministers' Meeting took place on 16th February 2011 in Nuuk with Denmark and Greenland as hosts. The Arctic countries are facing a number of common challenges in health and wish to work together to find the right solutions and exchange knowledge and share experiences. This applies particularly to prevention, telemedicine and research, as well as mental illness and the prevention of abuse and suicide. The meeting led to the "The Arctic Health Declaration" which expresses agreement on closer cooperation on health issues such as the sharing of "best practices" and that the indigenous peoples in the Arctic to a larger extent should be involved in research, health promotion and prevention.

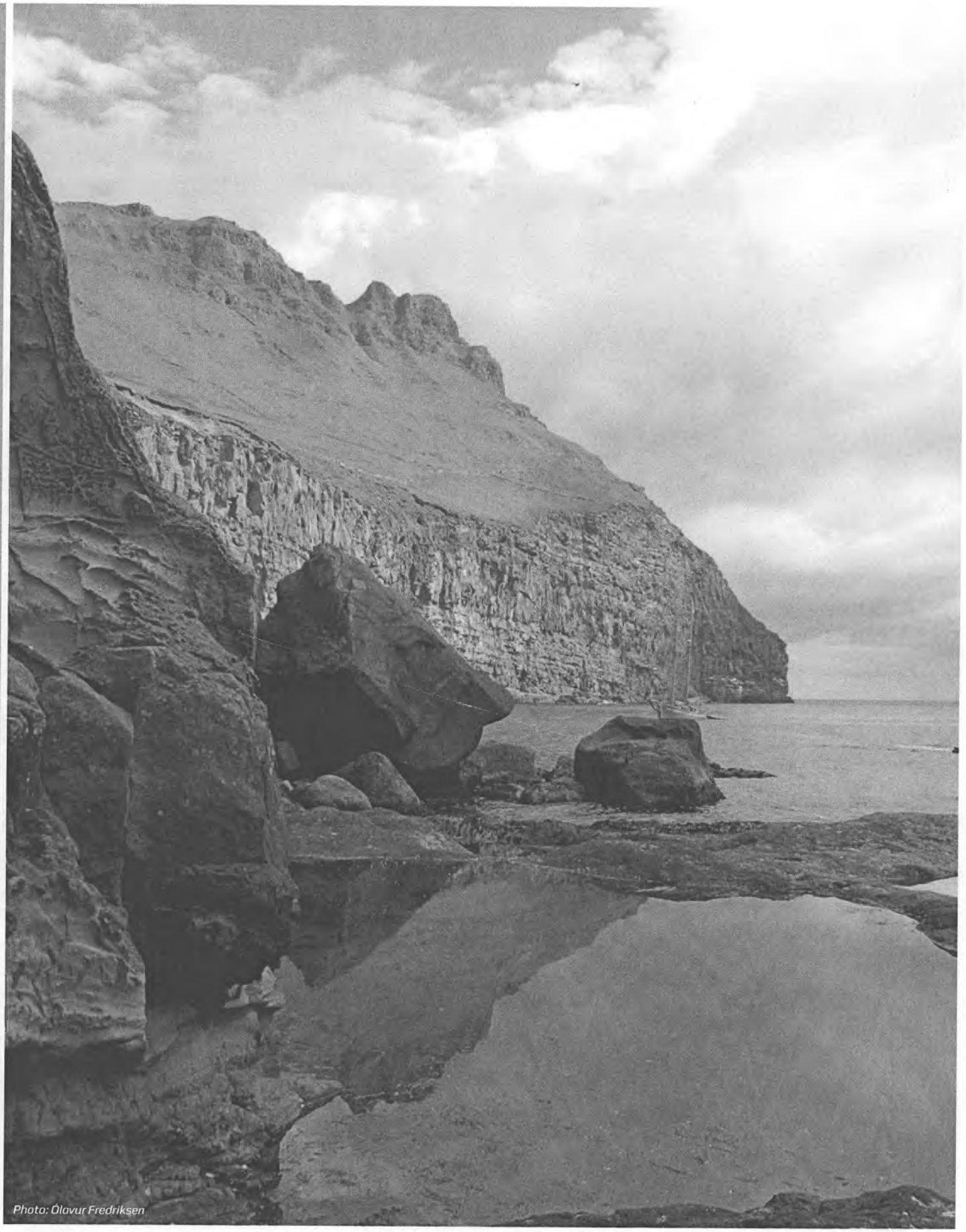


Photo: Olavur Fredriksen

4. Development with respect for the Arctic's vulnerable climate, environment and nature

- The Kingdom will pursue a vigorous and ambitious knowledge building on climate change in the Arctic and its consequences in order to foster global and local adaptation to far-reaching change.
- The Arctic nature and environment must be managed based on the best possible scientific knowledge and standards for protection, and international cooperation in this endeavour must be promoted.

The Arctic has increasingly become a part of the international agenda, and global developments have in turn increasingly become a part of the Arctic. With the Arctic Council's publication of Arctic Climate Impact Assessment from 2005, the world discovered the magnitude and consequences of climate change in the Arctic. However, 20 years earlier, the realization that heavy degradable man-made pollutants and heavy metals lead to pollution and the accumulation of toxins in animals and humans in the Arctic, had already spurred the creation of the Arctic Council as well as international agreements in 1998 that regulate pollutants. There is rightly an increased international focus on environmental regulation in the Arctic, including nature conservation, biodiversity and the marine environment. There is also considerable attention to the growing impact of toxic substances like mercury and persistent organic pollutants (POPs), which can have harmful effects on public health as well as ecosystems and biodiversity.

The following focuses on the strategic priorities to improve knowledge building on the consequences of rapid climate change in the Arctic, and to strengthen the protection of the environment and biodiversity in the Arctic.

4.1. IMPROVED UNDERSTANDING OF THE CONSEQUENCES OF CLIMATE CHANGE IN ARCTIC

Recent scientific studies conclude that warming in the Arctic since 1980 has been twice as much as the rest of the globe and that in 2005-2010 the Arctic had the highest average temperatures since records began in 1840. Global climate models predict that warming will continue. The effects of continued warming of Greenland's climate, ice sheet and ocean are studied using regional climate models with a view to facilitating adaptation to climate change. Arctic warming means that snow and ice are steadily melting faster and the permafrost is disappearing in the southern part of the Arctic. The effects of these changes are extensive - including rising sea levels, potential changes in the atmospheric content of greenhouse gases, potential changes in global ocean currents, and so on - and climate change in the Arctic is of crucial importance to global climate and environmental conditions.

In order to anticipate how global climate and environmental conditions will evolve, it is crucial to understand how climate

change affects the Arctic, and in turn how changes in the Arctic affect global climate trends. Such knowledge is essential for the adaptation to climate change in the Arctic and the rest of the world. The Kingdom is also working to support and promote the conclusion of a global agreement on limiting emissions of greenhouse gasses.

- In cooperation with the international research and scientific community, the Kingdom will strengthen the effort to quantify global and regional impacts of climate change in the Arctic, including knowledge about how Arctic ecosystems, sea ice and ice sheets respond to climate change. Such efforts include monitoring and research activities with the involvement of Greenland, Faroese and Danish research centres.

- Research and monitoring must reinforce the knowledge base on climate change impacts and their significance for the populations and communities within and without the Arctic as well as incorporating local and traditional knowledge. Furthermore, cooperation must be strengthened on identifying measures to adapt to climate change within the Kingdom.

- The Kingdom will assist in reinforcing the rights of indigenous peoples in negotiations towards a new international climate agreement by promoting the visibility of indigenous peoples' situation and also ensuring that the principles of the UN Declaration on the Rights of Indigenous Peoples from 2007 are observed.

ARCTIC CLIMATE IMPACT ASSESSMENT (ACIA) AND SNOW, WATER, ICE AND PERMAFROST IN THE ARCTIC (SWIPA)

In 2005, the Arctic Council released a major scientific work on climate change and its consequences in the Arctic - Arctic Climate Impact Assessment (ACIA). The ACIA- report pointed out that climate change in the Arctic will have major consequences for the Arctic environment and peoples of the Arctic and that the first signs of change are already visible. In 2011 the Arctic Council published a follow-up of the ACIA report: Snow, Water, Ice and Permafrost in the Arctic (SWIPA) which specifically focuses on the impact of climate change on snow, ice and frost conditions in the Arctic within the last ten years. The work, based on scientific articles and data is carried out by 200 of the world's leading Arctic researchers. SWIPA results confirm the predictions contained in the ACIA report, but in some areas the pace of change is happening much faster than expected. SWIPA shows the following: that the years between 2005-2010 were the warmest yet measured in the Arctic; that the summer sea ice could disappear within 30-40 years; that the Greenland ice sheet and other Arctic ice caps are continuously melting faster; that global sea level rises at the end of this century may be 0.9 to 1.6 m with a significant contribution from Arctic ice; and that changes in snow, ice and frost conditions fundamentally change the Arctic ecosystem, which will be particularly challenging for local communities and traditional lifestyles.

REGIONAL CLIMATE MODELLING IN THE ARCTIC

In cooperation with the Climate Research Centre in Nuuk, the Danish Meteorological Institute (DMI) is developing and applying a model for the climate system with high resolution (detail) to assess future climate change in the area around Greenland. The project is supported by the Commission for Scientific Research in Greenland (KVUG). The model system is initially envisaged as a tool to focus on increasing basic knowledge about the climate in the Arctic, with emphasis on Greenland and to assist in a better understanding of the effects of climate change. The model system focuses mainly on the inland ice and its interaction with the surrounding seas, but also contributes to knowledge of permafrost conditions and the interplay between weather, sea and ice more generally. The latter is taking place as a pilot project focusing on the Nuuk area where a range of activities at the Climate Research Centre are concentrated. This can be utilised for model verification and a greater interaction in the Greenland society with regards to climate change adaptation initiatives.

PROGRAMME FOR MONITORING OF THE GREENLAND ICE SHEET - PROMICE

The contribution from the Greenland ice sheet to global sea rise levels has accelerated over the past ten years and the net loss of ice is now at about 200 Gt / yr. The ice sheet will most likely be the main contributor to the rise in global sea level over the next hundred years, according to the Arctic Council SWIPA report from 2011. Changes in ice sheet mass balance may further affect ocean circulation in the North Atlantic and the marine resources around Greenland. To establish a better knowledge base, a long-term national monitoring of the ice sheet called PROMICE was launched in 2007. The goal of PROMICE is to determine the ice sheet's mass loss, explain why and provide data and observations to the global research effort in this area through:

- A network of automatic weather stations directly on the ice sheet
- Direct measurements of ice height and ice thickness from aircraft
- Mapping of ice flow from satellite
- Direct, continuous measurements of outlet glacier flow rate
- Observation-based modelling of melting and the formation of icebergs
- Monitoring of the smaller ice caps and glacier's mass loss
- Operation of database with free online access to all data collected

PROMICE is a collaboration between GEUS, the Danish Technical University and Asiaq, Greenland's Survey.

4.2. PROTECTING THE ENVIRONMENT AND BIODIVERSITY

The Arctic nature and wildlife are unique and fragile. This is due to the fact that ecosystems have evolved under low temperatures in the Arctic. Global warming is leading to increasingly ice-free seas in summer periods, and the lower prevalence of sea ice can have a major impact on the living conditions and distribution of species associated with sea ice. Similarly, longer periods of open water will result in increased activity, such as shipping in areas that previously couldn't be navigated, just as increased mineral exploitation, fishing and tourism pose a risk of pollution and accidents.

Increased shipping may also pose a risk of an increased influx of invasive species. To this must be added the slow degrading of problematic chemical substances that are often long-range transported. Climate change may likewise cause direct impacts on terrestrial biodiversity, while a number of climate-related and non climate-related anthropogenic impacts can affect biodiversity. This applies, for example, to increased traffic and its associated disturbance and erosion, fragmentation of habitats, and increasing use of areas in open land for commercial and recreational purposes.

On this basis, we can anticipate greater pressure on the Arctic ecosystems and fragile biodiversity. At the same time, there is an accumulation of pollutants through the food chain which could have major implications for the Arctic society. It is therefore essential, in collaboration with international partners, to ensure monitoring and studying of the environmental and health impacts to which the Arctic peoples, the Arctic ecosystem and biodiversity are exposed. It is equally important to ensure knowledge-building by the monitoring and study of migratory species (eg. whales, polar bears, migratory birds), ecosystems and biodiversity to be used in international conservation work. This will ensure the best possible foundation for future management in Greenland that is based on sustainable utilisation and protection of the Arctic environment.

Parameters such as migration routes, area utilization and core habitats may also change in line with anticipated changes in climate and ice conditions. Further analysis could lead to more accurate identification of problem areas and to possible future changes. Identifying these areas and estimates of future changes will be of great importance for the implementation of necessary adjustments to ensure sustained and effective protection of nature and the environment.

As regards environmental pressures and impacts, it remains necessary to ensure the monitoring and study of, for example, persistent organic pollutants (POPs), mercury, oil, particulates and other pollution to which the Arctic populations and ecosystems are exposed. Many years of continuous data collection of environmental impacts in the area provides important in-

formation both about the effect of existing international agreements on the reduction of long-range transboundary pollutants and information for use in future environmental work in the EU and other international fora. The impact of local pollution in the Arctic region has so far been minimal. One consequence of these environmental challenges is that it is necessary to ensure that future monitoring is conducted in a way that assesses all threats and impacts in the Arctic in an integrated way.

Efforts are to be focused on the national implementation of international agreements entered into on nature and the environment, and on safeguarding the marine environment against pollution for example by enhancing maritime safety. In doing this, it is essential that the highest international environmental standards are employed in the harvesting of resources in the Arctic, and that due to the special navigational conditions, the best possible prevention of maritime accidents in the Arctic and possible pollution that results can be ensured.

- Nature and the environment must be managed based on the best possible knowledge base. This is ensured through a long term monitoring and systematic collating of research findings. The protection of biodiversity under international standards must be enhanced by identifying important and ecologically sensitive areas.

- Efforts will be made to ensure the rights of the Arctic countries and access to the exploration and utilisation of biological resources in the Arctic, since the Kingdom is especially interested in protecting and utilising the genetic and biological resources in the Arctic under the Convention on Biological Diversity.

- The continued monitoring of long-range transboundary pollutants and their impact on ecosystems and humans in the Arctic must continue. Likewise, continued monitoring and also the prioritization of monitoring species and ecosystems must be assured. Furthermore, it is important to do an overall assessment and monitoring of all the threats to and impacts on the Arctic for the protection of nature and the environment.

- The most recent knowledge about pollutants in the Arctic is to be made available and applied proactively. Focus must be enhanced on the use of available information in international fora relating to global negotiations of agreements such as the UNEP's global mercury convention and the Stockholm Convention and other relevant agreements on persistent organic pollutants.

- Prevention of marine pollution in the Arctic must be reinforced. This includes better international sharing of knowledge and experience on preventative steps and cooperation, especially in the Arctic Council and the IMO on joint prevention measures.

- The Kingdom will participate in protecting the marine environment as soon as possible by implementing and ratifying the HNS Protocol on compensation and liability for damages arising from hazardous and noxious substances, and also the Ballast Water Convention which will help in protecting the marine environment from invasive species.

- Moreover, towards 2014, the Kingdom will carry out a risk-analysis of the maritime environment in and around Greenland, including the risk of oil and chemical contamination caused by the expected expansion in traffic and activity in the area. Based on the risk analysis, the Kingdom will assess to what extent it may be useful to strengthen the protection of the maritime environment in the Arctic. Possible initiatives could include increased international sharing of knowledge and experience on pollution control, enhanced preparedness for the prediction of drifting oil spills and strengthened international cooperation on maritime emergency preparedness.

ARCTIC ENVIRONMENT MINISTERS MEETING IN JUNE 2010

In June 2010, an Arctic Environment Ministers meeting was held in Ilulissat in Greenland with the Danish Minister for the Environment and the Member of Naalakersuisu for the Environment and Nature as hosts. Following up on the meeting, the Kingdom started work on identifying vulnerable marine areas and is looking at ways to protect them against the effects of shipping. Twelve vulnerable marine areas around Greenland have been identified, and it was decided that 6 of these must be investigated more closely. The work will initially focus on three high-priority fragile marine areas, namely:

1) Nordvandspolyniet (off Northwestern Greenland),
2) Disko Bay and Big Halibut Bank (West Greenland) and
3) Ittoqqortoormii (Scoresby Sound) and surrounding areas (East Greenland).

GREENLAND ECOSYSTEM MONITORING

The Arctic is characterized by a harsh climate with extreme light and temperature conditions, short summers and snow and ice cover in winters. The ecosystems and the species that live in the Arctic have had to adapt to these extreme conditions and high natural variability from year to year. Knowledge of how Arctic ecosystems function, how the systems affect the surroundings, what year-on-year variation in, for example, weather conditions means and how systems alter as a consequence of climate change requires large-scale study programs over long periods. At the Zackenberg research station and a similar station in Kobbefjord near Nuuk, multidisciplinary studies and research are being conducted that help to illuminate the workings of the Arctic's ecosystem and its development. For example, changes in biodiversity, the system's intake / release of greenhouse gases and their resilience in the light of climatic development. Together, the two programs are called the Greenland Ecosystem Monitoring and are carried out in collaboration between Greenland and Danish academic and research institutions, including ASIAQ, Greenland Climate Research Centre, the Greenland Institute of Natural Resources, University of Copenhagen, Geological Survey of Denmark and Greenland, and Aarhus University.

GREENLAND ENVIRONMENTAL ATLAS OF AREAS PARTICULARLY SENSITIVE TO OIL SPILLS

Commissioned by the BMP in Greenland, the Danish Environmental Research Institute has developed an Environmental Atlas which is an atlas of Greenland marine areas and fjords that are particularly sensitive to oil spills. The atlas enables oil companies and the Greenland Self-Government to ensure the best possible emergency preparedness in case of an oil spill in order to mitigate damage to nature and the environment.

The atlas forms an essential part of the overall preparedness that is being established in connection with oil exploration. It contains information about the local wildlife, local fishing and hunting interests and archaeological sites that are especially sensitive to potential oil spills. In addition, the atlas contains data on the physical environment - such as coastal types, oceanography - logistics and ways to control oil pollution. The atlas covers the entire area from Cape Farewell (60 ° N) in the south to the southern part of the Upernavik area (72 ° N).

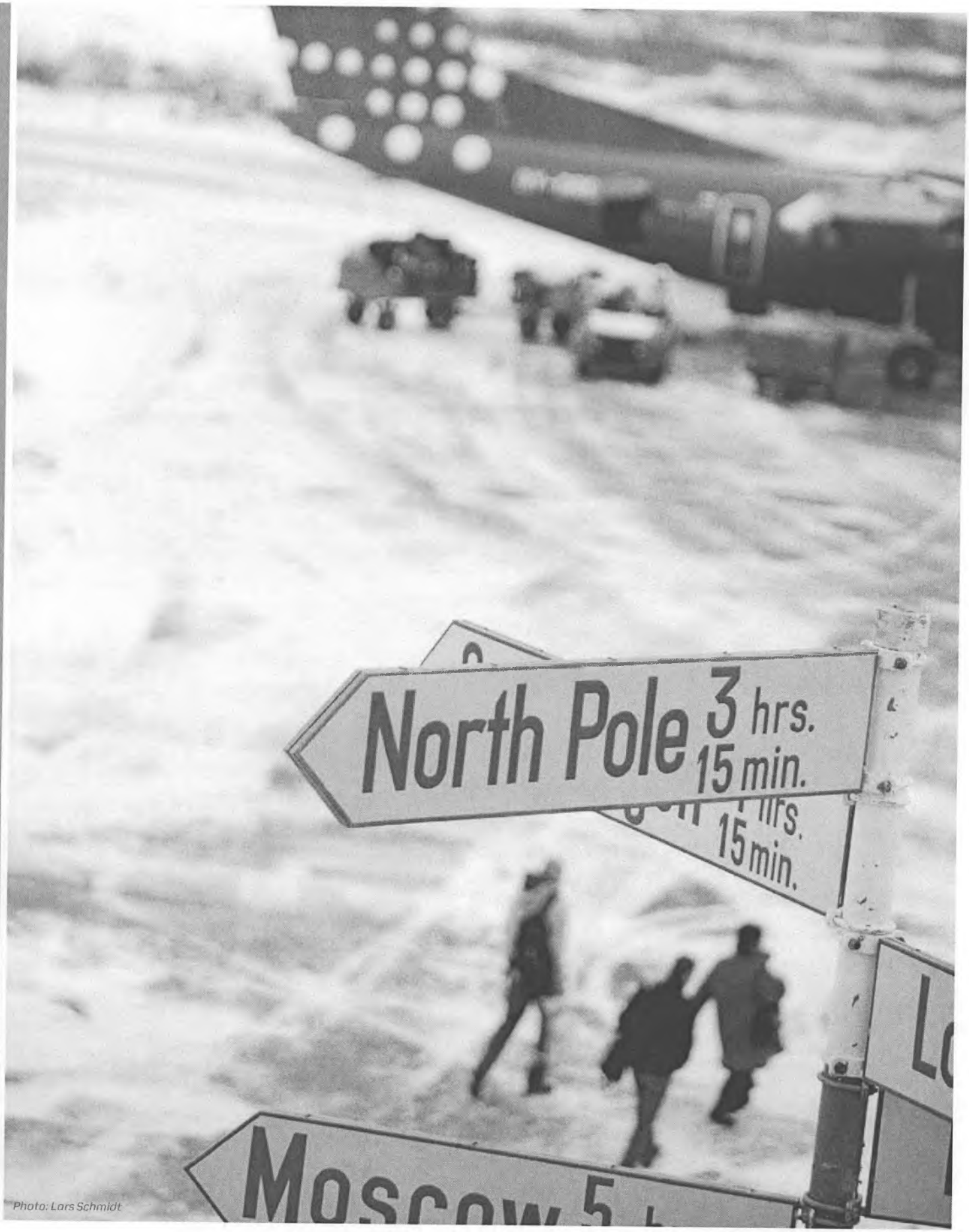


Photo: Lars Schmidt

5. Close cooperation with our international partners

- The Kingdom will prioritize global cooperation relevant to the Arctic, including, in particular, an ambitious focus on climate change, protection of nature and the environment, strict global maritime rules, and continue giving high priority to indigenous peoples' rights.
- The Kingdom will enhance cooperation in the Arctic Council. Cooperation with the EU is to be promoted and the Arctic to be given more weight in the Nordic context. "Arctic 5" is an essential complementary regional forum for the coastal states of the Arctic Ocean.
- To optimise the safeguarding of interests, the Kingdom will upgrade bilateral cooperation and dialogue regarding the Arctic, both with established and new partners.

International interest in the Arctic will continue to rise in coming years. A growing number of states, corporations, civil society organizations and international organizations will engage themselves in the region. This requires a solid and effective regional and global cooperation that constantly adapts to new opportunities and conditions. It is natural that the Kingdom plays a key role in shaping the future international architecture of the Arctic. Many international agreements and cooperation fora are relevant to the Arctic and whose interests require active safeguarding by the Kingdom. For example, this concerns world trade within the WTO, environmental and nature conservation within UNEP, in research, health, and in security and defence matters in NATO among others.

The Kingdom's Arctic strategy will form the basis of our cooperation with international partners on the Arctic and Arctic issues. A number of themes and organizations discussed in this chapter will make up the Kingdom's strategic priorities in foreign policy on the Arctic. The point of departure will be that today we have the requisite international legal basis and that the Arctic continues to be a region of cooperation. In particular, we will build on the Kingdom's firm tradition of cooperation with our Arctic neighbours, in parallel to the prioritising of other relevant collaborations globally, regionally and bilaterally.

5.1. GLOBAL SOLUTIONS TO GLOBAL CHALLENGES

The Kingdom will pursue a vigorous and ambitious climate policy to tackle the challenges that climate change poses in the Arctic and other vulnerable regions. The Kingdom's climate policy stems from the UN's Climate Change Convention (UNFCCC), whose goal is to stabilize atmospheric greenhouse gases at a level that prevents climate change that is dangerous to humanity. In negotiations on a future global climate agreement, the Kingdom continues to work towards achieving the common objective of limiting global temperature increases to a maximum of 2 degrees above pre-industrial levels.

Denmark shares the EU's ambition of reducing total global greenhouse gas emissions by at least 50% in 2050 compared to 1990, as well as reductions for the industrialized countries of 25-40% and 80-95% in 2020 and 2050, respectively - both compared to 1990. The target requires that sufficient global reductions in greenhouse gas emissions are achieved in the short and longer term. The government's ambition is that Denmark should become independent of fossil fuels by 2050 and that Denmark's binding renewable energy target under the EU in 2020 is 30 percent.

Greenland aims to reduce greenhouse gas emissions by 5% in the period 2013-2020 for the society, as it looks today, and as regards energy supplies that at least 60% of total energy production in civil society must be based on renewable energy by 2020. Activities within the minerals and hydrocarbons sector that are currently being developed, are not covered by the reduction of emission goals, but will be developed in accordance with international principles of sustainability.

Faroese climate policy, which involves a reduction of greenhouse gas emissions of at least 20% by 2020 compared to 2005, will entail that 75% of electricity production must be based on renewable energy by 2020. The effects of climate change are already being felt, and the Kingdom underlines the importance that adaptation measures are carried out in order to mitigate the already unavoidable climate impacts.

- The Kingdom will work towards the conclusion of an ambitious global climate agreement that includes reduction commitments and actions which, in accordance with current and future assessments of the UN's climate panel, are consistent in keeping the global temperature rise to a maximum of 2 degrees above pre-industrial levels.
- The Kingdom will continue, for example, through the Arctic Council, to contribute with knowledge and information inputs on Arctic climate change to the relevant international forums in which a global climate agreement under the UNFCCC is to be promoted. This also includes the need for climate change adaptation initiatives in the Arctic.

The Kingdom's global policy on nature and the environment in relation to the Arctic is particularly focused on the Convention on Biological Diversity and the Ramsar Convention on Wetlands of International Importance. Denmark, the Faroe Islands and Greenland have a long tradition of working together in global fora such as the Ramsar and Biodiversity Convention. The aim is to promote the protection and sustainable harnessing of the Earth's biological diversity and to ensure regeneration and preservation of the ecosystem services that underpins communities and well-being. Under the Biodiversity Convention of October 2010 in Nagoya, Japan, three important agreements were adopted to preserve biodiversity globally. The agreement contains the Nagoya protocol on access to genetic resources and benefit-sharing (ABS), the Strategic Plan for Biodiversity 2011-2020, and the Resource Mobilization Strategy.

Furthermore, reaching a global mercury agreement has long been a priority of the Kingdom. Mercury is a toxic heavy metal that accumulates in the food chain. In the Arctic region especially, mercury is a threat to public health since local and traditional diet such as seal, whale, sea birds and eggs can contain high levels of mercury. Under the auspices of the Arctic Council, there is particular focus on monitoring the levels and effects of mercury, and these findings are a part of the basis of global negotiations.

- The Kingdom will work to ensure that the 20 intermediate objectives of the strategic plan under the Biodiversity Convention are implemented focusing on problem areas of particular relevance to the Faroe Islands and Greenland. The Kingdom will bolster the knowledge base for the international protection and sustainable use of biodiversity and ecosystem services among others through The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Global Biodiversity Information Facility (GBIF).
- The Kingdom will work in relevant global fora in order to reduce pollutants brought by sea and air to the Arctic. The Kingdom will work for a globally binding mercury agreement under the auspices of UNEP and work to strengthen existing chemical agreements such as the Stockholm Convention on persistent organic pollutants and the LTRAP protocol.

Greenland and Denmark have a tradition of close and constructive cooperation in ameliorating the conditions of the world's **indigenous peoples**. Indigenous peoples are in some situations particularly exposed to human rights violations when new challenges arise, such as climate change. To the extent that their rights are recognized, which in itself has been difficult at times, one of the major challenges is to ensure respect for and observation of these rights. Denmark and Greenland possess experience and historical background, giving them sound credentials to work together to promote indigenous peoples' rights. The effort has resulted in the UN, at the initiative of Denmark and Greenland, having established a Permanent Forum on Indigenous Issues which has functioned since 2002.

This forum has already proved its worth as a venue for governments and representatives of indigenous peoples worldwide and is the only forum where individuals and groups of indigenous peoples are

represented. The forum actively seeks to raise awareness of the situation of indigenous peoples within the UN system. Moreover, Denmark and Greenland have also actively participated in negotiations on the UN Declaration on the Rights of Indigenous Peoples, adopted in 2007. The Declaration is an important starting point for future work in ensuring the rights of indigenous peoples and their survival through respect for their culture, language and way of life.

- The Kingdom will promote and protect indigenous peoples' rights. Denmark / Greenland are working to ensure that the principles outlined in the UN Declaration on the Rights of Indigenous Peoples of 2007 are carried out in practice.

- Denmark and Greenland also support the work being done by the UN special rapporteur for indigenous peoples, while also working to ensure that the Expert Mechanism on Indigenous Peoples' Rights (EMRIP) under the UN's Human Rights Council contributes positively to promote and protect indigenous peoples' rights.

UN International Maritime Organization (IMO) is the UN's specialised agency for maritime safety and security of international shipping and the prevention of pollution by ships. The IMO has 169 members, including Denmark, and 3 associate members, including the Faroe Islands. The IMO is absolutely critical to the global establishment of technical requirements of ships to avoid distortion in the world's free trade. It is a fundamental principle of the IMO that ships must be treated equally, whichever flag they fly.

The IMO is working to introduce the highest possible standards for health, safety and environment. Only by establishing global requirements can it be ensured that safety standards are not compromised. In recent years there has been a particular focus on the environmental agenda in the IMO, including the protection of sensitive marine areas, increased regulation of oil transportation, requirements of the ships' fuel and emissions, and not least the climate change agenda. In these areas, the Kingdom is playing a significant role in ensuring the creation of solutions that benefit both the environment and shipping.

- The Kingdom will ensure in the IMO that the Arctic and Greenland conditions are taken into account in the IMO's work and decisions regarding development opportunities for the maritime industry, increased maritime safety, protection of the marine environment and coastal zone, and also reduced emissions of greenhouse gases and reduction of air pollution.

DANISH / GREENLAND CONTRIBUTION TO INDIGENOUS PEOPLES' RIGHTS

Greenland and Denmark have for many years worked closely to promote indigenous peoples' rights. Denmark's first strategy in 1994 to support indigenous peoples was prepared based on a Danish / Greenland initiative, and just working with Greenland has helped to give Denmark a high international profile in the field.

Denmark and Greenland have historically been active in a number of relevant international forums where indigenous peoples' rights are discussed. These include the annual sessions of the UN Permanent Forum on Indigenous Issues, which was also created on a Danish/ Greenland initiative and the UN Expert Mechanism on Indigenous Peoples' Rights (EMRIP). Denmark / Greenland were also important players in the adoption of the UN Declaration on the Rights of Indigenous Peoples.

The establishment of the Self-Government arrangement for Greenland in 2009 is an illustration of Denmark's implementation of the UN Declaration. Finally, Denmark/ Greenland participates actively in negotiations in the UN Human Rights Council and General Assembly, among others, on resolutions relating to indigenous peoples' rights.

In 2011, a review of Denmark's strategy for support to indigenous peoples was finalised. The review concludes that the Danish / Greenland cooperation has led to groundbreaking institutional results and to improved living conditions for indigenous people.

5.2 ENHANCED REGIONAL COOPERATION

It is a central goal of the Kingdom to strengthen cooperation in the Arctic Council. As the only organization that has all 8 Arctic states as members and additionally 6 organizations of indigenous peoples as equal partners, the Arctic Council is the primary organ for concrete cooperation in the Arctic. The Council's work originates from collaboration on environmental issues, but over time has been extended, for example, to include sustainable development and the populations' living conditions. Recently, the Arctic Council has been instrumental in the development of a binding agreement between the 8 members on search and rescue (SAR) with the Faroe Islands and Greenland as "co-signatories," which is needed because of the increased access to areas that were previously covered by ice.

The Kingdom wants to ensure a future - oriented Arctic Council, i.e. that the Council has an increasingly direct impact on the Arctic peoples. The Arctic Council must evolve from a 'decision-shaping' to a 'decision-making' organisation. The Council's function as an instrument exerting influence on nation states and international organizations should be reinforced, and where feasible, the possibility of real decision-making ought to be developed. It is also important to ensure cooperation with all countries and organizations that are of importance to the Arctic and can contribute to cooperation within the Council. During the chairmanship of the Arctic Council 2009-2011, the Kingdom has worked for a strengthening of the Council including the establishment of a permanent, jointly-funded secretariat and the admission of new permanent observers.

- The Arctic Council must be reinforced as the only relevant political organization that has all Arctic states and peoples as members. At the same time the Arctic Council must cooperate with all relevant countries and organizations with interest in the Arctic. The Kingdom will emphasize that the human dimension, i.e. people's living conditions and well-being, is given increasingly more space in cooperation.

The Kingdom will retain the **"Arctic 5"** format consisting of the coastal states of the Arctic Ocean - Canada, Denmark / Greenland, Norway, Russia and the US - as a forum for issues primarily relevant for the five coastal states, currently the continental shelf issue. All three parts of the Realm are participating in the continental shelf issue while the Faroe Islands is ensured continued opportunity for scrutiny of any other activities in this forum. **"Arctic 5"** have met twice at ministerial level in 2008 and 2010, and in some cases at departmental level. Common to these meetings was that they concerned matters relating primarily to these coastal states.

- The Kingdom will promote its Arctic strategy in all relevant meeting formats, including any future meetings under "Arctic 5" auspices concerning specific action on joint issues.

Based on the European Commission's communication of November 2008, the European Union (EU) adopted in December 2008 and December 2009 the Council's conclusions on the Arctic and the European Parliament adopted in early 2011 a report on a sustainable EU policy for the Arctic. Both the Council's conclusions and the report are an expression of the growing interest that the EU has for the Arctic. Thus, the ground has been prepared for the EU to develop an overall Arctic strategy. The EU currently has interests in the Arctic in the form of, among others, research and fisheries and has indirect influence on the Arctic through e.g. its environmental laws. Furthermore, the EU and its member countries have interests in transportation and access in order to benefit from natural resources in the Arctic, including oil, gas and minerals and critical metals such as rare earth elements.

Denmark, the Faroe Islands and Greenland work to ensure a broad and close partnership with the EU. It will be in the Kingdom's interest to leave its mark on the shaping and implementation of EU policies, for example, in energy, climate, fishing, hunting, exploitation of minerals and the relationship to the populations and indigenous peoples in the Arctic. For the parts of the Kingdom that are not in the EU it will be of interest to participate in relevant EU programs where desirable and possible. Furthermore, it will be important that the EU's involvement in the Arctic takes place on the Arctic populations' own terms. We must seek to avoid further cases where the laws, traditions, cultures and needs of Arctic societies are neglected, as for example in the EU's ban on the import of seal products.

It is of particular importance to promote good relations between Greenland and the EU and expand the cooperative relations which exist between the parties involved. In addition to this, endeavours must be made to make the Faroe Islands more visible to the EU as part of the Arctic cooperation. The Kingdom will work to ensure that the EU has a place in the Arctic, including in relevant institutions such as the Arctic Council where the Kingdom supports the EU's wish for observer status.

- The Kingdom will actively contribute to the shaping of EU policies relevant to the Arctic and Arctic challenges, and in this context seeks to ensure the Arctic peoples' rights and interests. The Kingdom will contribute towards the EU having a space in international discussions on the Arctic.

- The Kingdom collectively and each part of the Danish Realm will advance the

development of cooperative relations between the EU and Greenland and the Faroe Islands, respectively.

The Nordic Council of Ministers has allocated a grant for collaborative projects concerning the Arctic region and contributes financially to the Arctic Council's work. In addition, a number of collaborative projects of Arctic relevance are being carried out in the Nordic Council of Ministers' various ministerial councils. The Kingdom wants the Arctic aspect of the Nordic Council of Ministers' work both directly and through ministerial councils to be given greater weight, both politically and financially.

- The Kingdom will promote the Arctic as a cross-disciplinary focus area of the Nordic Council of Ministers' work.

Important cooperation in and about the Arctic is being undertaken in a wide range of organizations other than the above-mentioned, for example through **NORA**, the Nordic Atlantic Cooperation (Faroe Islands, Greenland, Iceland and coastal Norway), **West Nordic Cooperation** (Iceland, the Faroe Islands and Greenland) and in **sector organizations**, such as NAMMCO (North Atlantic Marine Mammal Commission - consisting of Iceland, Norway, Greenland and Faroe Islands). To this must be added organizations that cover fishery, environmental or scientific interests.

- The Kingdom will seek to promote cooperation in and around the Arctic in the range of organizations representing regional or sector-organized interests, especially NORA, West Nordic cooperation and NAMMCO.

FACTS ABOUT THE ARCTIC COUNCIL

On the initiative of the Finnish government, officials met from the eight Arctic states (Canada, Russia, USA and the five Nordic countries) in Rovaniemi in 1989 to discuss cooperation and measures to protect the Arctic environment. This led to the adoption of the ***Arctic Environmental Protection Strategy*** (AEPS) in 1991. At the AEPS Ministerial Meeting in 1993 in Nuuk, the participating category of "Permanent Participants" was introduced covering the Arctic indigenous peoples. In 1996, cooperation was expanded in the setting up of the Arctic Council in Ottawa, Canada, from a narrow environmental focus to a broad program covering all aspects of sustainable development. With this, the focus was expanded from a solely environmental one to include more general living conditions of peoples in the Arctic. Arctic Council members include, besides the eight Arctic States, six organizations representing indigenous peoples in the Arctic, the so-called permanent participants. Moreover, a large number of countries and organizations participate as observers. The Arctic Council's traditional driving force has been the Council's six working groups that monitor developments in the Arctic on various parameters and prepare scientific reports with expertise, recommendations and suggestions for follow-up in the Arctic Council and other international bodies.

The Danish Kingdom's chairmanship of the Arctic Council in 2009-2011 was an important priority for Denmark, Greenland and the Faroe Islands. The Foreign Ministers meeting hosted by Denmark / Greenland in Nuuk in May 2011 was in terms of substance the most weighty and with the greatest ministerial participation in the Arctic Council's history. At the meeting the Nuuk Declaration was adopted, which among other things determines the role and criteria for admission of new observers, establishes a permanent secretariat for the Arctic Council in Tromsø in Norway, sets up a task force to develop an instrument for preventing and managing potential oil spills in the Arctic and mandates an enhanced communication effort for the Arctic Council. Furthermore, the ministers signed an agreement on search and rescue in the Arctic (SAR), which as the first legally binding agreement under the auspices of the Arctic Council adds a new dimension to the Council's work and bodes well for strong future cooperation in the Arctic region.

THULE - FUTURE ARCTIC HUB AND COLLABORATION PLATFORM?

The melting of the polar icecap and the consequent increased activity in the Arctic will lead to greater need for the presence of and entail more tasks for the armed forces in the area around northern and north-western Greenland. Under the defence agreement of 2010-2014, the armed forces is carrying out a streamlining of the North Atlantic operational command structure (see section 2.3), and in the course of the duration of the agreement it must be considered whether the Thule base may play a larger role in regard to the tasks of the armed forces in and around Greenland in cooperation with other partner countries. Thule Air Base is, with its deep water port, airport and well-developed infrastructure (including tank and storage capacity, workshop, hospital, quarters, support and office facilities), a unique capability in the Arctic region north of the Arctic Circle.

There is thus already an existing opportunity to provide the logistical prerequisites for increased presence in the area around the northerly and north-westerly Greenland. Furthermore, Thule Air Base has the potential to become a broader platform for supporting the collaborative intentions of the Illulisat Declaration of 2008 between the 5 coastal states in the Arctic Ocean. Collaboration on the logistical facilities in Thule could thus eventually include assignments and emergency preparedness in relation to the maritime environment, a base for exercises in connection to joint procedures such as search and rescue services, and also be a platform for joint research in the Arctic.

5.3. BILATERAL SAFEGUARDING OF THE KINGDOM'S INTERESTS

The rapid changes and the increasing importance of the Arctic where new opportunities and challenges are constantly arising and a number of new actors are registering their interest in the region, requires that we also make a gear-shift in bilateral safeguarding of the Kingdom's interests in the Arctic. We will also work closely on a bilateral basis with all our partners. The bilateral cooperation is also a good platform to promote multilateral initiatives in the Arctic, of which the continental shelf project is a good example.

Canada, USA, Norway and **Iceland** will remain key partners for close cooperation in areas such as the exploitation of resources, maritime safety, climate and environment, indigenous peoples, research, education, health and defence. Furthermore, we will maintain close contact with **Finland** and **Sweden** on Arctic issues.

In addition, the Kingdom also wants to further expand and develop cooperation with **Russia**, which has been increasingly engaged in international cooperation in the Arctic. For example, under the auspices of the Danish-Russian governing council, there is great mutual interest in closer cooperation on strengthening the safety of navigation in Arctic waters. Enhanced cooperation with Russia could also incorporate scientific collaboration, for example, on the continental shelf. It could also include the exchange of findings on economically, socially and environmentally sustainable development, as well as confidence building and studies on potential cooperation between the Danish and Russian defence, particularly in the maritime area.

Beyond the Arctic states, other legitimate stakeholders also have increasing interests in the Arctic. These interests are particularly linked to research on climate change, new international transportation opportunities, as well as opportunities to profit from the exploitation of supply-related energy and mineral resources in the Arctic. Among these stakeholders is the EU, but also the three **Northeast Asian countries**, China, Japan and South Korea. Both China and South Korea have significantly increased their research-related engagement in the Arctic, including the construction of icebreakers and the establishment of permanent research stations on Svalbard.

It is encouraging that the three Northeast Asian countries are joining the consensus among the coastal States that the United Nations Convention on the Law of the Sea must be the central foundation for the legal regulation in the Arctic. The Kingdom supports their respective wishes for observer status in the Arctic Council. Bilateral dialogues have also been established, especially on maritime law issues such as claims on the continental shelf in the Arctic region and unresolved boundary issues. Furthermore, special collaborative projects have been set up, for example between the University of Copenhagen and a number of Chinese universities within natural science, and a budding collaboration between the Danish Technical University and Harbin Institute of Technology on Arctic technology.

Global interest in the Arctic will inevitably increase even more in the coming years.

More countries will want to gain insight into and influence on international cooperation in the Arctic as its strategic, economic and energy-related potential becomes clearer. Here the Kingdom can play a major role in promoting an open and inclusive dialogue in bilateral relations. The Kingdom will strengthen the dialogue with new stakeholders in the Arctic and benefit from the resources and expertise that they bring along through cooperation in commerce and R & D. Alongside this, the new actors will be integrated into the norms and values that the Kingdom and other coastal states in the Arctic Ocean believe should apply to the Arctic.

- In order to efficiently pursue the Arctic strategy's diversified goals and interests, the Kingdom will develop close bilateral partnerships with our Arctic neighbours. As a major actor in the Arctic, the Kingdom will play a part in fostering new bilateral collaborations and dialogues on opportunities and challenges in the region.

JOINT COMMITTEE COOPERATION WITH THE USA

Joint Committee cooperation between Greenland, Denmark and the U.S. arose from the Igaliku Agreement, signed in 2004 by then U.S. Secretary of State Colin Powell, then Minister for Finance and Foreign Affairs Josef Motzfeldt and then Danish Foreign Minister Per Stig Moeller in the South Greenland village of Igaliku. The Igaliku Agreement consists of three parts:

- An agreement on the update of the defence agreement of 1951 and the establishment of an advisory group hereto (Permanent Committee)
- A joint statement on cooperation regarding environmental issues at Pituffik (the U.S. base at Thule)
- An agreement on technical and economic cooperation (Joint Committee cooperation)

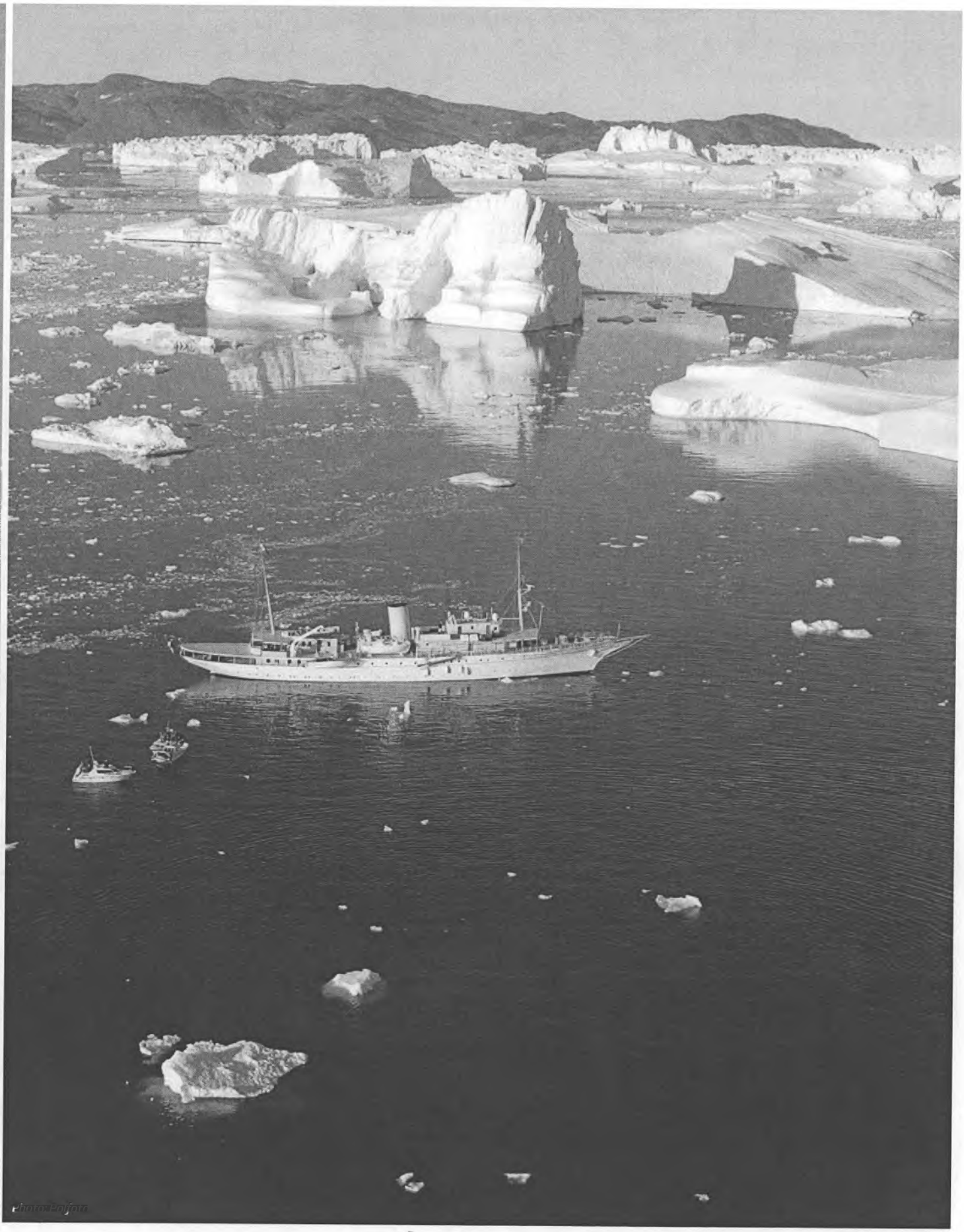
The Joint Committee is a tripartite forum for Greenland, USA and Denmark which aims to strengthen and promote economic and technical cooperation between Greenland and the U.S. with special focus on research, health, technology, education, culture and tourism.

CLOSE COLLABORATION WITH CANADA

Denmark / Greenland, as part of the ***Continental Shelf Project*** in 2002, collected data in three areas north of Greenland. These collections have been conducted in close collaboration with among others Canada, and the close cooperation has led to very successful measurements. In mid-2010 it was decided to intensify the bilateral technical cooperation via the establishment of a joint task force which among other things must explore ways to coordinate submissions of claims to the Commission for Continental Shelf Limits (CLCS).

In May 2010 Denmark and Canada signed a bilateral Memorandum of Understanding (MoU) on enhanced operational defence cooperation in the Arctic, focusing on joint military exercises, staff exchanges and cooperation in rescue operations. The agreement serves as a catalyst for intensifying day-to-day collaboration between Greenland's Command, Joint Task Force North in Yellowknife and MARLANT Maritime Forces Atlantic in Halifax. It is expected that close Danish - Canadian military cooperation will be further enhanced over the coming years partly via mutual exchange of findings in survival techniques in the Arctic, patrolling and surveillance and partly via continued participation in joint military exercises.

As a direct consequence of the oil disaster in Louisiana, the Greenland Bureau of Minerals and Petroleum and the National Energy Board of Canada, which are responsible for determining the respective regulations for Greenland and Canadian exploitation of ***oil and natural gas*** in the Arctic, entered into a bilateral agreement in 2010. The agreement formalises cooperation between the two authorities on information exchange of regulatory policy, specific oil and natural gas drilling and the overall development of their respective energy markets. The agreement specifies that the parties will meet at regular intervals. Similarly, it paves the way for the exchange of personnel, the carrying out of joint emergency exercises, building up of a joint emergency response, and that henceforth data and reports are shared. The formalized collaboration is a big step forward as both Greenland and Canada will obtain prior knowledge of initiatives which due to their geographical proximity will affect the counterpart. Furthermore, Denmark and Canada are party to the CANDEN-agreement on environmental cooperation, which ensures information exchange in case of oil spills and marine pollution, among other things.



6. Implementation and follow-up

- In order to ensure effective implementation, a steering committee is to be set up for the Kingdom's Arctic strategy, reinforced foreign policy coordination and cooperation, and intensified public diplomacy / public relations work regarding the Arctic.

The Kingdom's strategy for the Arctic marks an important milestone towards 2020 and beyond and aims to contribute to a sound foundation for positive development in the Arctic into the future. The Kingdom consists of three societies, each with their own political priorities and social structures. Therefore, the strategy's implementation in each individual area will be adjusted to each part of the Realm's unique legislation, political priorities and budget issues.

The Kingdom's Arctic strategy falls within the existing division of competences and responsibilities between the State and Greenland's Self-Government, and the State and the Government of the Faroes.

A chief aim of the Arctic strategy is to promote information exchange and coordination of efforts in all areas related to development in the Arctic, and thereby to obtain a clearer focus on common priorities and promote collaboration internally and externally where there is mutual interest. The strategy will thus provide the framework for Arctic-related activities of the Kingdom and the three parts of the Realm towards 2020.

A number of measures will be initiated immediately to ensure the effective implementation of the strategy:

- A cross-disciplinary Steering Committee is to be established for the Arctic Strategy, consisting of representatives of the government (ministries with Arctic activities), the Government of Greenland and the Government of the Faroes at high level. The steering committee is to meet on a biannual basis as a minimum. The Ministry of Foreign Affairs will serve as chairman and secretariat of the steering committee in close collaboration with the Government of Greenland and the Government of the Faroes and the Prime Minister's Office. In order to promote the coordination of activities and safeguarding of the Kingdom's interests in the Arctic, the Foreign Ministry will appoint a special Representative for the Arctic.
- In collaboration between the Government, the Government of Greenland and the Government of the Faroes concrete efforts are to be initiated to bolster foreign and security policy coordination and cooperation with regard to the Arctic. In addition to the existing dialogue mechanisms (also at ministerial level) and the establishment of a cross-disciplinary platform qua steering committee for the Arctic strategy, elements could include enhanced dialogue regarding multilateral and global economic organizations and issues, more systematic cooperation through the network representation abroad, establishment of an exchange mechanism between the Department of Foreign Affairs in Nuuk and the Foreign Ministry in Copenhagen and also joint public diplomacy / advocacy efforts (see below).
- At the same time, the Arctic strategy represents an ambition for intensified and more systematic outreach efforts both in the three parts of the Realm and internationally, for example via the

representations abroad. This key endeavour, in the form of public diplomacy / advocacy initiatives such as seminars, cooperation with think tanks, etc., could focus on issues such as how climate change affects the Arctic, the Arctic as a region of cooperation, the new trade opportunities in the Arctic, the Kingdom's cultural and political diversity, international law and the Arctic, etc. The Foreign Ministry will allocate resources hereto.

The Foreign Ministry, on behalf of the Government and in cooperation with the Government of Greenland and the Government of the Faroes, will report annually on developments in the Arctic and the status of the Strategy's implementation. The aim is to carry out a mid-term evaluation of the Strategy in 2014-2015 and consider the preparation of a new strategy in 2018-2019.

PUBLISHERS

Ministry of Foreign Affairs
Asiatisk Plads 2
DK- 1448 Copenhagen K
Phone: + 45 3392 0000
Fax: +45 3254 0533
E-mail: um@um.dk
Internet: www.um.dk

Department of Foreign Affairs
Government of Greenland
Postbox 1340
3900 Nuuk
Greenland
Tel +299 345000
E-mail: nap@nanoq.gl
Web page: www.nanoq.gl

Ministry of Foreign Affairs
Government of the Faroes
Tinganes
FO-100 Torshavn, Faroes
Phone: +298 306100.
Email: mfa@mfa.fo
Internet: www.mfa.fo

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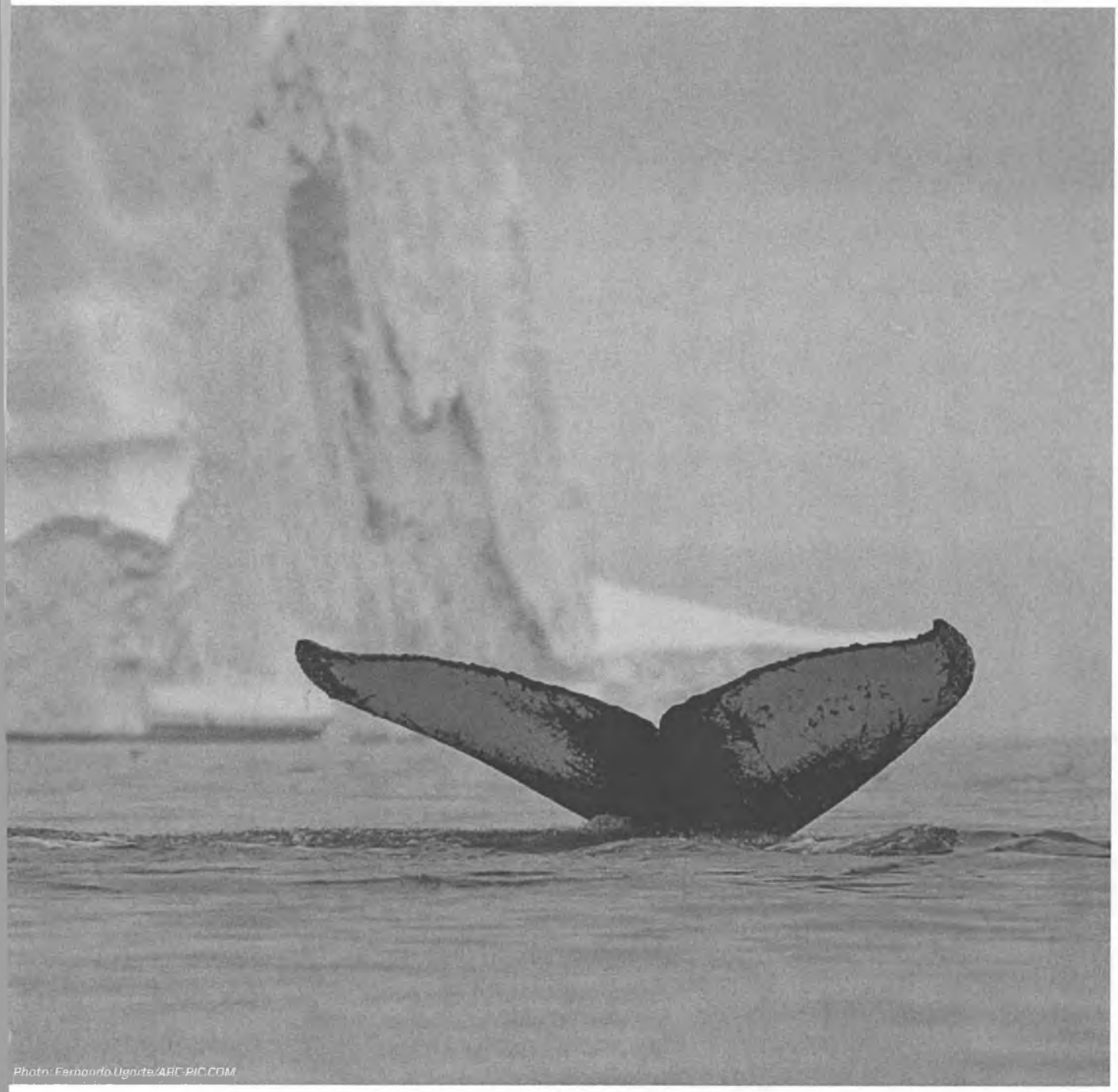

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Support Material (File 2)

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3

Research Documents

A.

Preliminary Build-out Plan for Alaska Ocean Observing System September 2011

National Federation of Regional Associations for Coastal and Ocean Observing

Alaska Ocean Observing System

INTEGRATED OCEAN OBSERVING SYSTEM

PRELIMINARY BUILD-OUT PLAN FOR

ALASKA OCEAN OBSERVING SYSTEM

SEPTEMBER 2011

THEMATIC ISSUES AND PRODUCTS

Introduction

Document organization: Guidance and directions for developing this build out plan were provided by the national Integrated Ocean Observing System (IOOS) and the National Federation of Regional Associations for Coastal and Ocean Observing (NFRA). Accordingly, each Regional Association develops a build out plan centered on four theme areas. The theme areas are: Marine Operations; Climate Variability and Change; Ecosystem, Fisheries and Water Quality; and Coastal Hazards. A fifth theme area was added for Integrated Products intended for issues that cross two or more of the original themes. For each theme area, the build out document identifies the important regional issue, priority products and services identified by regional stakeholders, and information requirements. The build out document is organized so that products within each major category can be compared among other Regional Associations. The AOOS plan describes only those major products that can be delivered by the end of the 10- year planning horizon (2021) and represents a "bare-bones" system rather than an "optimal" system.

Supplementary Material: Please refer to the following material for additional guidance:

- RA Build Out Guidance Document
- Terms and Definitions: Please refer to the Terms and Definitions Appendix in the Guidance Document

Geographic Regions, Areas, and Sites: For the purposes of this build out plan, AOOS will adopt a geographically nested design where each of Alaska's three ocean basins is considered a Region, each Region will have several Areas (Fig. 1), and each Area may have observation platforms at one or more Sites. In this document the Chukchi and Beaufort Seas are combined into the Arctic Ocean. Observations and products intended to address issues at the Regional scale are coarser than those developed to address issues at the Area scale. Fine scale observations (e.g. Sites) will generally inform larger scale issues (e.g. Areas). In some cases, thematic issues may be adequately addressed, in the context of available funding and resources, at the scale of a Region (e.g. ocean acidification, sea level rise, etc.). In other cases, the issue may only be relevant at the scale of Areas (e.g. coastal inundation, wave height, marine weather, etc.).

The National Weather Service already provides general weather and wave nowcasts and forecasts for all of Alaska. Similarly there are existing ocean circulation models for the North Pacific, Gulf of Alaska, Bering Sea, and Arctic Ocean. However, while a few of these models are quasi-operational, most are research-oriented. There are several observational platforms that serve the needs of Regional scale thematic issues such as the time series at GAK1 in the Gulf of Alaska and M2 in the Bering Sea for climate variability. However, stakeholder workshops in 2010 identified a need for more intensive observations and

forecasts of higher spatial resolution at the scale of Areas. Areas identified for more intensive observing and modeling efforts represent (1) relatively populated embayments and coastlines, (2) places of concern due to industrial activities,or (3) the need for more ecological understanding. The Areas are sized to be tractable for the deployment of atmospheric and oceanic instrumentation packages and for the development of higher resolution model domains based on lessons learned from the Prince William Sound demonstration. Over a 10-year AOOS build out to address the thematic issues and products, the nested design will provide coarser scale observations and forecasts for the Regions and more intensive observations and finer scale forecasts at a minimum of five Areas.

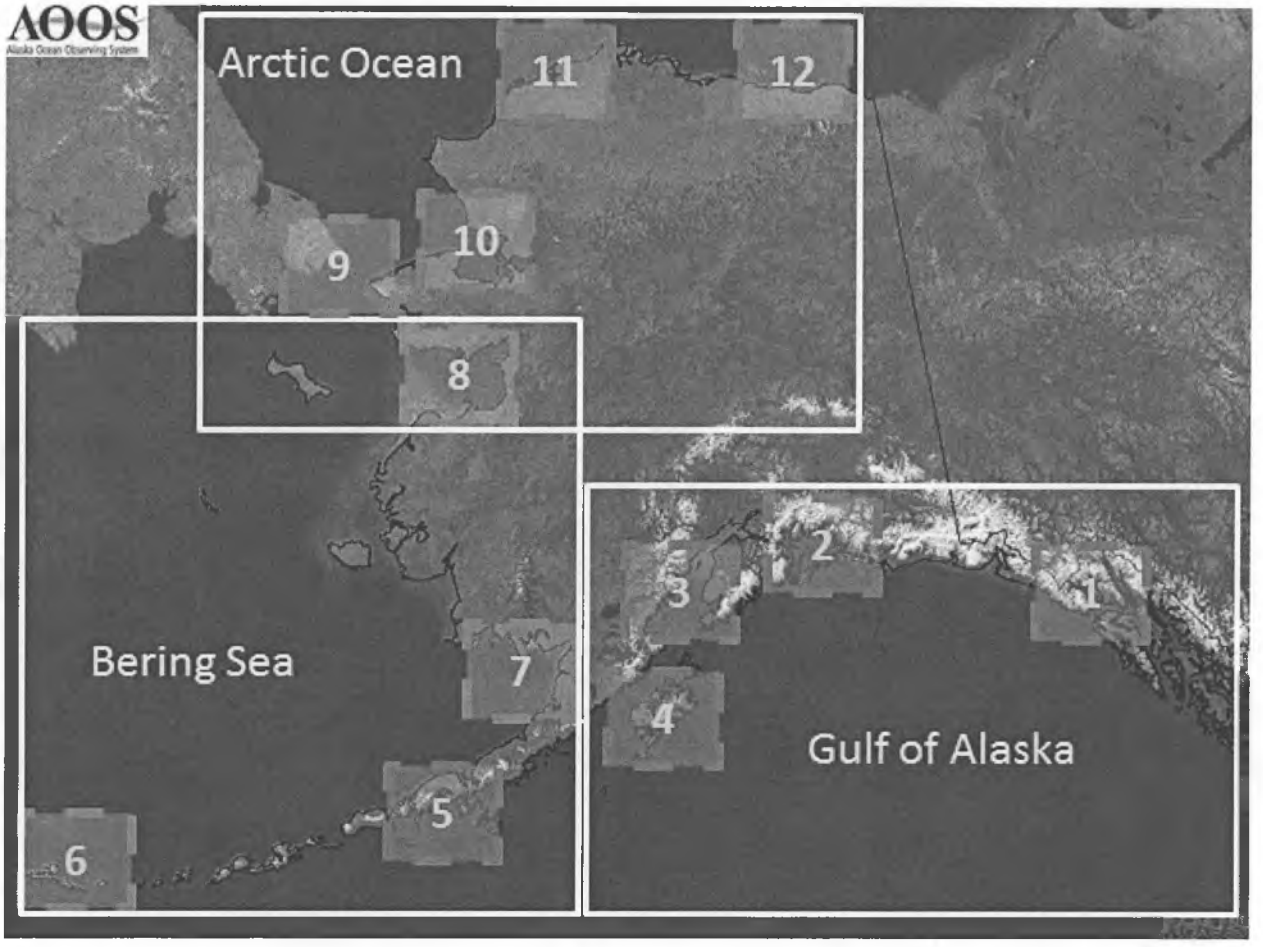

Figure 1. Areas of proposed intensive observing system development within each of the Alaska regions (Areas of existing emphasis are underlined): **Gulf of Alaska:** (1) Southeast, (2) Prince William Sound. (3) Cook Inlet, (4) Kodiak, (5) Unimak Pass; **Bering Sea**: (6) Adak/Western Aleutians, (7) Bristol Bay, (8) Norton Sound; and **Arctic Ocean**: (9) Bering Strait. (10) Kotzebue Sound, (11) Chukchi Sea. and (12) Beaufort Sea.

In each Region the build out will proceed with a prioritization of thematic issues. In some cases a thematic issue may already be adequately addressed at the Regional scale through products developed at the Data Management and Communications level with little or no additional infrastructure investment (e.g. climate variability and change, sustainable fisheries, ecosystem health, etc.). In other cases some limited infrastructure development may be needed to augment an existing effort (e.g. ocean acidification, harmful algal blooms, water quality, etc.). Several issues may only be addressed with considerable investment at the most intensive scale of observation and model resolution (e.g. real-time surface currents, forecasting storm surges, etc.).

In general, thematic issues at coarser Regional scales will be less costly to address and more tractable than those at finer Area scales. But several issues can only be addressed at the Area scale and the development steps will proceed from (1) identification (see Fig. 1) of an Area of focus (within one or more of the three Alaska Regions), (2) identify site(s) within an area for additional observations or weather (met stations, buoys, etc.), waves (e.g. wave buoys), and ocean conditions (e.g. buoys, moorings, routine glider deployments), (3) develop numerical simulations of actual conditions (nowcasts) and provide area specific forecasts using data assimilation techniques where practicable. Information products provided by these efforts will lead to developing additional decision support tools for coastal hazards (e.g. tsunami warning, coastal erosion, inundation, etc.), climate change and variability, and ecosystem assessments and management.

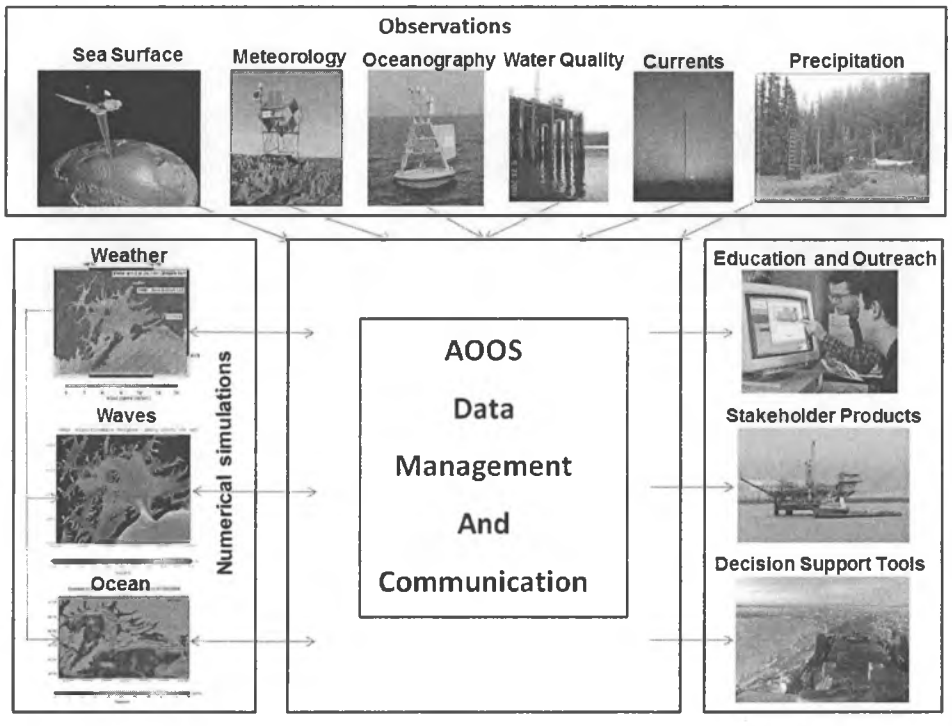

Figure 2. Conceptual strategy of the AOOS build out.

The AOOS advisory committees and Board will identify and select (respectively) successive or simultaneous build out areas based on annual budget allocations and stakeholder prioritization. A general strategy for the build out of AOOS is shown in Figure 2, where weather simulations are first developed based on weather observations, then ocean models are developed based on ocean observations and weather forecasts, etc. These observational and forecast components are conceptually described in this document. Every phase of development must have a data management and communication (DMAC) strategy (described elsewhere) so that all the observations are accessible to the computers running the models and to the public from the AOOS web site. The success of AOOS will, to some extent, depend on an integrated education and outreach (E&O) program (described separately).

1. Marine Operations

Issue 1.1 Safe and efficient commercial shipping and recreational boating.

Description of the issue: Many areas frequented by vessels in Alaska have no fine scale observations or forecasts of atmospheric or oceanic conditions, or cost effective communications for mariners to receive recent weather or wave and currents information.

Importance to the region: Alaska's maritime operations are diverse, spanning many government, industrial, and recreational user communities. The state is home to a $6 billion commercial fishing industry, offshore oil exploration in the Arctic as well as development and production in Cook Inlet, a Marine Highway System (ferries) serving otherwise isolated coastal communities in the Gulf of Alaska, cruise ships carrying a million passengers per year, and active charter and recreation fleets. AOOS hosted a workshop in May 2010 to discuss the important marine operations issues for Alaska. A summary and report of this workshop can be found at www.aoos.org/workshops-and-reports/.

Who are the impacted and targeted users: Stakeholders and interested organizations are represented by the University of Alaska Fairbanks, U.S. Coast Guard (Search and Rescue), Marine Exchange of Alaska (Vessel Tracking System), the Alaska Energy Authority (Tidal Energy), the U.S. BOEM (Offshore Oil Development), the Prince William Sound and Cook Inlet Citizens Advisory Councils (Oil Spill Response), the National Weather Service (Weather and Sea State), Alaska Association of Harbormasters and Port Administrators (Tsunami Warning), the Oil Spill Recovery Institute (Oil Spill Research), offshore oil and gas companies such as Shell and ConocoPhillips (Offshore Oil Production), the Southwest Pilot's Association (Risk Assessment), and commercial shipping interests (Insurance Risk).

1.1.1 PRODUCTS AND SERVICES: Weather and sea state conditions for mariners

Site-specific weather conditions (see Table 1) will be collected using a low cost meteorological sensor array measuring key IOOS atmospheric variables. This array may be similar to the standardized weather stations used by the NOAA NERRS in the System Wide Monitoring program or the experimental array at Cape St. Elias (http://denali.micro-specialties.com/CapeStElias/CSE%20Metadata.htm), although, depending on funds available, these could also be standard NWS weather stations or the SnoTel stations now used in Prince William Sound and Cook Inlet. The design will include, at a minimum, wind speed and direction, air temperature, and barometric pressure. Precipitation will also be an important variable in many areas. Some installations with immediate access to sufficient power supplies and internet bandwidth may be augmented with webcams for qualitative sea state and ice observations.

Once weather stations are deployed and observations are available, numerical models can be developed or expanded to simulate area-wide synoptic weather conditions. Observational data will be critical for evaluating model performance. AOOS has taken a lead role in developing collaborations with the University of Alaska Anchorage and Fairbanks campuses to develop Weather Research Forecasting (WRF) atmospheric circulation models that now provide statewide, regional (e.g. GOA, Bering), and area scale (e.g. Prince William Sound and Cook Inlet) nowcasts/forecasts. There is an on-going effort to integrate the nowcasts/forecasts with the National Weather Service regional forecasts. The WRF nowcasts and forecasts are disseminated through the AOOS Model Explorer (www.aoos.org). The wind nowcasts/forecasts are used directly and also as input to area-scale synoptic wave and ocean circulation models. The performance of wind nowcasts/forecasts are evaluated by site-scale weather observations, and subsequently inform wave and ocean circulation models.

Site-specific sea state conditions are observed with wave buoys. AOOS collaborated with the NDBC, Scripps, and the US Army Corp of Engineers in 2011 to deploy the first CDIP wave buoy in Alaska as part of an expanding effort to provide observations of sea state to mariners. This buoy is providing measurements of wave height, period, and direction to aid in validating a synoptic wave model for Cook Inlet. This wave buoy is intended as a demonstration of the technology in Alaska, and if successful will be used in other areas around the state.

Synoptic sea state conditions are obtained using wave models linked to the AOOS wind nowcast/forecast models and wave buoy observations. In the near term, AOOS will continue collaborating with Texas A&M University on developing Simulating Waves in the Nearshore (SWAN) wave model domains for Prince William Sound and Cook Inlet. In the longer term, to economize the modeling effort, AOOS may seek a contract for a coupled approach with the wave modeling conducted in tandem with the atmospheric modeling from one location.

TABLE 1.1.1 INFORMATION REQUIREMENTS (FOR WEATHER AND SEA STATE):

Geographic Focus			Observations and models				
Regions	Areas	**	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Land	Wind speed	15 min	Point	Site*
	Prince William Sound	**2**	Land	Wind direction	15 min	Point	Site*
	Cook Inlet	**3**	Land	Temperature air	15 min	Point	Site*
	Kodiak	4	Land	Pressure air	15 min	Point	Site*
	Alaska Peninsula	5	Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
Bering Sea	Adak	6	Buoy	Wave height	1 hr	Point	Site
	Bristol Bay	7	Buoy	Wave period	1 hr	Point	Site
	Norton Sound	8	Buoy	Wave direction	1 hr	Point	Site
	Bering Strait	9	Buoy	Water temperature	1 hr	Point	Site
Arctic Ocean	Kotzebue Sound	10	Model	Wave Nowcast/Forecast	6hr/48hr	1 km	Area
	Chukchi Sea	11					
	Beaufort Sea	12					

**Areas in bold have some existing AOOS infrastructure

* minimum or 3 sites (TBD)/area

1.1.2 PRODUCTS AND SERVICES: Improved wind and ocean current nowcasts/forecasts

AOOS will continue funding the development of a Data Assimilating Regional Ocean Modeling System (ROMS) forecasting model for Prince William Sound, the north Gulf of Alaska (GOA), and the northeastern Pacific Ocean. The NOAA CO-OPS is developing a ROMS domain for Cook Inlet. WRF and ROMS nowcasts and forecasts are produced daily, and images, analysis, and model output are disseminated by NASA's Jet Propulsion Lab (JPL) and are also available on the AOOS Model Explorer (www.aoos.org).

Experiments in Prince William Sound have shown that ROMS performance is improved through data assimilation of fresh water discharge and ocean conditions. Fresh water discharge relies on improving hydrological forecasts. Observations of ocean conditions are provided by a suite of fixed and mobile instruments such as moorings, gliders, and HF radar arrays (see 1.3.1).

TABLE 1.1.2 INFORMATION REQUIREMENTS (FOR WIND AND OCEAN CURRENTS NOWCASTS/FORECASTS):

Geographic Focus			Observations and models				
Regions	Areas	**	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Land	Wind speed	15 min	Point	Site*
	Prince William Sound	**2**	Land	Wind direction	15 min	Point	Site*
	Cook Inlet	**3**	Land	Temperature air	15 min	Point	Site*
	Kodiak	4	Land	Pressure air	15 min	Point	Site*
	Alaska Peninsula	5	Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
Bering Sea	Adak	6	Buoy	Wave height	1 hr	Point	Site
	Bristol Bay	7	Buoy	Wave period	1 hr	Point	Site
	Norton Sound	8	Buoy	Wave direction	1 hr	Point	Site
	Bering Strait	9	Buoy	Water temperature	1 hr	Point	Site
Arctic Ocean	Kotzebue Sound	10	Model	Wave Nowcast/Forecast	6hr/48hr	1 km	Area
	Chukchi Sea	**11**	Station	Stream discharge	15 min	Point	Site
	Beaufort Sea	12	Model	Glacier discharge	24 hr	1 km	Area
			Model	Hydrology Forecast	6hr/48hr	3 km	Area
			Buoy	Salinity water	1 hr	Point	Site
			Buoy	Temperature water	1 hr	Point	Site
			Buoy	Currents	1 hr	Point	Site
			Mooring	Salinity water	1 hr	Point	Site
			Mooring	Temperature water	1 hr	Point	Site
			Mooring	Pressure	1 hr	Point	Site
			Mooring	Currents	1 hr	Point	Site
			Radar	Currents	1 hr	1 km	Area
			Glider	Salinity water	Continuous	Point	Site
			Glider	Temperature water	Continuous	Point	Site
			Model	Ocean Nowcast/Forecast	6hr/48hr	3 km	Area

** Areas in bold have some existing AOOS infrastructure

*minimum of 3 sites (TBD)/area

1.1.3 PRODUCTS AND SERVICES: Improved sea ice extent and trajectory nowcasts/forecasts

As Arctic sea ice retreats, and northern oceanic passages stay open for longer periods, more vessels are passing through Alaska waters. These vessels take shipments to international destinations, as well as supporting increased economic development in western and northern Alaska, and touring the Arctic for recreation. In 2011, an ice free passage along the north coast of Russia is expected for up to three months allowing cargo and cruise ships direct access between Russian and US west coast ports (www.arcus.org/search/seaiceoutlook/2011/august). For example, the Russian gas producer Novatek plans to send the 120,000-ton tanker Vladimir Tikhonov along Russia's Arctic Coast to the Bering Strait in August — the largest ship of its kind to ever traverse the Northern Sea Route.

The NWS and ARCUS now provide sea ice maps that depict the location of fast ice and the ice shelf based on satellite image analysis. But highly mobile broken ice continues to be problematic especially for vessels in transit. AOOS will explore using ice radars, bottom mounted ice thickness sonars and numerical modeling to develop a sea ice trajectory

nowcast/forecast as an aid to vessels working in the Arctic (see: www.crrel.usace.army.mil/sid/hopkins_files/Seaice/Cook_inlet.htm).

TABLE 1.1.3 INFORMATION REQUIREMENTS (FOR SEA ICE EXTENT AND TRAJECTORY NOWCASTS/FORECASTS):

Geographic Focus			Observations and models				
Regions	Areas	**	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	**Cook Inlet**	**3**	Land	Wind speed	15 min	Point	Site*
Bering Sea	Bristol Bay	7	Land	Wind direction	15 min	Point	Site*
	Norton Sound	8	Land	Temperature air	15 min	Point	Site*
	Bering Strait	9	Land	Pressure air	15 min	Point	Site*
Arctic Ocean	Kotzebue Sound	10	Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
	Chukchi Sea	**11**	Mooring	Ice thickness	24 hr	Point	Site
	Beaufort Sea	12	Radar	Ice density and trajectory	15 min	1 km	Site
			Webcams	Ice floe density	15 min	Point	Site
			Model	Ice trajectory	6hr/48hr	1 km	Area
			Model	Sea Ice Nowcast/Forecast	6hr/48hr	3 km	Area

**Areas in bold have some existing AOOS infrastructure

*minimum of 3 sites (TBD)/area

Issue 1.2: Search and Rescue

Description of the issue: The United States Coast Guard (USCG) must often conduct time-consuming searches for lost, missing, or distressed vessels and persons in Alaska's coastal oceans. Search and rescue (SAR) and minimizing the loss of life, injury and property damage by rendering aid to the distressed in the maritime environment have always been a Coast Guard priority. Coast Guard SAR response involves costly multi-mission stations, cutters, aircraft and boats linked by communications networks.

A SAR responder is faced with many challenges, including acquiring atmospheric winds, oceanic currents, sea surface temperature, craft/personal conditions, and other information that may not be precisely known. The USCG adopted a new Decision Support Tool (DST) in early 2007 known as the Search and Rescue Optimal Planning System (SAROPS) for planning search and rescue operations. SAROPS uses a sophisticated, cutting-edge animated grid model to project how/where floating persons or objects might move. It allows searchers to define the situation, access environmental data such as wind and water current patterns, compute drift models, simulate environmental hazards, and develop a comprehensive search plan with available resources. The two most important input parameters for SAROPS are: (1) atmospheric surface (10-meter) wind (both speed and direction); and (2) ocean surface current (both speed and direction). Currently, SAROPS accesses these data sets through the Applied Science Associates' Environmental Data Server (EDS), that manages a number

of global and regional wind and current data sets. These include both observations and computer forecast models. For the northeastern Pacific area, the EDS is presently accessing NOAA NCEP's Global Forecast System (GFS) and North America Mesoscale (NAM) 10-meter surface winds fields. Providing higher resolution forecasts would improve the SAROPS model for use in Alaska.

Importance to the region: See 1.1.

Who are the impacted and targeted users: See 1.1

1.2.1 PRODUCTS AND SERVICES: Real time surface currents sent to the USCG EDS for use in SAR operations

The success of SAR operations critically depends upon the quality of the surface wind and current data sets accessible through EDS. Of particular interest is the measurement of surface currents from HF radars. The accuracy of surface current measurements with HF radars has been reported to be between 4 to 20 cm s-1 making this an ideal tool both for direct observation as well as data assimilation by numerical models.

Observational data need to be assimilated into models for more precise predictions. Furthermore, a single model realization without measures of uncertainties will be of very limited use. Finally, the data have to be readily available for both nowcast and forecast fields, in a timely manner, using a standard format.

The challenge in Alaska is to maintain continuous real-time operation of these systems at remote sites. To address the technical challenge, HR radars have now been designed with more reliable power supplies and telecommunications.

TABLE 1.2.1 INFORMATION REQUIREMENTS (FOR REAL TIME SURFACE CURRENTS):

Geographic Focus		**
Regions	Areas	
Gulf of Alaska	Cross Sound/Icy Strait	1
	Prince William Sound	**2**
	Cook Inlet	**3**
	Kodiak	4
	Alaska Peninsula	5
Bering Sea	Adak	6
	Bristol Bay	7
	Norton Sound	8
	Bering Strait	9
Arctic Ocean	Kotzebue Sound	10
	Chukchi Sea	**11**
	Beaufort Sea	12

Observations and models				
Platform	Parameters	Time step	Resolution	Spatial
Land	Wind speed	15 min	Point	Site*
Land	Wind direction	15 min	Point	Site*
Land	Temperature air	15 min	Point	Site*
Land	Pressure air	15 min	Point	Site*
Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
Buoy	Wave height	1 hr	Point	Site
Buoy	Wave period	1 hr	Point	Site
Buoy	Wave direction	1 hr	Point	Site
Buoy	Water temperature	1 hr	Point	Site
Model	Wave Nowcast/Forecast	6hr/48hr	1 km	Area
Radar	Currents	1 hr	1 km	Area
Buoy	Currents	1 hr	Point	Site
Model	Ocean Nowcast/Forecast	6hr/48hr	3 km	Area

** Areas in bold have some AOOS infrastructure

*minimum of 3 sites/area

1.2.2 PRODUCTS AND SERVICES: Improved communications of vessel location and weather and sea state

Most vessel traffic (per capita) in Alaska now has access to emergency VHF radio broadcasts and much of it is within cell phone coverage areas; however, the area represented is less than 15% of Alaska's waters. The lower 48 states now have 99% VHF coverage out to 20 miles. The USCG does not intend to fully implement Rescue 21, the new national VHF distress communication system, in Alaska and most commercial vessels will continue relying on HF radio and satellite telephone (or internet). The USCG will not be fully implementing the vessel Automated Information System (AIS) in Alaska either, and will rely on industry to provide additional communication infrastructure. The Alaska Marine Exchange is implementing the regional AIS infrastructure and in the future may be adding Rescue 21 Digital Selective Calling to selected new and existing AIS relay stations (Fig. 3). A significant contribution by AOOS to maritime safety in Alaska would be to facilitate the expansion of AIS relay stations in the three ocean basins, and to augment existing weather stations with AIS transmitters to communicate weather conditions directly to mariners at sea.

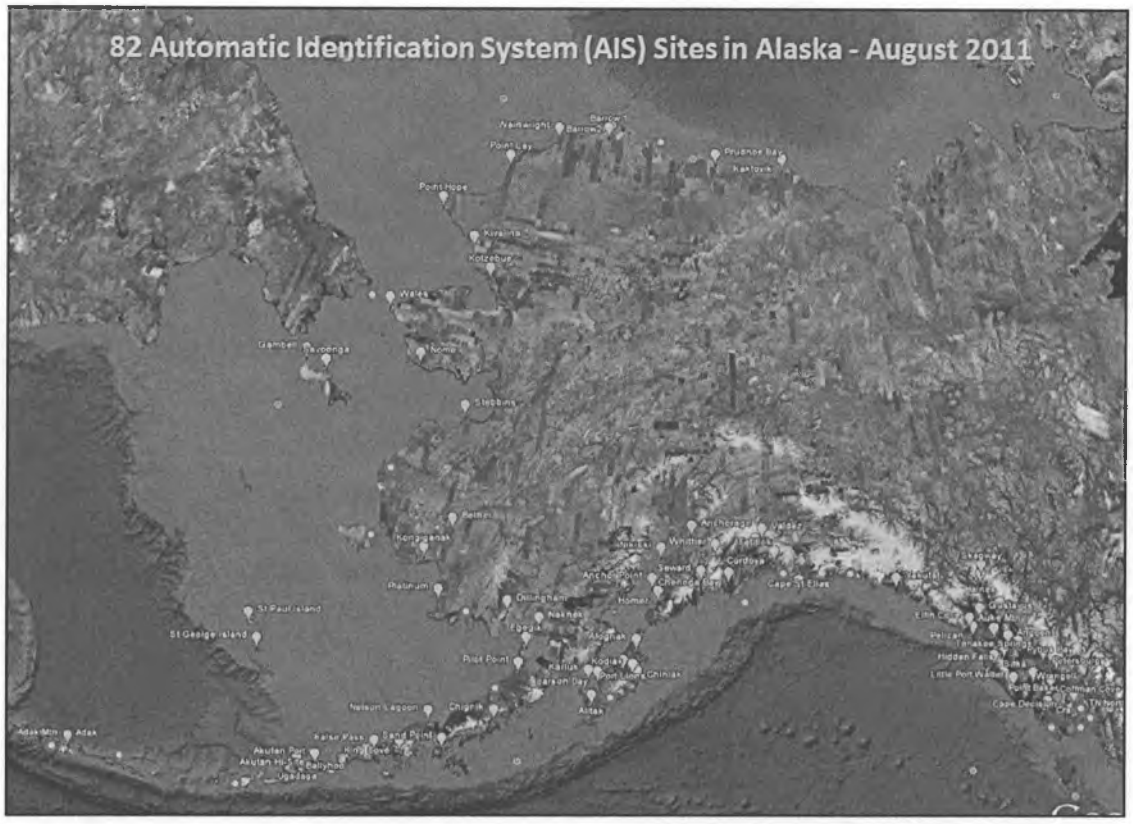

Figure 3. Proposed (yellow) and existing (blue) AIS stations in Alaska (courtesy of the Alaska Marine Exchange).

TABLE 1.2.2 INFORMATION REQUIREMENTS (FOR COMMUNICATION OF WEATHER AND SEA STATE):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Land	AIS Transmitter	Continuous	Point	Site*
	Prince William Sound	2					
	Cook Inlet	3					
	Kodiak	4					
	Alaska Peninsula	5					
Bering Sea	Adak	6					
	Bristol Bay	7					
	Norton Sound	8					
	Bering Strait	9					
Arctic Ocean	Kotzebue Sound	10					
	Chukchi Sea	11					
	Beaufort Sea	12					

***minimum of 3 sites (TBD)/area**

Issue 1.3: Spill response

Description of the issue: Under the National Contingency Plan the USCG serves as the Federal On Scene Coordinator for oil spill response and NOAA is designated to provide the Scientific Support Coordinator (SSC). NOAA's Office of Response and Restoration staffs the SSCs with oceanographers, modelers, chemists, and biologists available 24 hours a day. During a real oil spill, the primary Decision Support Tool for evaluating potential trajectories is the General NOAA Oil Modeling Environment (GNOME). GNOME forecasts spill trajectories based upon the best wind and ocean circulation forecasts available at the time of the response. Twice daily overflights of the spill are made to validate the real oil spill trajectory.

Importance to the region: NOAA does not officially respond to oil spills until formally requested by the U.S. Coast Guard. Therefore, the GNOME model as implemented by NOAA is generally not used in small oil spills, oil spill drills, or in pre-staging equipment in advance of an oil spill. This was demonstrated recently in Cook Inlet during the Mt. Redoubt volcanic eruption of 2009. The oil terminal at Drift River was in imminent danger of being overwhelmed by the ash flow, but the U.S. Coast Guard had not issued a request for spill trajectory scenarios from NOAA. Spill response organizations such as Alyeska Pipeline Service Company (Alyeska) in Prince William Sound and Alaska Clean Seas in the Beaufort Sea need oil spill trajectory forecasts for better planning scenarios, and to anticipate the placement of protection and response equipment.

Who are the impacted and targeted users: See 1.1

Geographic site selection: See 1.1: Areas Prince William Sound (2), Cook Inlet (3), Chukchi Sea (11), and Beaufort Sea (12).

1.3.1 PRODUCTS AND SERVICES: Real time surface currents used by NOAA HAZMAT, Coast Guard and others to track and forecast oil & chemical trajectories

See 1.2.1

TABLE 1.3.1 INFORMATION REQUIREMENTS (FOR REAL TIME SURFACE CURRENTS):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Prince William Sound	2	Radar	Currents	1 hr	1 km	Area
	Cook Inlet	3					
Arctic Ocean	Chukchi Sea	10					
	Beaufort Sea	11					

1.3.2 PRODUCTS AND SERVICES: Ocean circulation models & forecasts

See 1.1.2

INFORMATION REQUIREMENTS (FOR OCEAN CIRCULATION MODELS & FORECASTS):

See TABLE 1.1.2

Issue 1.4: Offshore Energy (includes oil and gas, wind, tidal, waves, etc.)

Description of the issue: Exploration for potential offshore energy has accelerated in Alaska in the last five years, and may be a primary source of energy for Alaska and the nation for many decades. Offshore energy is used here to describe all forms of energy derived from the sea including oil and gas (see 1.4.1), as well as marine renewable energy sources such waves, tides, currents, and winds (see 1.4.2). A tidal energy project is being planned for Upper Cook Inlet, with NOAA taking the lead in developing an ocean circulation model as an aid in siting this and other area projects. There are several sites in Southeast Alaska that also have potential for ocean current development. Oil and gas development is on-going in Cook Inlet and exploration is progressing in the Chukchi and Beaufort Seas.

Importance to the region: In Alaska, the Bureau of Ocean Energy Management (BOEM) is the primary federal agency administrating ocean energy development in offshore waters. The environmental issues of greatest concern to BOEM include monitoring the marine environment for changes attributable to offshore energy development, conducting research on oil spill fate and effects especially in ice environments, and minimizing impacts of seismic and acoustic operations. Issues relevant to AOOS and IOOS include quantifying change in the marine and coastal environment due to offshore activity, determining the role of currents in the distribution of anthropogenic pollutants, and the fate of pollutants, particularly in broken ice.

Who are the impacted and targeted users: See 1.1. In addition, users include statewide Alaska Native Villages that are aggressively pursuing wind energy sources to offset the high cost of petroleum energy products.

Geographic site selection: See 1.1: All Areas

1.4.1 PRODUCTS AND SERVICES*:* Atmospheric and oceanographic information to assist with offshore oil and gas operations

See 1.1.2

INFORMATION REQUIREMENTS (FOR WEATHER, WAVE, OCEAN CIRCULATION OBSERVATIONS AND NOWCASTS/FORECASTS):

See TABLE 1.1.2

1.4.2 PRODUCTS AND SERVICES: Atmospheric and oceanographic information to assist with alternative energy development such as wind, waves, and currents.

See 1.1.2

INFORMATION REQUIREMENTS (FOR WEATHER, WAVE, OCEAN CIRCULATION OBSERVATIONS AND NOWCASTS/FORECASTS):

See TABLE 1.1.2

2. Climate Variability and Change

Issue 2.1: Changes in ocean conditions over time

Description of the issue: The ocean is a fundamental part of the climate system. Short-term fluctuations (years to a few decades) such as the El Niño-Southern Oscillation, the Pacific decadal oscillation, the North Atlantic oscillation, and the Arctic oscillation, represent climate variability rather than climate change. On longer time scales, alterations to ocean processes such as thermohaline circulation, play a key role in redistributing heat by carrying out a very slow and extremely deep movement of water. These processes drive the long-term redistribution of heat in the world's oceans.

Importance to the region: The goal of this section is to provide data characterizing the response of Alaska's oceans to oscillations in climate. Quantitative information acquired includes mixed layer depth, vertical stratification, timing of the spring phytoplankton bloom, zooplankton species abundance, and summer mixing that results in production. AOOS hosted a workshop in May 2010 to discuss the important climate variability and change issues for Alaska. A summary and report of this workshop can be found at www.aoos.org/workshops-and-reports/.

Who are the impacted and targeted users: Resource managers, policy makers, commercial and recreational fishing, coastal communities, and subsistence users.

Geographic site selection: Gulf of Alaska, Bering Sea, Arctic Ocean (Chukchi Sea)

2.1.1 PRODUCTS AND SERVICES: Coastal climate records on key parameters over time. Regional contributions to climate indices and national climate assessments.

TABLE 2.1.1 INFORMATION REQUIREMENTS (COMPILING AND ARCHIVING OCEAN CLIMATOLOGIES):

Geographic Focus		
Regions	Areas	
Gulf of Alaska	Cross Sound/Icy Strait	1
	Prince William Sound	2
	Cook Inlet	3
	Kodiak	4
	Alaska Peninsula	5
Bering Sea	Adak	6
	Bristol Bay	7
	Norton Sound	8
	Bering Strait	9
Arctic Ocean	Kotzebue Sound	10
	Chukchi Sea	11
	Beaufort Sea	12

Observations and models				
Platform	Parameters	Time step	Resolution	Spatial
Buoy	Temperature water	1 hr	Point	Site
Buoy	Salinity	1 hr	Point	Site
Buoy	Turbidity	1 hr	Point	Site
Buoy	Chlorophyll fluorescence	1 hr	Point	Site
Buoy	Nutrients	1 hr	Point	Site
Buoy	Ambient Noise	1 hr	Point	Site
Mooring	Temperature water	1 hr	Point	Site
Mooring	Salinity	1 hr	Point	Site
Mooring	Chlorophyll fluorescence	1 hr	Point	Site
Mooring	Ambient Noise	1 hr	Point	Site
Glider	Temperature water	Continuous	Transect	Area
Glider	Salinity	Continuous	Transect	Area
Glider	Turbidity	Continuous	Transect	Area
Glider	Chlorophyll fluorescence	Continuous	Transect	Area
Ship	Temperature water	2/Year	10 km	Area
Ship	Salinity	2/Year	10 km	Area
Ship	Phytoplankton	2/Year	10 km	Area
Ship	Zooplankton	2/Year	10 km	Area
Ship	Nutrients	2/Year	10 km	Area

Issue 2.2: Ocean acidification

Description of the issue: Ocean acidification is the term used to describe increasing acidity, or decreasing pH, in the world's oceans. As carbon dioxide levels rise in the atmosphere, the ocean absorbs this gas, resulting in more acidic seawater. Scientists estimate that the ocean is 25 percent more acidic today than it was 300 years ago.

Importance to the region: Because cold water can absorb more carbon dioxide than warm water, the polar regions are most affected by ocean acidification. Increasing acidification can now be measured throughout these regions, and biological responses are detectable. The coastal seas around Alaska are more susceptible to ocean acidification because of unique circulation patterns and colder temperatures. These factors increase the transport of carbon dioxide from the atmosphere into surface waters. As the pH in the ocean decreases, it reduces the availability of carbonate ions, which play an important role in shell formation for a number of marine organisms such as corals, marine plankton, and shellfish. Some of the smaller calcifying organisms, such as Pteropods and other planktonic calcifiers, may be particularly susceptible to increases in acidity with potentially negative cascading effects on predator organisms such as salmon. Commercially important shellfish like crabs and oysters, and coraline marine habitats may all decline as a result of increased ocean acidification.

Who are the impacted and targeted users: Resource managers, policy makers, commercial and recreational fishing, shellfish growers, coastal communities

Geographic site selection: (Fig 4) Gulf of Alaska, Bering Sea, and Arctic Ocean

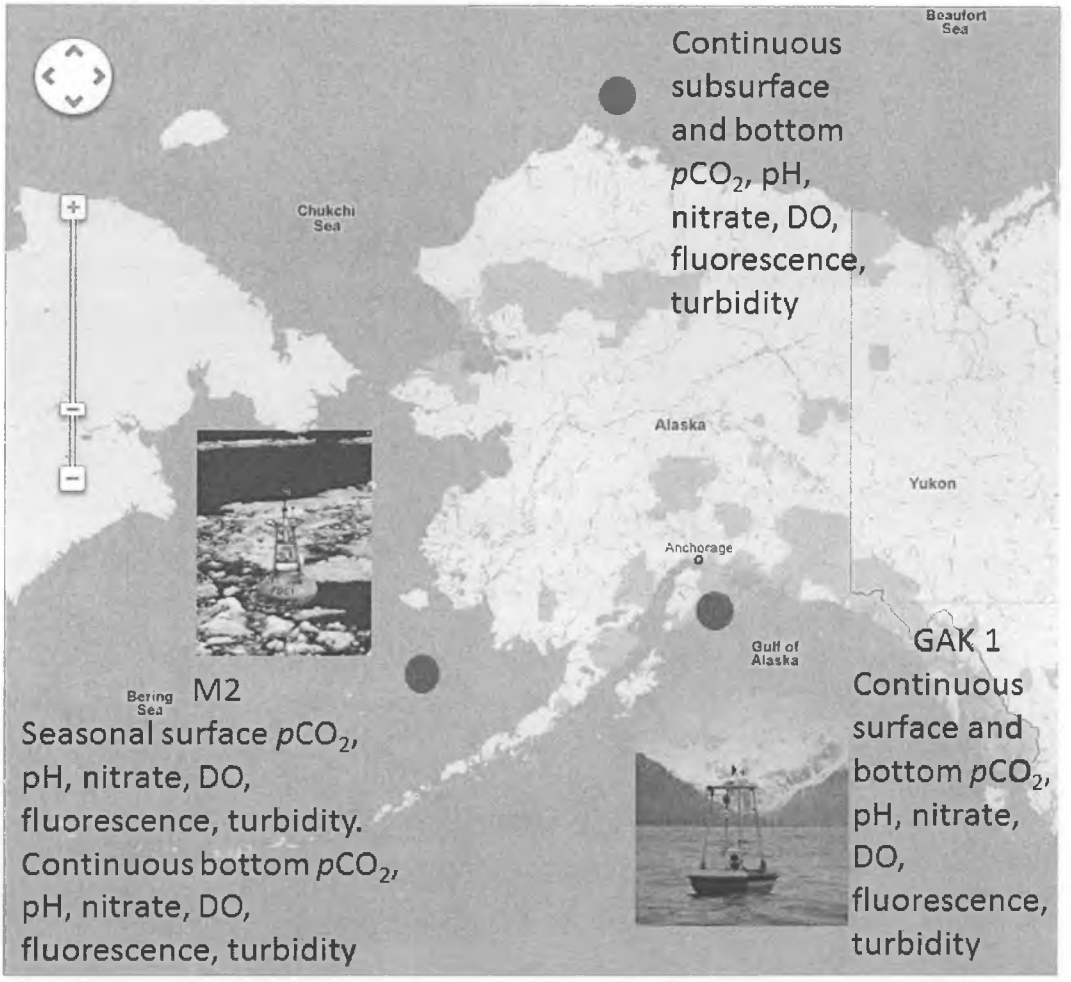

Figure 4. Location of ocean acidification moorings funded by NOAA, NSF, NPRB, and AOOS in the Arctic, Bering, and Gulf of Alaska in 2011 (from http://www.sfos.uaf.edu/oarc/).

2.2.1 PRODUCT AND SERVICES: Status and trends in ocean acidification as well as warnings sent to interested parties such as shellfish growers when ocean conditions may become unfavorable due to extreme changes.

TABLE 2.2.1 INFORMATION REQUIREMENTS (FOR OCEAN ACIDIFICATION TIME SERIES):

Geographic Focus			Observations and models				
Regions	Areas	**	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Buoy	pH	1 hr	Point	Site
	Prince William Sound	2	Buoy	Temperature water	1 hr	Point	Site
	Resurrection Bay	*	Buoy	pCO_2	1 hr	Point	Site
	Cook Inlet	3	Buoy	Salinity	1 hr	Point	Site
	Kodiak	4	Buoy	Dissolved oxyegn	1 hr	Point	Site
	Alaska Peninsula	5	Buoy	Turbidity	1 hr	Point	Site
Bering Sea	Adak	6	Buoy	Fluorescence	1 hr	Point	Site
	Bristol Bay	7	Mooring	pH	1 hr	Point	Site
	Shelf M2	*	Mooring	Temperature water	1 hr	Point	Site
	Norton Sound	8	Mooring	pCO_2	1 hr	Point	Site
	Bering Strait	9	Mooring	Salinity	1 hr	Point	Site
Arctic Ocean	Kotzebue Sound	10	Mooring	Dissolved oxyegn	1 hr	Point	Site
	Chukchi Sea	**11**	Mooring	Turbidity	1 hr	Point	Site
	Beaufort Sea	12	Mooring	Fluorescence	1 hr	Point	Site
			Ship	pH	2/year	10 km	Region
			Ship	Temperature water	2/year	10 km	Region
			Ship	pCO_2	2/year	10 km	Region
			Ship	Salinity	2/year	10 km	Region
			Ship	Dissolved oxyegn	2/year	10 km	Region
			Ship	Turbidity	2/year	10 km	Region
			Ship	Fluorescence	2/year	10 km	Region

** Areas in bold have some existing AOOS infrastructure

*Not necessarily representing specific Areas

Issue 2.3: Sea Level Change

Description of the issue: There is a widespread consensus that substantial long-term sea level rise across the globe will continue for centuries to come. For this century, one meter of sea level rise is well within the range of recent projections, although for Alaska this will be confounded somewhat by subsidence or uplift events. There are two main factors that have contributed to observed sea level rise. The first is thermal expansion: as ocean water warms, it expands in volume. The second is from the contribution of land-based ice due to increased melting. The major store of water on land is found in glaciers and ice sheets that are now rapidly decreasing in size.

Importance to the region: On the timescale of centuries to millennia, the melting of ice sheets could result in even higher sea level rise. Partial deglaciation of the Greenland and West Antarctic Ice Sheets could result in sea level rise of 4–6 meters or more. Such an increase in sea level would imply major changes in coastlines and ecosystems, and inundation of low-lying areas, with greatest effects in estuaries.

Who are the impacted and targeted users: Resource managers, policy makers, and coastal communities. Current sea level rise potentially impacts all human populations living in coastal regions and on islands.

Geographic site selection: Statewide

2.3.1 PRODUCT AND SERVICES: Improved forecasts for communities in areas affected by sea level rise, land subsidence, and coastal inundation.

TABLE 2.3.1 INFORMATION REQUIREMENTS (FOR SEA LEVEL CHANGE AND INUNDATION FORECASTS):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Model	Digital elevation	NA	1 m	Area
	Prince William Sound	2	Model	Digital shoreline	NA	1 m	Area
	Cook Inlet	3	Model	Bathymetry	NA	1 m	Area
	Kodiak	4	Model	Flooding/Inundation	NA	1 m	Area
	Alaska Peninsula	5	Model	Uplift/Subsidence	NA	1 m	Area
Bering Sea	Adak	6					
	Bristol Bay	7					
	Norton Sound	8					
	Bering Strait	9					
Arctic Ocean	Kotzebue Sound	10					
	Beaufort Sea	12					

3. Ecosystems, Fisheries and Water Quality

Issue 3.1 Healthy and Productive Ecosystems

Description of the issue: Alaska's coastal waters support a rich and diverse ecosystem, and are home to the nation's largest fisheries, as well as abundant populations of seabirds and marine mammals. Many economically important fisheries are now declining and conflicts exist between threatened and endangered species and development industries over critical marine habitats. The health of ecosystems in Alaska has direct social and economic implications that are likely to be more profound as the effects of climate change are manifested by large-scale ecosystem adjustments. In addition, as human activities increase in Alaska waters, management challenges increase and will require new sources of information and decision support tools. The relationship between changing ocean conditions and fish and shellfish populations is now better understood but decision support tools will require better data integration

Importance to the region: The Alaska region continues to demonstrate susceptibility to climate variability and change. Additional threats include oil spills, mineral extraction industries, overfishing, noise and pollution. The loss of sea ice is affecting marine mammal migrations, and potentially expanding the northern range of fishes and invertebrate species through the Bering Strait. Socioeconomic changes are likely to follow as in the mid-1970s when the relative dominance of the commercially important fish species changed. These ecosystem adjustments were linked to decadal-scale changes in the atmosphere and ocean of the North Pacific. As a consequence, the commercial fishing industry had to invest heavily in new infrastructure to remain economically viable. AOOS hosted a workshop in May 2010 to discuss the important ecosystem health and fisheries issues for Alaska. A summary and report of this workshop can be found at www.aoos.org.

Who are the impacted and targeted users: Representative stakeholders include resource managers, policy makers, the fishing industry, subsistence-based communities, academic and agency researchers, and everyone who depends on healthy and productive marine ecosystems.

Geographic site selection: Statewide

3.1.1 PRODUCTS AND SERVICES: Integrated datasets and displays linking habitats with physical oceanographic properties (Habitat GIS/seabird data portals).

TABLE 3.1.1 INFORMATION REQUIREMENTS (FOR COMPILING DATASETS FOR THE SPATIAL ANALYSIS OF HABITATS):

Geographic Focus			Observations** and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Model	Digital elevation	NA	<1 m	Area
	Prince William Sound	2	Model	Digital shoreline	NA	1 m	Area
	Cook Inlet	3	Model	Bathymetry	NA	1 m	Area
	Kodiak	4	Ship	Singlebeam	NA	1 m	Area
	Alaska Peninsula	5	Ship	Multibeam	NA	1 m	Area
Bering Sea	Adak	6	Aerial	LIDAR	NA	<1 m	Area
	Bristol Bay	7	Aerial	Video	NA	1 m	Area
	Norton Sound	8	GIS	Habitat Maps	NA	Multiple	Area
	Bering Strait	9	GIS	Seabirds*	NA	Multiple	Area
Arctic Ocean	Kotzebue Sound	10	GIS	Marine Mammals*	NA	Multiple	Area
	Beaufort Sea	12	GIS	Fish Species*	NA	Multiple	Area
			GIS	Benthic Species*	NA	Multiple	Area
			GIS	Zooplankton Species*	NA	Multiple	Area
			GIS	Phytoplankton Species*	NA	Multiple	Area

*Distribution and abundance estimates

** See also the atmospheric and oceanic variables in Sec. 2.1.1

3.1.2 PRODUCT AND SERVICES: Regional ecosystem assessments or syntheses will be conducted that integrate biological, chemical and physical conditions from new and historical data to identify seasonal and interannual variability for inclusion in an Alaska Coasts and Oceans Report. These syntheses will include relevant data and analyses from federal and state fisheries surveys in the respective ocean basins.

TABLE 3.1.2 INFORMATION REQUIREMENTS (FOR PRODUCING AN ANNUAL OCEANS SYNTHESIS PUBLICATION):

Geographic Focus		
Regions	Areas	
Gulf of Alaska	Cross Sound/Icy Strait	1
	Prince William Sound	2
	Cook Inlet	3
	Kodiak	4
	Alaska Peninsula	5
Bering Sea	Adak	6
	Bristol Bay	7
	Norton Sound	8
	Bering Strait	9
Arctic Ocean	Kotzebue Sound	10
	Beaufort Sea	12

Observations and models				
Platform	Parameters	Time step	Resolution	Spatial
Synthesis	Temperature air	Seasonal	1 km	Region
	Temperature water	Seasonal	1 km	Region
	Salinity	Seasonal	1 km	Region
	Turbidity	Seasonal	1 km	Region
	pH	Seasonal	1 km	Region
	Chlorophyll	Seasonal	1 km	Region
	Nutrients	Seasonal	1 km	Region
	Precipitation	Seasonal	1 km	Region
	Wind speed & direction	Seasonal	1 km	Region
	Freshwater runoff	Seasonal	1 km	Region
	Sea Ice thickness & extent	Seasonal	1 km	Region
	Wave height and period	Seasonal	1 km	Region
	Ocean currents	Seasonal	1 km	Region
	Ocean fronts	Seasonal	1 km	Region
	Habitat Maps	Seasonal	1 km	Region
	Seabirds*	Seasonal	1 km	Region
	Marine Mammals*	Seasonal	1 km	Region
	Fish Species*	Seasonal	1 km	Region
	Benthic Species*	Seasonal	1 km	Region
	Zooplankton Species*	Seasonal	1 km	Region
	Phytoplankton Species*	Seasonal	1 km	Region

*Distribution and abundance estimates

3.1.4 PRODUCTS AND SERVICES: Distributed Biological Observations (DBO) using vessels of opportunity. A marine Distributed Biological Observatory (DBO) in the U.S. Arctic is envisioned for consistent monitoring of biophysical responses in four pivotal oceanographic areas along a north-south latitudinal gradient. Each area exhibits high biological productivity, biodiversity, and gradients in ecosystem properties and direct linkages to subsistence-based coastal communities. All areas are projected to experience increased commercial use with the loss of sea ice. The Bering Strait region represents potential conflicts between commercial shipping and resource exploration, subsistence hunting, and management of biological resources. As sea ice retreats, the DBO will track the rate of ecosystem change and sample currently unknown impacts. The DBO integrates biological and physical sampling, including both mooring and dedicated repeat ship occupations using a collaborative international network of logistical support.

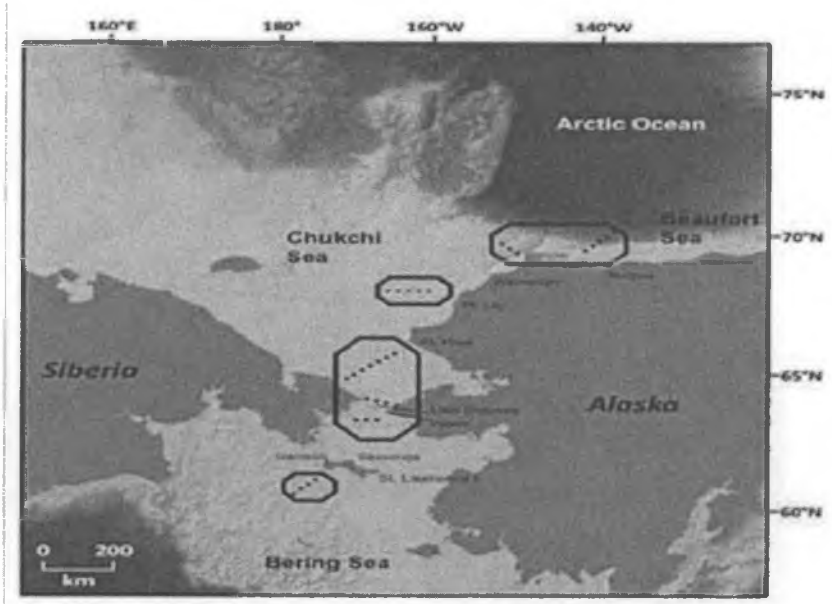

Figure 5. Four possible regional locations of Distributed Biological Observatory transect lines and stations for standard hydrological and biological measurements in the Pacific Arctic sector, including acoustics for marine mammal detection. These stations would include Canadian, Chinese, Japanese, Korean, Russian, and U.S. research vessels, coordinated through the international Pacific Arctic Group, and land-based research from coastal communities using helicopters, small ships, and long-term moorings.

TABLE 3.1.4 INFORMATION REQUIREMENTS (FOR A DBO USING VESSELS OF OPPORTUNITY):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Ship	Temperature water	Opportunistic	Transects	Area
	Prince William Sound	2	Ship	Salinity	Opportunistic	Transects	Area
	Cook Inlet	3	Ship	Chlorophyll	Opportunistic	Transects	Area
	Kodiak	4	Ship	Nutrients	Opportunistic	Transects	Area
	Alaska Peninsula	5	Ship	Turbidity	Opportunistic	Transects	Area
Bering Sea	Adak	6	Ship	Ice algae	Opportunistic	Transects	Area
	Bristol Bay	7	Ship	Phytoplankton	Opportunistic	Transects	Area
	Norton Sound	8	Ship	Zooplankton	Opportunistic	Transects	Area
	Bering Strait	9	Ship	Forage Species	Opportunistic	Transects	Area
Arctic Ocean	Kotzebue Sound	10	Ship	Benthic invertebrates	Opportunistic	Transects	Area
	Chukchi Sea	11	Ship	Seabirds	Opportunistic	Transects	Area
	Beaufort Sea	12	Ship	Marine mammals	Opportunistic	Transects	Area

Issue 3.2 Sustainable Fisheries

Description of the issue: One of the major impediments to the rational control or management of marine resources is inadequate or poor data. Fisheries management

decisions are often based on population models, but the models need quality data to be accurate. Scientists and fishery managers need simpler models, better population estimates, and better estimates of population and oceanographic baselines.

Importance to the region: Fishing is a mainstay of the Alaska economy, second only to the oil industry and wholly reliant on a healthy marine ecosystem and high quality data relevant to fishery managers.

Who are the impacted and targeted users: Resource managers, policy makers, commercial and recreational fishing industry, subsistence users, and Alaska coastal communities.

Geographic site selection: Statewide

3.2.1 PRODUCT AND SERVICES: Seasonal and annual climatologies and ecosystem syntheses of fundamental parameters and derived information products important for fisheries and ecosystem-based management.

INFORMATION REQUIREMENTS (FOR PRODUCING DERIVED SEASONAL AND ANNUAL OCEAN CLIMATOLOGIES AND ECOSYSTEM SYNTHESIS PUBLICATIONS):

See 3.1.2

3.2.2 PRODUCTS AND SERVICES: Surface current mapping for larval fish transport

INFORMATION REQUIREMENTS (FOR SURFACE CURRENT MAPPING):

See 1.2.1

3.2.3 PRODUCTS AND SERVICES: Participate in coordination of interagency monitoring programs and data collections for potential use in 3.2.1 (above). There is an extensive array of seabird, marine mammal, and fish surveys conducted in Alaska, and many of these programs have developed a time series useful to the synthesis in Section 3.2.1. See Appendix A.

TABLE 3.2.3 INFORMATION REQUIREMENTS:

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Archive	Seabirds	Multiple	Multiple	Region
	Prince William Sound	2	Archive	Marine Mammals	Multiple	Multiple	Region
	Cook Inlet	3	Archive	Fishes	Multiple	Multiple	Region
	Kodiak	4	Archive	Forage Species	Multiple	Multiple	Region
	Alaska Peninsula	5	Archive	Shellfish	Multiple	Multiple	Region
Bering Sea	Adak	6	Archive	Zooplankton	Multiple	Multiple	Region
	Bristol Bay	7	Archive	Phytoplankton	Multiple	Multiple	Region
	Norton Sound	8					
	Bering Strait	9					
Arctic Ocean	Kotzebue Sound	10					
	Beaufort Sea	12					

Issue 3.3 Harmful algal blooms

Description of the issue: Toxic or Harmful Algal Blooms (HABs) are becoming an increasing public health concern on a global scale. HAB events are generally attributed to anthropogenic nutrient enrichment of coastal waters. In Alaska, of most concern is Paralytic Shellfish Poisoning (PSP), caused by several species of dinoflagellates in the genus *Alexandrium*. Shellfish become toxic when environmental conditions such as changes in salinity and temperature enable toxic dinoflagellate cells to rapidly reproduce causing a toxic bloom. PSP episodes in Alaska tend to be seasonal, occurring most often during late spring and summer. Off-season occurrences of PSP are most likely caused by tissue retention of toxins from summer bioaccumulation.

Another HAB of concern in Alaska is caused by the marine bacteria *Vibrio parahaemolyticus*. This is the leading cause of seafood-associated gastroenteritis in the United States, and typically is associated with the consumption of raw oysters gathered from warm-water estuaries. Oysters associated with a 2004 outbreak on a cruise ship in Alaska were harvested from an oyster farm when mean daily water temperatures exceeded 15.0 degrees C. In this case, rising temperatures of ocean water seem to have contributed to one of the largest known outbreaks of *V. parahaemolyticus* in the United States.

Importance to the region: The economic consequences of the HABs has drastically impacted the commercial oyster farms and clam fisheries in Alaska., as well as recreational and subsistence users.

Who are the impacted and targeted users: Resource managers, policy makers, coastal communities, Alaska Natives, commercial farms, consumers

Geographic site selection: Gulf of Alaska and Western Aleutians

3.3.1 PRODUCTS AND SERVICES: Early information to coastal managers for when conditions are conducive for harmful algal blooms (includes alerts for shellfish consumers, growers and others)

TABLE 3.3.1 INFORMATION REQUIREMENTS (FOR HABS DETECTION AND MONITORING):

Geographic Focus			Observations and models				
Regions	Areas	*	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Mooring	Temperature water	1 hr	Point	Site
	Prince William Sound	**2**	Mooring	Salinity	1 hr	Point	Site
	Cook Inlet	**3**	Mooring	Chlorophyll Fluorescence	1 hr	Point	Site
	Kodiak	4	Mooring	Nutrients	1 hr	Point	Site
	Alaska Peninsula	5	Mooring	Turbidity	1 hr	Point	Site
Bering Sea	Adak	6					

*Areas in bold have some AOOS infrastructure

Issue 3.4 Hypoxia

Description of the issue: Ocean hypoxia (low-oxygen) areas or "dead zones" in the world's oceans have been increasing in number and size since oceanographers began noting them in the 1970s. These are generally attributed to regional eutrophication (such as the Gulf of Mexico) or areas of anthropogenic nutrient enrichment. There are no known areas of ocean hypoxia or ocean deoxygenation in Alaska and the nearest occurrence is off the Oregon coast.

Importance to the region: Not a critical concern at this time in Alaska.

Who are the impacted and targeted users: Resource managers, policy makers

Geographic site selection: None in Alaska at this time.

3.4.1 PRODUCTS AND SERVICES: Ocean monitoring of temperature, nutrients and phytoplankton blooms, and dissolved oxygen

INFORMATION REQUIREMENTS (FOR EARLY DETECTION OF DEOXYGENATION):

Geographic Focus			Observations** and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Mooring	Temperature water	1 hr	Point	Site
	Prince William Sound	2	Mooring	Salinity	1 hr	Point	Site
	Cook Inlet	3	Mooring	Nutrients	1 hr	Point	Site
	Kodiak	4	Mooring	Chlorophyll Fluorescence	1 hr	Point	Site
	Alaska Peninsula	5	Mooring	Turbidity	1 hr	Point	Site
Bering Sea	Adak	6	Mooring	Dissolved oxygen	1 hr	Point	Site
	Bristol Bay	7					
	Norton Sound	8					
	Bering Strait	9					
Arctic Ocean	Kotzebue Sound	10					
	Beaufort Sea	12					

Issue 3.5 Minimizing the Impact from Polluted Waters

Description of the issue: Alaska has a reputation of being a pristine wilderness despite well publicized pollution events such as the Exxon Valdez oil spill and the Selendang Ayu shipwreck in the Aleutian Islands. Less well publicized are smaller scale events such as cruise ship polluters, oil and other industry discharges, and sewage discharges from coastal communities.

Importance to the region: Economic mainstays of Alaska are the fishing and commercial cruise ship industries and both are based on a healthy marine environment. Many of Alaska's coastal communities and Alaska native villages depend on the ocean for food. Even minor pollution events could easily disrupt this fragile economy and subsistence lifestyle.

Who are the impacted and targeted users: Resource managers, commercial fisheries, cruise ships, coastal communities, Alaska Natives

Geographic site selection: Statewide

3.5.1 PRODUCTS AND SERVICES: Early warnings for when large spatial scale pollution events may be present or forecasted.

TABLE 3.5.1 INFORMATION REQUIREMENTS (FOR INFORMING THE PUBLIC ON PRESENT OR IMMINENT EVENTS):

Geographic Focus			Observations** and models				
Regions	Areas		Platform	Parameters*	Time step	Resolution	Spatial
Gulf of Alaska	Cross Sound/Icy Strait	1	Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
	Prince William Sound	2	Model	Ocean Nowcast/Forecast	6hr/48hr	3 km	Area
	Cook Inlet	3					
	Kodiak	4					
	Alaska Peninsula	5					
Bering Sea	Adak	6					
	Bristol Bay	7					
	Norton Sound	8					
	Bering Strait	9					
Arctic Ocean	Kotzebue Sound	10					
	Beaufort Sea	12					

* See also Section 1.2.1

3.5.2 PRODUCTS AND SERVICES: Assist public health officials and resource managers with ready access to multiple sources of information on regional water quality

INFORMATION REQUIREMENTS (FOR PUBLIC DISSEMINATION OF EVENT SPECIFIC POLLUTION RELATED DATA AND INFORMATION):

See 3.5.1

4. Coastal Hazards

Issue 4.1 Providing hazard and disaster information when and where it is needed

Description of the issue: The goal of the AOOS coastal hazards program is to improve forecasts of extreme weather events and sea ice conditions and the likely effects on coastal communities. The effects of climate change in Alaska are dramatically manifested by the loss of sea ice. As a direct result, the Bering Sea and Arctic Ocean coasts are experiencing significantly increased wave heights, coastal erosion, storm surge and subsequent coastal inundation, and thawing coastal permafrost. AOOS will focus on water level and coastal inundation, wave observations and coastal erosion, and sea ice trends and drift trajectory data products.

Importance to the region: With the rapid loss of sea ice, Arctic weather and ocean conditions are increasingly endangering Alaska Native coastal communities. In a statewide assessment, flooding and erosion affects 184 out of 213 Native villages (GAO 2003). While some villages may need to be permanently moved, relocation is prohibitively expensive. Meanwhile, better forecasting and communication of storm surge events and coastal inundation is needed to help communities prepare for threatening storm events. AOOS hosted a workshop in May 2010 to discuss the important coastal hazards issues for Alaska. A summary and report of this workshop can be found at www.aoos.org.

Who are the impacted and targeted users: See Section 1.1: Alaska coastal communities.

Geographic site selection: Arctic Ocean and Bering Sea areas (see Fig. 1)

4.1.1 PRODUCTS AND SERVICES: Improved forecasts for coastal communities of extreme weather events, storm surges, and erosion events

See 1.1.1

TABLE 4.1.1 INFORMATION REQUIREMENTS (FOR IMPROVED FORECASTS FOR COASTAL COMMUNITIES):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Bering Sea	Bristol Bay	7	Land	Wind speed	15 min	Point	Site*
	Norton Sound	8	Land	Wind direction	15 min	Point	Site*
	Bering Strait	9	Land	Temperature air	15 min	Point	Site*
Arctic Ocean	Kotzebue Sound	10	Land	Pressure air	15 min	Point	Site*
	Chukchi Sea	11	Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
	Beaufort Sea	12	Satellite	Various	24 hr	Various	Region

*** minimum or 3 sites (TBD)/area**

4.1.2 PRODUCTS AND SERVICES: Increase water level observations and coastal inundation forecasts (See also Sea Level Change Section 2.3.1)

There are presently only three permanent water level gauges north of the Aleutians at Nome, Red Dog, and Prudhoe Bay. This area covers about half of Alaska's considerable coastline and dozens of Alaska Native villages. AOOS will facilitate the deployment of water level sensors at new village sites, likely using a bottom mount and a shore-based bubbler system at each site. Data from the bottom mount will be retrieved bi-annually while the bubbler will stream real-time data seasonally during ice-free seasons. These data will be used by the NWS for forecasting, and by the USACE for wave and inundation models to help inform safe development and community relocation plans.

TABLE 4.1.2 INFORMATION REQUIREMENTS (FOR WATER LEVEL OBSERVATIONS AND COASTAL INUNDATION MODELING):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Bering Sea	Bristol Bay	7	Land	Water level	15 min	Point	Site
	Norton Sound	8	Model	Coastal inundation	0.5 hr	0.5 km	Area
	Bering Strait	9					
Arctic Ocean	Kotzebue Sound	10					
	Chukchi Sea	11					
	Beaufort Sea	12					

4.1.3 PRODUCTS AND SERVICES: Increased wave observations and forecasts

AOOS will facilitate the deployment of additional wave buoys and develop wave forecast models for areas with coastal communities in need of additional wave information. These area locations cover missing gaps for NWS forecasters as well as USACE modelers, and will help implement the IOOS National Operational Waves Observation Plan in Alaska. The buoys will measure wave height, period, and direction. Real-time data from the buoys will be communicated and made available through the AOOS web portal, as well as pushed to the NWS for ocean forecasting center.

TABLE 4.1.3 INFORMATION REQUIREMENTS (FOR WAVE OBSERVATIONS AND FORECASTS):

Geographic Focus			Observations and models				
Regions	Areas		Platform	Parameters	Time step	Resolution	Spatial
Bering Sea	Bristol Bay	7	Buoy	Wave height	1 hr	Point	Area
	Norton Sound	8	Buoy	Wave period	1 hr	Point	Area
	Bering Strait	9	Buoy	Wave direction	1 hr	Point	Area
Arctic Ocean	Kotzebue Sound	10	Buoy	Water temperature	1 hr	Point	Area
	Chukchi Sea	11	Model	Wave Nowcast/Forecast	6hr/48hr	1 km	Area
	Beaufort Sea	12					

4.1.3 PRODUCTS AND SERVICES: Improved Sea Ice thickness, extent and trajectory nowcast/forecasts

See 1.1.3

INFORMATION REQUIREMENTS (FOR IMPROVED SEA ICE EXTENT AND TRAJECTORY NOWCAST/FORECASTS):

See TABLE 1.1.3

5. INTEGRATED PRODUCTS

This section is for products that apply to many users and don't fall into one of the above categories.

Issue 5.1

Description: The National Ocean Policy Task Force defines coastal and marine spatial planning as a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas. Coastal and marine spatial planning identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives.

5.1.1 PRODUCTS AND SERVICES: Integrated regional maps in support of coastal and marine spatial planning.

INFORMATION REQUIREMENTS (FOR DEVELOPING DATA VISUALIZATION TOOLS TO AID IN CMSP):

See 3.1.1 and 3.1.2

5.1.2 OTHER PRODUCT AND SERVICES: Visualizations of observing information that serve multiple purposes, including coastal and marine spatial planning. AOOS will focus on developing data visualization tools for the spatial analysis of coastal ecosystems in response to the new National Ocean Policy recommendation for Coastal and Marine Spatial Planning (CMSP).

INFORMATION REQUIREMENTS (FOR DEVELOPING DATA VISUALIZATION TOOLS TO AID IN CMSP):

See 3.1.1 and 3.1.2

B.

State of the Arctic Coast 2010

State of the Arctic Coast 2010

Scientific Review and Outlook

International Arctic Science Committee
Land-Ocean Interactions in the Coastal Zone
Arctic Monitoring and Assessment Programme
International Permafrost Association

April 2011

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Executive Summary

The coast is a key interface in the Arctic environment. It is a locus of human activity, a rich band of biodiversity, critical habitat, and high productivity, and among the most dynamic components of the circumpolar landscape. The Arctic coastal interface is a sensitive and important zone of interaction between land and sea, a region that provides essential ecosystem services and supports indigenous human lifestyles; a zone of expanding infrastructure investment and growing security concerns; and an area in which climate warming is expected to trigger landscape instability, rapid responses to change, and increased hazard exposure. A high proportion of Arctic residents live on the coast and many derive their livelihood from marine resources.

This report addresses a recognized need for a more detailed assessment of the impacts of environmental and social change in the Arctic coastal zone. The Arctic Climate Impact Assessment (ACIA, 2005) provided an overall synthesis of observed and anticipated impacts on social and ecological systems in the Arctic, but did not attempt a focused treatment of the coastal zone. Five years on, the circumpolar Arctic coast is arguably one of the most critical zones in terms of the rapidity and the severity of environmental change and the implications for human communities dependent on coastal resources.

Rapid environmental, social, economic, political and institutional changes are defining characteristics of the past decade in the Arctic basin. In the physical environment, the prospect of a seasonally ice-free Arctic Ocean appears more likely and imminent, as previous records for annual minimum sea ice extent have been broken successively in recent years and the trajectory of ice loss is more rapid than the most extreme model projections in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007a). The past decade has also been the warmest on record for global surface air temperature and some Arctic regions have grown warmer at an even faster pace than the global mean, validating projections in earlier assessment reports that foresaw earlier and more severe climate change at high latitudes. In the face of unprecedented and jarring changes in the local environment on which traditional livelihoods and cultures depend, Arctic coastal communities are coping with rapid population growth, technological change, economic transformation, confounding social and health challenges and, in much of the Arctic, rapid political and institutional change.

It is evident that the coast is a critical component of the Arctic system requiring explicit attention. As a focus of human activity with attendant hazards, the circumpolar Arctic coast is clearly a priority for monitoring and change detection to support proactive adaptation and sustainable development.

This report is organized in four parts. Chapter 1 provides an introduction. Chapter 2 assesses the state of the Arctic coast under three broad disciplinary themes – physical, ecological, and human systems. Chapter 3 considers the need for and progress toward integrative approaches to monitoring, understanding, and managing change in Arctic coastal systems. Chapter 4 provides a synthesis and identifies data gaps and research priorities over the coming decade.

Key Findings

Physical State of the Circum-Arctic Coast

- The evolution of Arctic coasts over the coming decades will be strongly influenced by changes in the natural environment caused by the effects of climate warming.
- Surface air temperatures have reached record levels over the past decade. Record warm air temperatures in 2010 extended across Greenland and the Canadian Arctic.
- The past decade has seen successive new record minima in Arctic sea-ice extent and 2010 had the third smallest summer minimum extent of the past 30 years. At the same time, the mean ice thickness has been decreasing, driven primarily by export of perennial ice.
- Less extensive sea ice creates more open water, allowing stronger wave generation by winds. This, combined with warmer sea-surface and ground temperatures, has the potential to increase erosion along Arctic coasts. Record warm sea-surface temperatures in 2007 contributed to rapid coastal erosion in Alaska.
- Sea-level rise in the Arctic coastal zone is very responsive to freshening and warming of the coastal ocean (leading to increased sea level at the coast) and is highly susceptible to changing large-scale air pressure patterns.
- Relative sea-level change depends on vertical land motion (uplift or subsidence), the patterns of which are predominantly a legacy of former glaciation. The rate of uplift in some regions exceeds the rate of sea-level rise, leading to falling relative sea level.
- Sea-level rise in much of the Arctic is moderated by gravitational effects (fingerprinting) associated with ice loss from regional glaciers and ice caps and especially from the Greenland Ice Sheet.
- Arctic ice shelves will continue the recent rapid pace of collapse due to climate warming and the decrease in multi-year sea ice.
- Carbon entering the coastal system from terrestrial sources appears to be more labile than in the past. Because this organic matter is a direct source of energy for secondary production and a potentially important indirect source once remineralized, the higher lability may have far-reaching, yet unknown consequences for Arctic coastal marine productivity.
- Despite increasing annual freshwater discharge, some Arctic deltas are being progressively flooded, with most of the Mackenzie Delta front (the second largest Arctic delta) retreating at 1-10 m/year or more.
- Storm-surge inundation of low coastal areas and deltas affects coastal communities and can have profound impacts on delta ecology through salinization of freshwater environments. Early-season surges can disrupt waterfowl breeding and winter surges may flood or break up winter ice roads, a critical form of transportation for many northern activities.
- Decadal-scale mean rates of coastal retreat are typically in the 1-2 m/year range, but vary up to 10-30 m/year in some locations. The highest mean erosion rates are in the Beaufort Sea, the East Siberian Sea, and the Laptev Sea.
- Recent results on erosion of ice-rich bluffs point to the importance of interaction between high sea-surface temperatures, which drive thermal

abrasion and undercutting, and the timing of ice break-up and freeze-up in combination with storm dynamics.

- The distribution and stability of gas hydrates in the Arctic coastal zone is poorly documented, but there is concern that climate change and other effects such as coastal erosion may destabilize some hydrate deposits.
- Rocky shorelines comprise 35% of the Arctic coastline and most are effectively stable on timescales relevant to adaptation planning and management.

Ecological State of the Circum-Arctic Coast

- Arctic coastal habitats are the prime lifeline for Arctic communities and provide a wide range of ecosystem services.
- They support very large populations of fish, mammals and birds that are harvested by Arctic and non-Arctic communities.
- The Arctic coastal zone provides habitat to an estimated 500 million seabirds alone.
- Arctic coastal habitats are highly vulnerable to changing environment conditions, including climate change and growing human activities such as oil and gas exploration and development.
- Arctic river deltas are biological hotspots on the circumpolar Arctic coast. They have high biodiversity and are extremely productive in relation to adjacent landscapes. The high biodiversity remains poorly understood, but may be related to the complex natural patterns of water level fluctuation that occur in these vast lake-rich systems.
- Arctic ice shelf microbial mat cryo-ecosystems are severely threatened by ice shelf collapse, with some of the richest examples already lost.

Social, Economic and Institutional State of the Circum-Arctic Coast

- Social, cultural, health and demographic conditions, economic systems, industrial structure and the relative importance of subsistence activities vary across the spectrum of communities on the circumpolar Arctic coast.
- The Arctic economy as a whole is dominated by four major characteristics: the continuing importance of traditional subsistence activities and local living resources in most regions, the lack of manufacturing industries, the local and regional impacts of large-scale natural resource extraction or exploitation projects, and the major importance of the public sector for service provision and transfer payments from the south.
- Disposable household income (DHI) is largest in the Arctic regions where large-scale resource extraction occurs. These are, however, also the regions where the discrepancy is largest between DHI and gross regional product, demonstrating that actors outside of the region reap a large portion of the benefits from the economic activities there.
- Even though the Arctic has a relatively large proportion of people living in a near-traditional manner, close to nature and utilizing the resources there for food and subsistence, it is also well linked to the global economy, in particular as a large supplier of natural resources. The same processes we see in the advanced industrialized regions, of a knowledge-based economy with a focus

on innovations, are also taking place in the Arctic.

- Although climate change and other processes affecting natural resources and environmental conditions impose large impacts on quality of life and economic activity for communities on the Arctic coast, other factors and processes will often be more important, especially in the short run. Where communities are already stressed, even small changes in the availability or quality of natural resources may be critical.
- Recently established integrated marine regional plans, as for example in the Barents Sea, are milestones in the implementation of ecosystem-based management. Laudable as these efforts are, however, it is clear that more work needs to be done, particularly on societal impacts of industrial activities and on the socio-economic impacts of ecosystem changes in the Arctic coastal zone. In each case, a multifactor perspective is essential.
- The Arctic Human Development Report found that, for people in the Arctic, fate control, cultural integrity and contact with nature are central for well-being and should be included in future statistical data collection efforts. The Arctic Social Indicators project has proposed a suite of indicators for these factors, in addition to aspects considered in the United Nations Human Development Index, and is working toward the implementation of these indicators in the Arctic.
- Statistical data specific to coastal regions are difficult to obtain, at least for circumpolar comparisons. Economic, social and demographic connections between coastal and inland areas hinder a clear delineation of what should be included, or excluded, in a coastal-based study such as this.
- At a time of incipient rapid changes in the Arctic coastal zone resulting from climate change and other factors, there are growing health challenges in Arctic communities. Monitoring of the human health situation across the Arctic is critically important, especially for indigenous people in rural areas and remote communities.

Integrated Approaches to Coastal Change in the Arctic

- Arctic coasts may be usefully viewed as complex social-ecological or social-biophysical systems. A social-ecological system is an ecological system intricately linked with and affected by one or more social systems and vice versa.
- The health of Arctic coastal and marine ecosystems is increasingly under pressure, putting at risk ecosystem goods and services that support coastal communities.
- There are major feedback loops in the Arctic system associated with rapid changes in the regional climate. For this reason, the impacts of climate change in the Arctic may extend to a global scale.
- There are two general approaches to more integrated understanding considered in this report:
  - Indigenous communities in general embrace holistic perspectives on the environment and culture.
  - The traditional scientific approach can be applied within a system science framework, with the application of integrated assessments to analyze the interactions in social-ecological systems, as outlined in the risk-based management approach.

- The holistic perspective of indigenous culture suggests that efforts to understand, manage, and respond to change in Arctic coastal systems may benefit from the integration and complementarity of both approaches. Recognizing the value of traditional ecological knowledge may contribute to enhanced resilience and adaptive capacity in coastal communities.

Monitoring, Detecting and Modelling Coastal Change

- Reduction of negative impacts through adaptation to climate change requires new approaches in monitoring strategies to detect and track changes in the Arctic coastal environment. Understanding and prognosis of change is an essential component of resilience in Arctic coastal communities.
- Biophysical and human monitoring both clearly demonstrate that the Arctic environment is changing rapidly – sustained observation and monitoring is essential to document change and validate projections.
- Field-based monitoring in the Arctic coastal zone is challenged by remoteness, accessibility, communications, and instrument performance in extreme cold, but new survey technologies, instrumentation, and higher resolution of remotely sensed data are revolutionizing monitoring capabilities.
- These new techniques, decreasing costs, and higher resolution are enabling better spatial and temporal coverage of coastal change.
- Models represent key tools for understanding current changes and projecting future changes and associated impacts on Arctic coastal ecosystems and human communities.
- Models provide a means of interpolating between periods or locations of observation, a valuable capacity in times of reduced research and monitoring budgets.

Vulnerability, Adaptation, Adaptive Capacity and Resilience

- Increasingly governments, communities, and industry stakeholders are exploring ways to reduce the negative impacts of climate change and take advantage of new opportunities through adaptation.
- Many Arctic coastal communities are experiencing vulnerabilities to decreased or less reliable sea ice, greater wave energy, rising sea levels, changes in winds and storm patterns, storm-surge flooding or coastal erosion, with impacts on travel (on ice or water), subsistence hunting, cultural resources (e.g. archaeological remains, burial sites) and housing and infrastructure in communities.
- In some places, this has necessitated community relocation, which in some cases increased vulnerability.
- In places, coastal erosion is threatening critical infrastructure or contaminated sites, with potential for spreading of pollutants.
- There has been great progress in recent years in the understanding of exposures and identification of elements of adaptive capacity that may enhance resilience, but other challenges including social, technical, financial, and institutional barriers may be inhibiting successful adaptation.
- There is a wide range of adaptive capacity among coastal communities of the circumpolar Arctic. A community with a greater resource base, including physical resources, financial capacity, knowledge (of all kinds), and social cohesion, is in

a better position to successfully adapt than one that lacks resources and options.

- Arctic indigenous peoples are traditionally resilient. This has allowed them to adapt to a harsh climate and changing environmental conditions over multi-century time-scales.
- With a faster pace of change and numerous compounding challenges, the indigenous peoples of the Arctic are generally less resilient today, although developments in regional governance and cultural initiatives, as well as growing familiarity with climate change, may be improving the situation to some extent.
- Quantitative scientific research concerning past, present, and future environmental changes and impacts is a key component informing policy and decision-making.
- Adaptation strategies perceived as imposed from outside will not be incorporated into the community's reservoir of mechanisms for coping with change, will not form a component of its adaptive capacity, and will thus not contribute to its resilience and ultimate sustainability.

Governance and Adaptation

- National agencies are the main actors in regional governance. In some areas such as northern Canada, regional (or in this case, territorial) agencies may play an equally important part. At national and international scales, almost all international land boundaries are settled, meaning that national jurisdiction at the coast is generally clear.
- There are enormous differences across the circumpolar Arctic in population size and distribution, economy, culture, institutional framework, and other factors.
- There are few Arctic-specific international regimes: the 1973 Polar Bear Treaty is the only legally binding regime.
- The Arctic Council, based on soft law (1996 Declaration), works primarily through assessment programs and projects to develop consensual knowledge and understanding on the status of the Arctic environment and related issues among the eight Arctic countries.
- Integrated coastal area management and integrated ecosystem-based oceans management are desirable strategies for coastal area governance and may embody a number of best practices which have emerged from recent reviews.
- Conclusions from consideration of integrated ecosystem-based management include the following:
  - Management needs to be flexible;
  - Decision-making must be integrated and science-based;
  - National commitment is required for effective management;
  - Area-based approaches and trans-boundary perspectives are necessary;
  - Stakeholder and Arctic resident participation is a key element;
- Adaptive management is critical.
- It has been recommended that future research should focus on increasing support, opportunity, and capacity for local decision-making or effective resident input to decisions on broader institutional policies with local impacts.

POLICY RECOMMENDATIONS

Oil Spill Prevention and Response in the U.S. Arctic Ocean

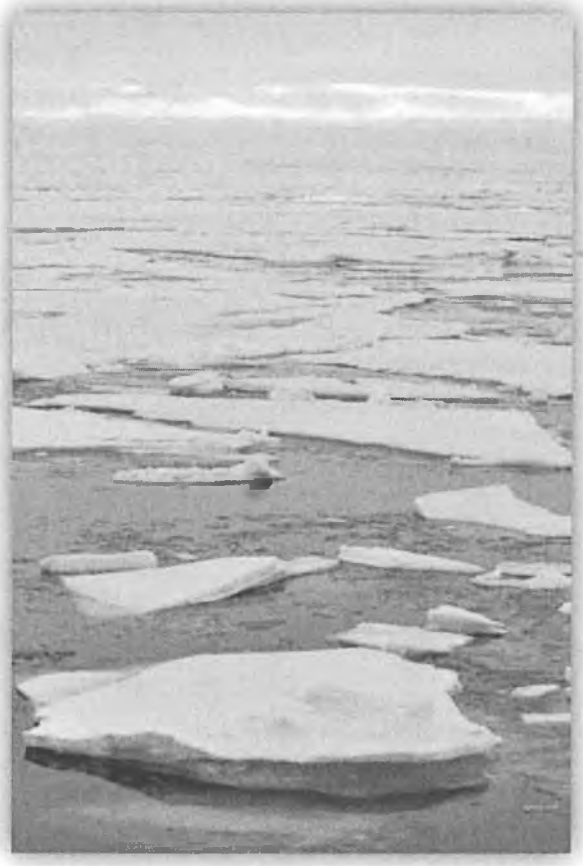
THE PEW ENVIRONMENT GROUP

OIL SPILL PREVENTION AND RESPONSE IN THE U.S. ARCTIC OCEAN:

Unexamined Risks, Unacceptable Consequences

Policy Recommendations by the Pew Environment Group[1]

The BP Deepwater Horizon oil spill in the Gulf of Mexico graphically illustrated the risks of offshore oil and gas drilling and the need for better prevention and response systems. The largest blowout and spill in U.S. history, which began with an explosion and fire April 20, 2010, released at least 50,000 barrels a day for three months for a total of at least 205 million gallons (4.9 million barrels). This disaster clearly exceeded the limits of existing technologies for stopping a well blowout, as well as the strategies to contain and clean up marine oil spills. The Gulf of Mexico—with its temperate waters, proximity to large population centers and ready access to necessary infrastructure and response resources—has some of the best conditions in the United States for offshore oil spill response. Yet even with these advantages, the spill response proved to be woefully inadequate. This was in large part due to lax oversight and inadequate environmental analysis, spill containment, response preparedness and assessment of risks.



Offshore oil and gas drilling plans are being considered for perhaps the most remote and extreme part of the U.S. outer continental shelf (OCS): the Arctic Ocean. The northernmost portion of the OCS, the Arctic Ocean is characterized by a demanding and challenging physical environment. Sea ice is present most of the year, and the sun does not rise for two months in winter. Extended periods of heavy fog, freezing temperatures and weeklong storms approaching hurricane strength are not uncommon. These harsh and icy conditions have, until now, been a barrier to industrial activity.

Figure 1. Arctic Sea Ice *(Photo: Patrick Kelley/USCG)*— Arctic Sea Ice is characterized by the presence of sea ice for much of the year and is important in structuring Arctic marine ecosystems.

1 This document provides policy recommendations and a summary of the findings of the accompanying technical report. Factual statements herein are taken from the technical report, which provides further details as well as full citations for all sources of information. Although the recommendations included herein are directed toward offshore oil and gas drilling in the Arctic Ocean, some of the recommendations address issues that arise throughout the U.S. outer continental shelf. For the accompanying technical report, *Oil Spill Prevention and Response in the U.S. Arctic Ocean: Unexamined Risks, Unacceptable Consequences,* scientific peer review was conducted by three experts in oil spill response, oceanography and Arctic marine ecology. This review informed the development of these policy recommendations.

The Arctic Ocean's coastal villages are remote, with no connecting roads. No airports or ports along the coast are capable of supporting the influx of equipment and personnel that would be required to respond to a catastrophic oil spill.

Although it is defined by its extreme conditions and remote location, the Arctic Ocean is ecologically important, with phytoplankton, ice algae and copepods underpinning the region's marine food web. It supports a variety of iconic marine mammals such as bowhead whales, walrus, polar bears and ice seals, which are well adapted to the area's conditions and are found nowhere else in the United States. Millions of birds and various species of whales migrate great distances to the Arctic each year. More than 100 species of fish—including Arctic cod, capelin, herring and saffron cod—are found there. Indigenous communities along the coastline depend upon a healthy Arctic marine ecosystem to support the many species at the heart of their subsistence way of life.

Figure 2. *(Photo: Stephanie Sell)*—Ringed seals live in Arctic waters and are generally found with drifting sea ice. Scientists are concerned about how the loss of sea ice will impact them.

Although we know that the Arctic Ocean's ecosystems are unique, we have incomplete scientific information on many of its species and little understanding of how its ecosystems function. Compounding that lack of information is the unprecedented change that the Arctic Ocean's climate is undergoing. The loss of sea ice during summer is fundamentally altering the way Arctic ecosystems function in ways that are unknown and unpredictable. Climate change is warming the Arctic at twice the rate of the rest of the planet, decreasing ice coverage and opening up the possibility for offshore drilling at the same time that marine fish and wildlife are undergoing a great deal of stress from these rapid changes.

Figure 3. *(Photo: Henry Huntington)*—The North Slope in February. Its extreme environment could make oil spill response much more challenging.

The extreme physical environment and remote location and the unpredictable effects of climate change mean that the risks, difficulties and unknowns of oil exploration and development are far greater in the Arctic than in any other U.S. ocean area.

Industry and government plans for oil and gas exploration and development in the Arctic Ocean have been rushed, relying on a cursory environmental analysis of the potential impacts of a catastrophic oil spill. They also rely on inadequate and unproven oil spill response plans and techniques. These plans have been pushed forward despite the lack of information on Arctic marine ecosystems and the effects of climate change and a lack of understanding of the impacts that oil and gas drilling would have on the Arctic Ocean's unique species. Government officials have not fully analyzed the risks of a catastrophic oil spill in the Arctic or the existing capacity to respond to such a spill, nor have they enacted requirements focused solely on spill prevention and response in the Arctic.

To shed light on these unique challenges, the Pew Environment Group commissioned a technical report, prepared by the Nuka Research and Planning Group and Pearson Consulting, to examine the risks and potential consequences of an oil spill in the Arctic Ocean. "Oil Spill Prevention and Response in the U.S. Arctic Ocean: Unexamined Risks, Unacceptable Consequences" identifies the need for additional research on Arctic marine ecosystems and oil spill response techniques, risk assessments and prevention measures that reflect Arctic conditions. Based on the report's technical analysis, the Pew Environment Group recommends reform of the federal government's approval and oversight of Arctic Ocean oil and gas activities in four areas:

1 ***Federal resource management agencies must complete a comprehensive science plan, including research and data collection on the Arctic marine environment, before oil and gas exploration and development proceed.***

2 ***Oil spill risk assessments and spill prevention technologies must reflect Arctic conditions.***

3 ***Spill response must be tailored to Arctic conditions, and response planning standards must be strengthened.***

4 ***Review and oversight of oil and gas drilling must be enhanced.***

Implementing recommendations across these four areas would provide the government with a basis for determining whether, when, where and how to responsibly conduct oil and gas activities in the Arctic Ocean. These reforms would go a long way toward ensuring that oil and gas activities have the least possible impact on the Arctic marine environment and the region's subsistence-based indigenous communities.

Significant time and resources will be necessary to effectively address the issues identified in these recommendations and the technical report. But with so much at stake in one of the world's most

iconic and fragile ocean environments, it is responsible to adopt a precautionary approach to oil and gas drilling.

We must heed the lessons of the Deepwater Horizon blowout and proceed with careful, inclusive planning and decisions based on sound science. At present, offshore oil and gas drilling in the Arctic Ocean cannot be undertaken with any level of assurance that the marine environment can be protected from a spill or that industry can respond effectively. All proposed oil and gas activity should be suspended until the issues identified in the recommendations below are addressed through regulations or legislation.

RECOMMENDATIONS

1 Federal resource management agencies must complete a comprehensive science plan, including research and data collection on the Arctic marine environment, before oil and gas exploration and development proceed.

The Arctic Ocean is among the least understood places on Earth. We have limited information on some Arctic marine species, but much is not known or understood about the larger ecosystem. For example, we know very little about how the Arctic marine food webs work, and we have an incomplete understanding of most of the species that inhabit the Arctic Ocean. Complicating this lack of basic information about species and ecosystems is the rapid and profound environmental transformation that is occurring in the Arctic as a result of climate change. The loss of sea ice during the summer is fundamentally altering the way the Arctic marine ecosystems function. Without a thorough understanding of Arctic marine species and ecosystems, and of the shifts that are occurring because of climate change, it is impossible to accurately assess the impacts of offshore oil and gas drilling or to develop a viable plan to respond effectively to a major oil spill.

To prevent and prepare for oil spills in the Arctic Ocean, decision makers need complete information on the physical environment and the unique challenges it poses to offshore oil and gas drilling. They also need to understand the effect of drilling and oil spills on marine ecosystems. A prediction of the impacts of spilled oil in Arctic waters must take into account the behavior of oil in an environment with sea ice, the varying characteristics of sea ice throughout the year, Arctic weather conditions, the long-term fate of oil in cold water and the specific vulnerabilities of Arctic marine species and ecosystems. A comprehensive science plan and ecosystem assessment are needed for the U.S. Arctic to improve our knowledge of the environmental conditions and marine ecosystem structure and function to help decision makers avoid irrevocable impacts on the Arctic environment and its people's subsistence way of life.

An independent science gap analysis should be completed for the Arctic Ocean. Before leaders can make informed decisions about oil and gas activities, an analysis must be completed to assess current scientific information, identify gaps in our understanding of Arctic marine ecosystems and define the research that will be necessary to fill those gaps. That assessment should, at a minimum, identify the specific research needs related to species, weather and ice conditions, and the behavior of oil in Arctic waters.

Figure 4. *(Photo: Brad Benter/USFWS)*—Walrus move seasonally, with the sea ice. The population size of many marine mammals remains unknown, and changing conditions make it even more difficult for researchers. Scientists are still working toward getting an estimate for walrus in the U.S. Arctic.

The U.S. Geological Survey (USGS), at the direction of Interior Secretary Ken Salazar, is conducting an evaluation of science gaps related to OCS oil and gas development in the Beaufort and Chukchi seas. The USGS report is a good first step toward assessing the scientific gaps in knowledge, but it should undergo review by the public and by an independent science panel or organization, such as the National Research Council, to ensure that the gap analysis is thorough and scientifically defensible.

Ecologically sensitive areas must be identified and protected. Areas within an ecosystem are not equal in biological and ecological terms; some areas are more important than others to the ecosystem or human populations. Identification of important ecological areas (IEAs), based on essential habitats and functions in the Arctic ecosystem, along with traditional cultural activities, can be an important step toward protecting traditional-use areas and critical habitats and ensuring ecosystem functionality. A comprehensive science plan for the Arctic Ocean should include identification of IEAs, which should be mapped and incorporated into decisions about where and when offshore drilling can occur. The most ecologically sensitive areas in the Arctic Ocean should be removed from the leasing process.

In addition, Arctic coastal areas require more detailed environmental sensitivity index (ESI) mapping. ESI maps are a critical component of oil spill contingency planning and response in that they identify the most biologically productive areas of coastal shoreline that are used by marine species and/or people where resources should be directed first. Existing ESI maps for the Arctic are outdated and at a scale that is too coarse. To be an effective planning tool, the maps must be updated to include more detailed information.

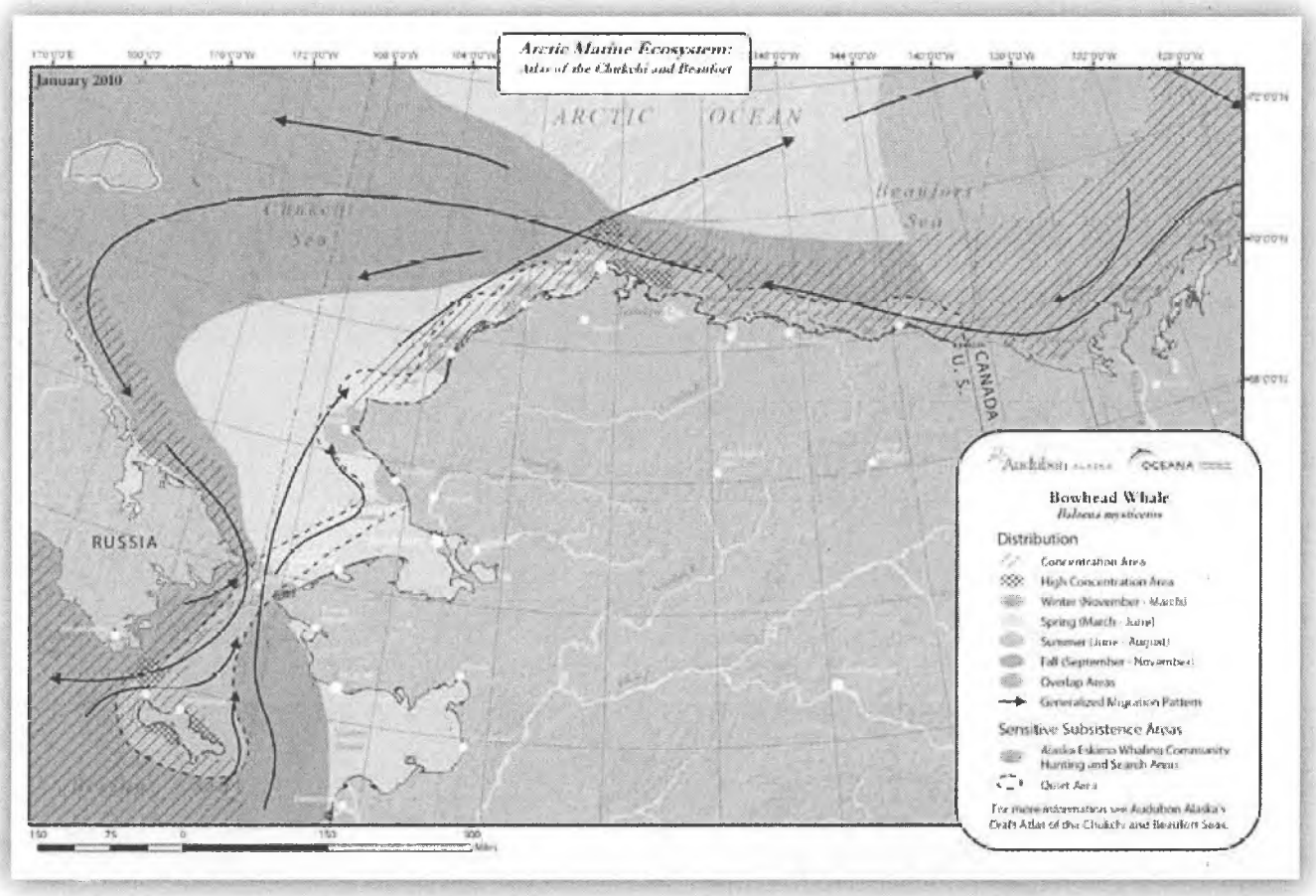


Figure 5. Bowhead Whale Migration Route *(Image: Audubon Alaska in coordination with Oceana)*—The bowhead whale is the only baleen whale that does not migrate to temperate waters and lives year-round near the sea ice.

Decision makers should incorporate traditional knowledge into Arctic research.
Communities along Alaska's Arctic coastline have followed a subsistence-based lifestyle in a physically challenging and ecologically rich region for millennia. To survive, residents have had to hone and share detailed knowledge about the region's species and conditions. This traditional knowledge should accompany research to aid the Western scientific understanding of the Arctic marine environment. Scientists' use of traditional knowledge has been rising, but a great deal more can and should be done to take advantage of and incorporate this information in research activities and management decisions. For example, a local observation and monitoring network could draw on the presence and expertise of the many hunters using the Arctic coastline who are likely to be the first to see new species, changes in existing species and other forms of ecosystem change. In the documentation of existing knowledge and the gathering of new information, those who have that knowledge should be involved throughout the research and management continuum to help analyze, interpret and apply that knowledge appropriately, in conjunction

with Western scientific findings and other relevant information. Key entities and agencies with experience in this area include the North Slope Borough Department of Wildlife Management, the Northwest Arctic Borough Planning Department, and the co-management marine mammal commissions.

Increase research funding and coordination. In addition to the need for a plan to identify ecosystem information gaps, there is also a need for a comprehensive approach to funding and oversight of science and research in the Arctic Ocean. Dedicated funding from the Oil Spill Liability Trust Fund could provide the resources needed to complete necessary research and also provide continuing funding for monitoring of species and the effects of climate change. Agencies must work together to share expertise and resources. They should also recognize and incorporate the wealth of knowledge from partners such as the North Slope Borough Department of Wildlife Management, the Alaska Ocean Observing System, the co-management marine mammal commissions and the University of Alaska, among others.

2 Oil spill risk assessments and spill prevention technologies must reflect Arctic conditions.

Risk is a product of probability and consequence. Understanding the oil spill risks associated with oil and gas drilling requires the ability to predict the probability of an oil spill and then anticipate its potential adverse consequences. Spill scenarios may range from a catastrophic well blowout to smaller spills from a pipeline, tank or vessel. Very large oil spills and well blowouts are low-probability events, but the consequences can be disastrous. Most of the planning in the Arctic Ocean has assumed that the probability of an oil spill is extremely low, based on data from other regions of United States. To reduce the potentially catastrophic impacts of oil spills from oil and gas drilling in the Arctic Ocean, a comprehensive risk assessment is needed that provides a complete picture of the types of spills that may occur and their potential impact on the Arctic environment. Specific measures must then be adopted to reduce the probability and impact of a spill. Useful risk assessments will require understanding of how and where spills might occur and how the timing, size and location of spills could affect the Arctic ecosystem in the short and long term.

An Arctic Ocean-specific risk assessment must be prepared. Because oil exploration and production in the Arctic Ocean have been limited, estimates of possible well blowouts in the Arctic have been based on data from temperate spills in the Gulf of Mexico (before the Deepwater Horizon spill). These estimates, however, have failed to adequately assess the extent to which the Arctic environment could change the equation. Arctic conditions, such as dynamic ice cover, freezing temperatures, reduced visibility (from fog or darkness), high winds and sea states, and extreme storms add to the probability of an accident or error that might cause a spill. These factors must be incorporated into estimates of future oil spill probability. Likewise, the potential consequences of an oil spill to the Arctic ecosystem can be estimated only after better baseline

science is developed. The area's sensitivity to oil spills, based on geography, season, ice conditions, and life stages of key organisms, must be better understood. To estimate how various spill scenarios might affect the Arctic ecosystem, trajectory models must have the capability to predict how oil spilled in ice-infested Arctic waters will behave. At this point, if a major oil spill were to occur in the Arctic Ocean, there would be no way to reliably estimate where the oil would travel or what the short- and long-term impacts would be.

Figure 6. *(Photo: NOAA/ESRL)*—A storm brews in the Arctic, top. *(Photo: Patrick Kelley/USCG)*—Low-lying clouds.

A sound risk assessment will require a realistic estimate of the frequency of oil spills in the offshore Arctic and a complete understanding of ecological vulnerabilities and environmental sensitivities. It must also include realistic assessments of the potential impacts from catastrophic blowout scenarios in a range of seasons and conditions.

There are several established methodologies for conducting oil spill risk assessments. One instructive example is a project on shipping being conducted by the state of Alaska and the U.S. Coast Guard in the Aleutian Islands using a methodology suggested by the National Academy of Sciences. A similar process should be conducted in the Arctic Ocean for oil and gas operations.

Spill prevention technologies must address Arctic-specific risks. After an analysis of how Arctic conditions affect the likelihood of oil spills and the impact of these spills on the environment, appropriate spill prevention measures should be identified. Measures should include restricting drilling in certain locations or imposing seasonal drilling restrictions. Prevention technologies should include redundant engineering controls such as multiple blowout prevention systems, on-site blowout containment structures and double-walled pipes or tanks. Finally, vessels and other equipment operating in the Arctic must meet appropriate engineering standards, carry additional equipment and adhere to precautionary procedures to reduce the probability of spills. To the extent that engineering standards and equipment designed for Arctic conditions do not exist, they must be developed before drilling is approved.

3 Spill response must be tailored to Arctic conditions, and response planning standards must be strengthened.

Even under ideal conditions in populated regions with temperate climates, cleaning up an oil spill in open water is challenging. It requires simultaneous efforts to stop the spill, contain the oil and remove as much of it as quickly as possible from the water. The Deepwater Horizon cleanup enlisted thousands of people, more than 3 million feet of containment boom, millions of gallons of dispersants and more than 6,500 vessels. An oil spill in Arctic waters would be considerably more challenging. Standard oil containment and recovery techniques may be constrained or ineffective because of ice or weather conditions. In addition, oil lasts longer in Arctic waters because it evaporates more slowly or may be trapped in or under ice. Moreover, the infrastructure to support an effective containment and removal response effort is limited. Consequently, an oil spill in the U.S. Arctic Ocean could be devastating to the environment and to the people who depend on it for their subsistence.

Oil spill response systems and technologies are unproved in the Arctic Ocean. Of the three response options available, all face limitations in Arctic conditions and may harm marine species. There are very narrow conditions in which mechanical recovery, in-situ burning and dispersants can be used in Arctic waters.

Mechanical recovery, the industry's primary response system, employs skimmers, booms, boats and personnel to collect and remove oil from the surface. The equipment is most effective in open water; in broken ice conditions, with ice concentration as low as 10 percent, the efficiency of mechanical recovery falls significantly. This method depends heavily on the ability of personnel to position boats, booms and skimmers and is susceptible to shutdown if any of these factors is affected by poor visibility, dense fog, high sea states and/or freezing temperatures.

In-situ burning is the industry's secondary response technique. Small-scale trials have shown that it may work in a variety of ice conditions; however, burning oil in sea ice requires that the slick be thick enough to ignite, and burning is not safe or feasible in high winds. In addition, in-situ burning creates toxic smoke and leaves behind oily residue that is difficult to recover and can harm marine species. Moreover, in higher ice concentrations, thick slicks are likely to occur in the open leads or polynyas between solid ice. These interfaces between ice and water are ecologically vital; the impact of an oil spill would be widespread on a range of species, from phytoplankton at the base of the food chain that live on the underside of the ice, to marine mammals that surface and breathe at these openings.

Chemical dispersants are still relatively untested in the Arctic Ocean, and many questions remain about their use in ice-infested waters. Dispersants become less effective in conditions such as those in the Arctic: reduced water temperatures, presence of sea ice and bad weather. Very little is known about the toxic effects of dispersants on marine organisms and communities. Furthermore,

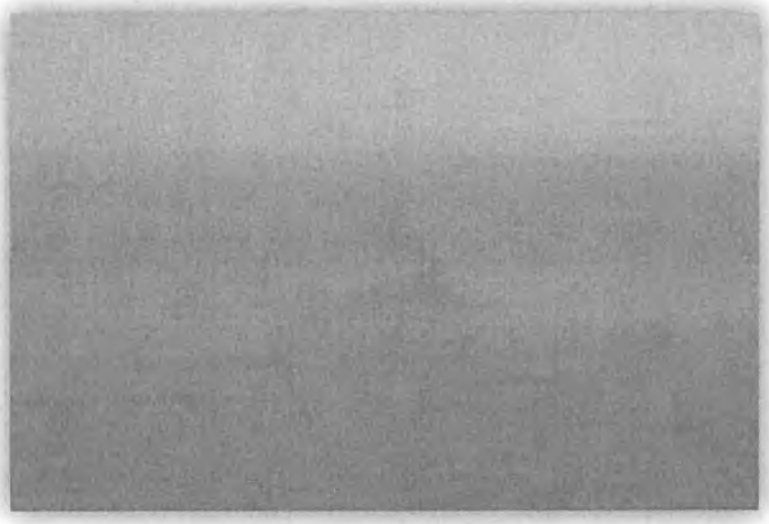
no studies have examined the effect of subsea dispersant application; the Deepwater Horizon spill was the first use of this tactic. In addition, dispersant application is limited by environmental conditions and weather, and aerial applications require low wind and good visibility. For these reasons, dispersants have not been preapproved for use in the Arctic Ocean.

Figure 7. *(Photo: SINTEF)*—SINTEF JIP controlled study with pre-positioned booms and response.

Current industry spill response plans are based on small-scale laboratory and field trials that have been extrapolated without large-scale verification. The Joint Industry Program (JIP) recently completed testing on oil spill response in broken ice conditions, but these tests, conducted in the Norwegian Barents Sea, did not include the logistical and operational constraints associated with day-to-day operations in the U.S. Arctic Ocean. A given technology may work well under controlled conditions in which preplanned tests eliminate real-world variables such as detection and containment of oil and mobilization of required equipment and personnel within the window of opportunity for effective treatment. These controlled trials provide critical information, but they do not demonstrate effectiveness or feasibility.

Response plans must include relief wells and other containment options. During an oil spill, stopping the flow of oil as quickly as possible is critical to minimizing environmental damage. For offshore drilling operations, the two methods for controlling a blowout are drilling a relief well and installing a containment structure. These options must be tested and ready for immediate deployment to avoid a blowout as long as the Deepwater Horizon incident, and they must be proved effective in Arctic conditions.

Spill response plans should require that industry is able to quickly deploy an alternative drill rig to immediately begin drilling a relief well, which must be completed before the end of drilling season, when sea ice forms. Canada has adopted such a policy, called same-season relief well capability. The policy requires companies to have the resources and personnel available in advance and to demonstrate that a relief well can be drilled within a specific time frame. In the Arctic, this might mean that exploration or production drilling should not occur late in the season if a relief well cannot be completed before ice precludes drilling activity.



Spill response plans should also include a requirement that companies have a prefabricated containment structure, demonstrated to work at the well location, before beginning exploration or production drilling. The structure and necessary resources or personnel would have to be available for immediate deployment.

Figure 8. *(Photo: Collection of Pablo Clemente-Colon, chief scientist, National Ice Center)*—Icebreaker navigates through heavy fog.

A response gap analysis must be prepared by responding agencies. In light of the questions regarding the effectiveness of oil spill response methods in Arctic conditions, a response gap analysis must be conducted. The purpose of this gap analysis (distinct from the research gap analysis) is to quantify the limit at which environmental conditions (temperature, wind, sea state, ice, visibility) preclude response and to calculate the frequency with which those conditions typically occur in the Arctic Ocean. This information will define the effectiveness of each spill response method in Arctic waters.

The analysis must be conducted by the agencies with responsibility for response: the U.S. Coast Guard (USCG), the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). Such an analysis will help to define additional preventive measures, including seasonal drilling limits, which must be in place during times when an oil spill could not be contained or cleaned up.

Infrastructure gaps must be assessed and addressed. Because of its remote location and harsh environment, the Arctic Ocean's Alaskan coast has widely scattered communities and few year-round residents. Transportation, communication, equipment storage and deployment infrastructure are nonexistent or extremely limited. If a catastrophic oil spill were to occur, days or weeks could pass before response personnel and assets could be mobilized and deployed. The nearest USCG station is nearly 950 air miles away, and the closest major port is Dutch Harbor, 1,300 miles away.

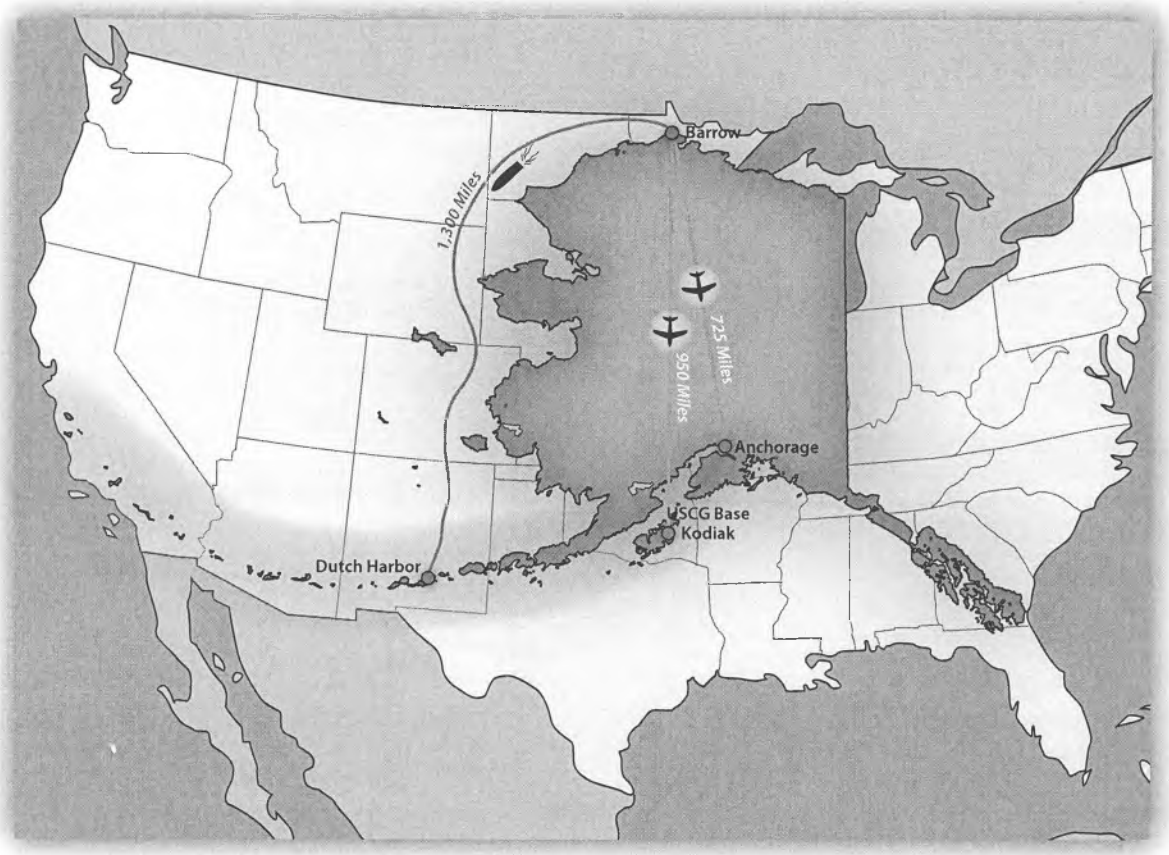


Figure 9. *(Image: Nuka Research and Planning)*—**Distance from Barrow, Alaska (in U.S. Arctic Ocean), to nearest major port (Dutch Harbor) and nearest Coast Guard air station (Kodiak)**

Limited air access makes quick transportation of response equipment impossible, and storage and housing to mount an adequate response effort do not exist, especially in the Chukchi Sea, where lease sites are up to 150 miles from shore. The lack of infrastructure for a major oil spill response is a limiting factor in the Arctic that has not been addressed effectively. A comprehensive assessment of infrastructure needs must be conducted by the Department of the Interior (DOI) in coordination with the USCG, NOAA, and state and borough governments. Strategies to address these infrastructure gaps must be put in place before oil and gas development in the Arctic Ocean can proceed. The USCG's pending high-altitude study should inform this effort.

Spill trajectory models based on Arctic conditions must be developed. Because accurate models of movement of oil in sea ice do not exist, it is impossible to accurately project oil spill trajectories for the U.S. Arctic Ocean. This information is critical to the development of an effective oil spill contingency plan.

Worst-case scenarios must be based on actual conditions. Oil spill contingency plans are based on worst-case discharge scenarios. To be effective planning tools, such scenarios should be based on actual well flow data. Currently, worst-case projections in the Arctic are based on unsupportable well flow assumptions that minimize the potential effects of an oil spill and skew decisions about whether and how to approve exploration or development activity. Moreover, using an inaccurate flow rate will lead to a response plan that may be insufficient to address an actual worst-case spill.

In areas such as the Chukchi Sea, where actual flow rates are unknown, spill plans assume a flow rate of 5,500 barrels of oil a day. This assumption, an average developed by the state of Alaska, is not based on well pressure information from wells in the surrounding region or on known geophysical data. A worst-case scenario based on this assumed flow rate can seriously underestimate the size of a spill and its impact. Rather than relying on an unsupported flow rate, the federal government should require that estimated flow rates be based on available information. Drillers must collect sufficient geophysical and offset well data to estimate subsurface well pressures before drilling can safely begin. Flow rates can be estimated using this and any other available data, and DOI must maintain the technical engineering expertise necessary to verify the accuracy of these rates. More accurate estimates of well flow rates will ensure that worst-case scenarios do, in fact, estimate a worst-case spill. Accurately predicting a worst-case spill is critical to determining whether and under what conditions drilling can occur, and to ensuring that adequate response capability is in place.

Worst-case discharge volume estimates should also factor in the time required to stop the blowout. The flow rate (in barrels per day) must be multiplied by the number of days required to stop a discharge. The Deepwater Horizon blowout continued for three months, and other blowouts have lasted longer. Yet most Arctic Ocean oil spill contingency plans consider a duration of only 30 days or less, severely underestimating the total volume of oil that could be spilled and the corresponding spill response resource needs and environmental impacts.

Response planning standards must be strengthened. Oil spill contingency plans must meet a number of statutory and regulatory planning standards for how a response would be conducted, but there is no performance standard requirement. Regulations do not require industry to demonstrate that its response plan will work in real-world Arctic conditions, that response equipment can be deployed immediately and that chosen equipment can in fact remove oil from the environment and meet an acceptable performance target. Instead, current plans are paper exercises with no process to verify that they will work. A response planning standard should be adopted requiring industry to define the amount of oil that could be released during a catastrophic oil spill. Additionally, industry must be required to demonstrate in detail that adequate equipment, personnel and resources—and contracts to immediately deploy them—are in place and ready to respond to a catastrophic spill.

Spill recovery and cleanup assumptions must be questioned, verified and amended as necessary before DOI approves a response plan. The approved spill response plan for Shell Oil's Arctic exploration drilling assumes 90 percent open-water recovery of oil under a worst-case spill scenario, despite the well-accepted fact that recovery under the most optimal conditions averages about 20 percent.

Response standards must clarify that removal of oil is the priority of spill response. The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) defines the term "remove" to include actions to minimize or mitigate damage to public health or the environment. Mitigation, however, is a separate response method and should not be considered to be a means of removal. Merging mitigation into a definition of removal can lead to dependence on cheaper mitigation methods rather than employment and refinement of removal techniques.

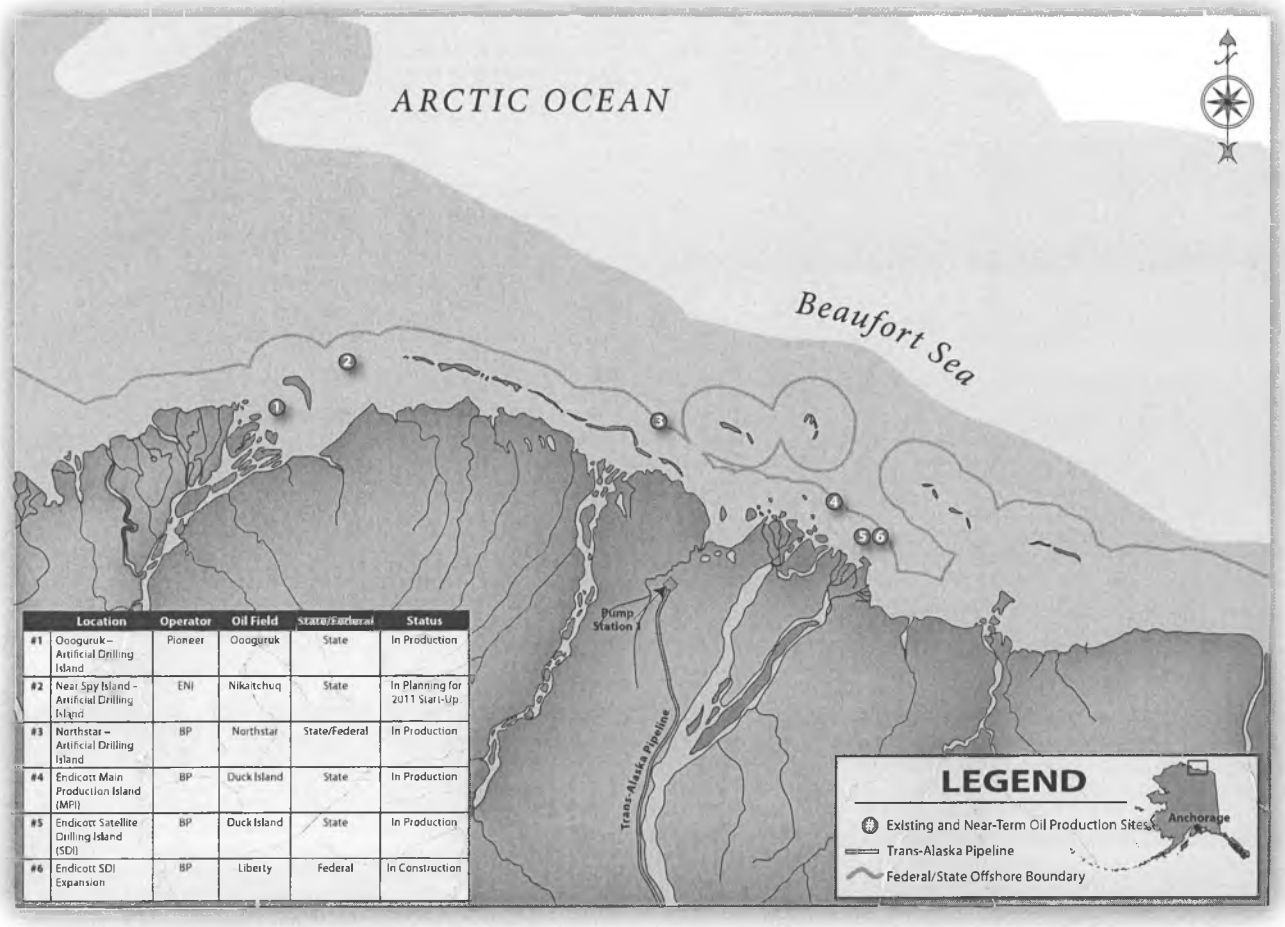
Independent third-party review of contingency plans is perhaps the best way to ensure that effective planning standards are met. In addition, contingency plan requirements should be audited regularly for ongoing compliance during the period of exploration and/or production.

4 Review and oversight of oil development activities must be enhanced.

Historically, little offshore oil and gas activity has occurred in the U.S. Arctic Ocean. The Bush administration greatly expanded the area available for leasing, however, increasing it from 9 million to 69 million acres. This rapid expansion of activity occurred without a clear understanding of Arctic conditions and ecosystems, the region's subsistence-dependent communities and the effect of rapid climate change on the region.

Lax oversight of the oil and gas industry, a factor in the Deepwater Horizon catastrophe, has been repeatedly acknowledged in government reports issued before and after the Gulf spill. Included are reports from DOI (May 25 and Sept. 1, 2010) and its inspector general's office (Sept. 10, 2008); the House Committee on Oversight and Government Reform (Oct. 7, 2009); and the Government Accountability Office (April 8, 2010). Strong oversight of offshore oil and gas drilling is a critical measure for preventing oil spills and ensuring that the impact of any spill is minimized.

Review and oversight of oil development activities must be objective. Review of oil exploration and development plans and permits must be free of undue influence from industry. Federal employees must assess risks objectively and challenge unrealistic assumptions from industry to ensure protection of public resources. Considerable attention has focused on the decision-making culture within DOI and the extent of influence that industry has exerted over the agency charged with regulating its activities and protecting public resources. The culture and approach of the former Minerals Management Service (MMS)—now BOEMRE—must change.



	Location	Operator	Oil Field	State/Federal	Status
#1	Oooguruk – Artificial Drilling Island	Pioneer	Oooguruk	State	In Production
#2	Near Spy Island – Artificial Drilling Island	ENI	Nikaitchuq	State	In Planning for 2011 Start-Up
#3	Northstar – Artificial Drilling Island	BP	Northstar	State/Federal	In Production
#4	Endicott Main Production Island (MPI)	BP	Duck Island	State	In Production
#5	Endicott Satellite Drilling Island (SDI)	BP	Duck Island	State	In Production
#6	Endicott SDI Expansion	BP	Liberty	Federal	In Construction

Figure 10. Existing Production

Structural and regulatory changes DOI has undertaken to reform management and enhance oversight of industry are a step in the right direction. However, additional standards must be adopted, and the organizational changes and ethics reforms included in legislation proposed by Congress should be passed.

Review and oversight of oil development activities must involve all relevant agencies. BOEMRE cannot continue operating in a "silo," as MMS did for many years. In particular, NOAA, which has resource protection responsibilities for Arctic marine species under the Marine Mammal Protection Act, the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act, should have a greater role in making initial decisions about whether, when, where and how oil and gas development activities can occur.

NOAA should have a substantive role in the preparation of five-year oil and gas leasing programs as well as oil spill response plans. Specifically, NOAA should conduct a comprehensive analysis on

the functioning of the Arctic ecosystem and species that could be affected by oil development. NOAA should also engage more fully in permitting and environmental analysis decisions under the National Environmental Policy Act.

The USCG, the on-scene coordinator and lead agency for response, should play a meaningful part in identifying how oil and gas drilling in the Arctic Ocean proceeds. The USCG should have joint authority (with BOEMRE) to review oil spill response plans. Currently, the USCG is responsible for reviewing oil spill response plans for vessels but has not been actively engaged in the review of plans for offshore facilities. It is illogical to treat vessels and facilities differently and to make the USCG responsible for spill response but not formally involved in response planning or spill prevention for facilities. The U.S. Fish and Wildlife Service (USFWS), the USGS and the EPA should also be involved in decisions affecting resources within their jurisdictions.

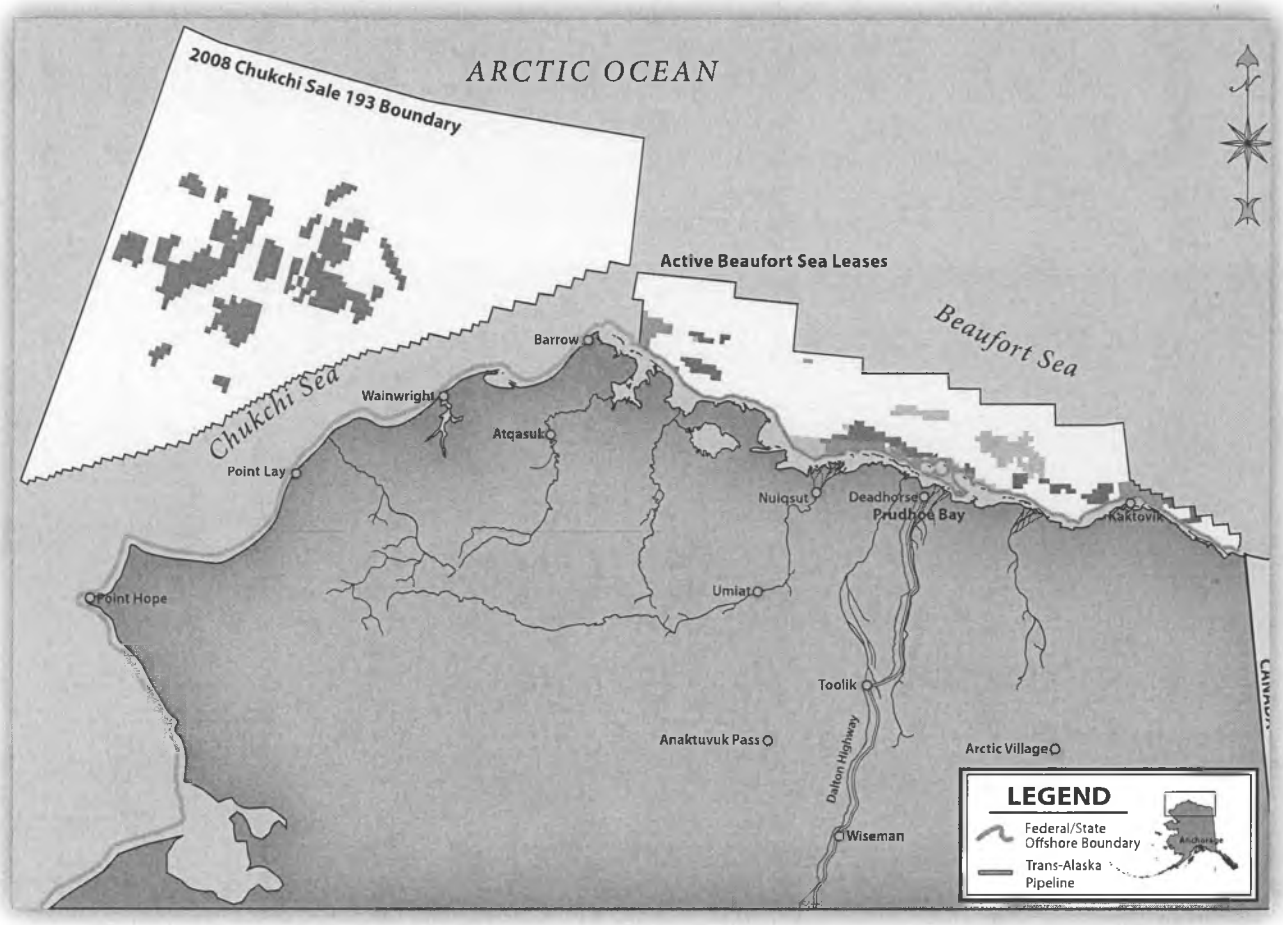


Figure 11. Map of Active Lease Areas in Arctic OCS (Chukchi and Beaufort Seas)

Figure 12. *(Photo: USGS)*—U.S. Coast Guard cutter Healy in the Arctic.

Oversight must include enhanced inspections and testing. The Deepwater Horizon spill highlighted the fact that industry inspections and emergency drills are not occurring at a level necessary to reduce the risk of spills. Inspections of facilities—including unannounced visits—should be conducted frequently to test the functioning of equipment and safety systems. In addition, regular and frequent test runs on emergency procedures and spill response should be required before drilling permits are issued, and operations should be halted if violations are found.

Equally important, BOEMRE must change the current management of inspection programs to ensure that inspectors have sufficient training and resources to undertake thorough and objective inspections and that their expertise is not undermined. The OCS Safety Oversight Board's Sept. 1, 2010, report documents a number of structural and management deficiencies in the existing inspection system, including a lack of bureauwide guidance on practices and inspector roles and responsibilities. Specifically, there is no standard bureauwide guidance for inspectors on applicable rules, regulations and policies as well as standard practices, roles and responsibilities. In addition, inspectors are not receiving the certification and training necessary to perform their jobs effectively and do not have sufficient resources, such as laptop computers. Equally disturbing, management routinely pressures inspectors to minimize reporting violations or undermines inspectors by rescinding citations. BOEMRE management's culture of supporting industry must change, and the inspection programs must be restructured and enhanced to ensure that inspectors have the training, resources and independence to perform their jobs.

Citizen input must be incorporated into oversight through regional citizens' advisory councils. Establishment of regional citizens' advisory councils (RCACs) could help prevent future oil spills. These councils should follow the model of the Prince William Sound RCAC, established by the Oil Pollution Act of 1990 after the Exxon Valdez oil spill. In Prince William Sound, citizen participation in the oversight of industry activities has prevented complacency and ensured vigilant review. The RCAC also performs an important independent oversight function by reviewing oil spill contingency plans. This has proved to be one of the most important methods for preventing oil spills in Prince William Sound and ensuring that tested, well-maintained response capability is in place.

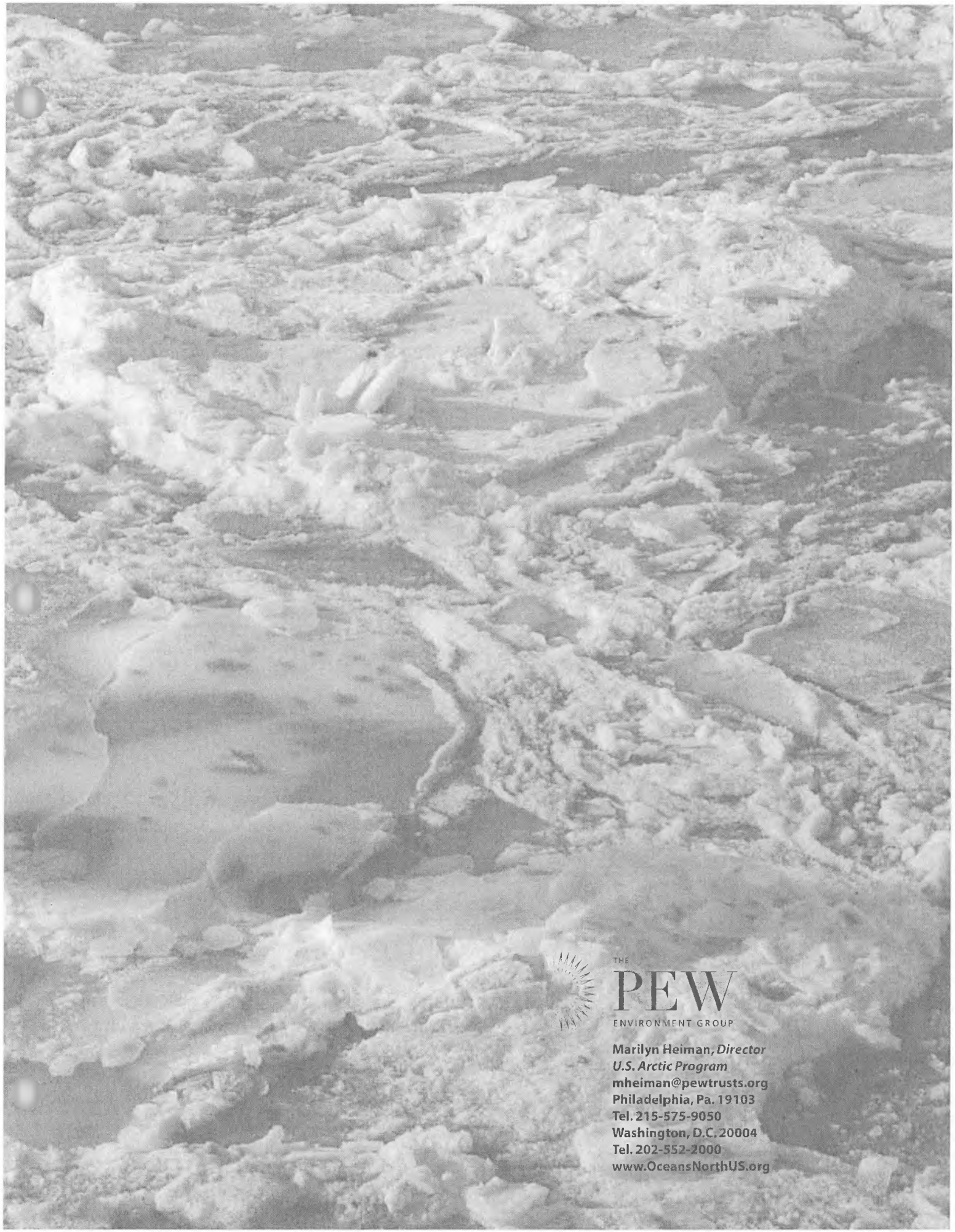
Similar RCACs in the Arctic could provide advice and recommendations to DOI and the industry on development activity as well as associated pipelines and tankers in the region. They would also provide advice to DOI regarding the five-year leasing schedule, lease sales, exploration and production in the region, and oil spill contingency plans.

Adequate funding for oversight activities can be provided through statutorily established funding. Agencies with expertise on Arctic marine species and the environment and with responsibility for some aspect of spill response—including the USCG, NOAA, USFWS, USGS and EPA—should receive sufficient funding to undertake necessary monitoring and enforcement activities. Funding should be made available from the Oil Spill Liability Trust Fund for drills, inspections and contingency plan reviews, as well as review of five-year programs, lease sales and individual permits for offshore drilling. Funding for the Oil Spill Liability Trust Fund should be made permanent.

CONCLUSION

The Arctic Ocean presents unique challenges to oil and gas drilling that should not be underestimated. Before exploration and production drilling proceeds in Arctic waters, DOI and other agencies with relevant expertise must reassess the conditions under which future drilling might occur. The key issues that must be addressed include: (1) the need for research and data collection to provide an understanding of Arctic species, ecosystems and environmental conditions, and the impacts of oil spills in that environment; (2) the need for candid risk assessments and imposition of risk prevention measures; (3) identification of the response gap (shortfalls in spill response systems) and spill prevention measures such as drilling restrictions that must be in place to mitigate that response gap; and (4) vigilant oversight by government agencies and citizens to reduce the possibility of oil spills.

Cover photos, from left: spectacled eider, U.S. Fish and Wildlife Service; oil rig, Stockbyte/Getty Images; bearded seal, Brendan Kelly; children, Burgess Blevins/Getty Images; background ice, Nuka Research and Planning LLC



THE
PEW
ENVIRONMENT GROUP

Marilyn Heiman, *Director*
U.S. Arctic Program
mheiman@pewtrusts.org
Philadelphia, Pa. 19103
Tel. 215-575-9050
Washington, D.C. 20004
Tel. 202-552-2000
www.OceansNorthUS.org

ARCTIC OIL SPILL REPORT

Oil Spill Prevention and Response in the U.S. Arctic Ocean: Unexamined Risks, Unacceptable Consequences details major gaps in response planning and Arctic marine ecosystem science. Government and industry oil spill response plans fail to account for the region's remoteness and harsh conditions and fail to protect the fragile Arctic marine ecosystems and food webs that support walrus, polar bears and other marine mammals found nowhere else in the United States.

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- The Arctic Ocean is a vital ecosystem for unique species found nowhere else in the US: polar bears, ice seal species, walrus, bowhead whales, and myriad fish and bird species. This ecosystem and its iconic species already are under strain from climate change. Even a moderate-sized spill that occurs in an area where sensitive or threatened species are concentrated could have devastating effects.
- Approximately 8,000 people live in this area, and depend on marine mammals and fish for as much as 60 percent of their diet. A reduction in the availability or safety of subsistence foods could have a profound impact on both the economy and culture of Arctic communities.
- Shifting sea ice, high seas, brutal winds and sub-zero temperatures could shut down spill response any time of the year. Even if drilling were limited to open-water season, a blowout that occurred late in the fall could continue for eight or nine months if a relief drill could not be completed before the ice pack moved in.

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U.S. Coast Guard Ice Breaker Healy In U.S. Arctic Waters
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Walrus, Arctic Ocean
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Sea Ice in the Arctic
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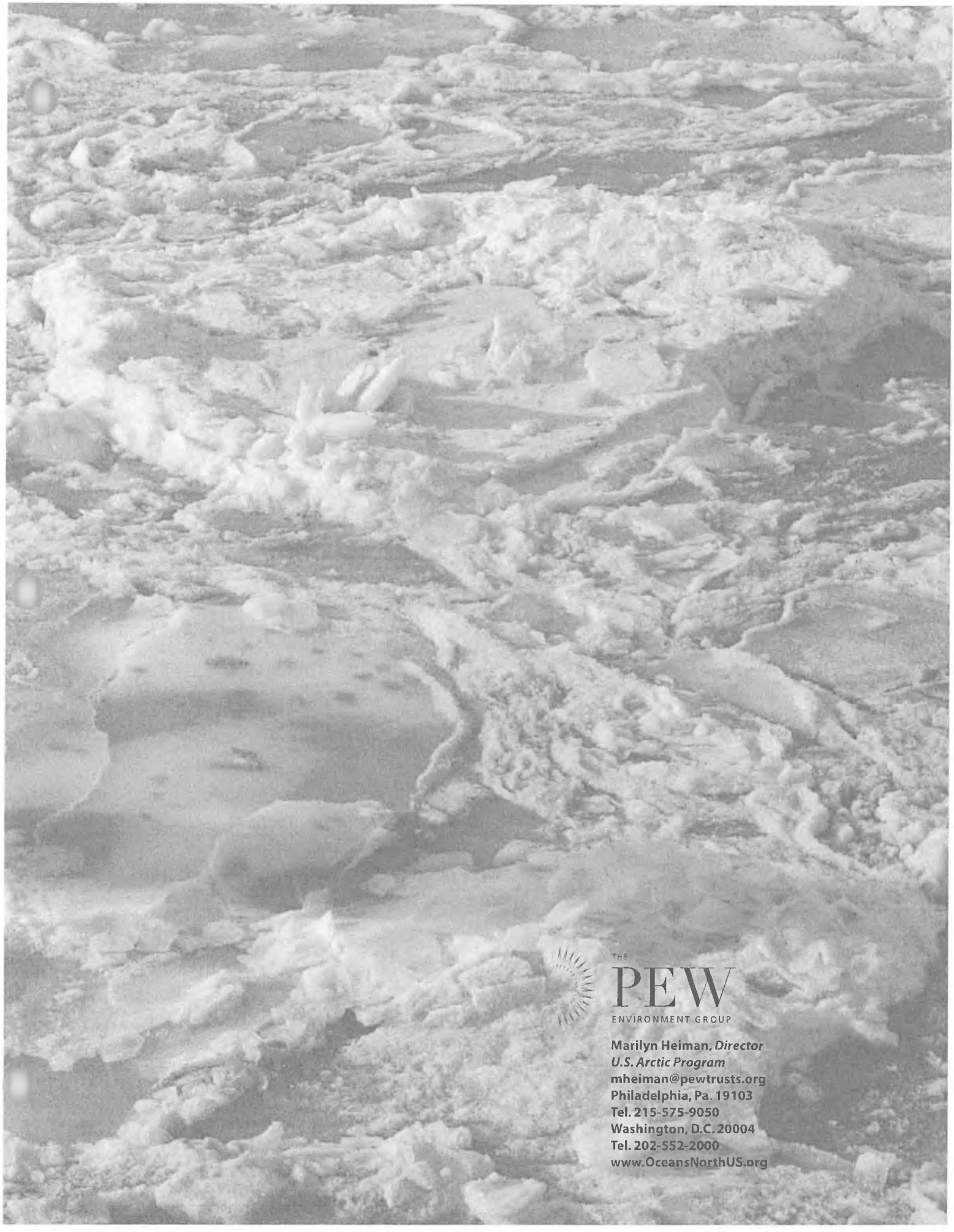

THE
PEW
ENVIRONMENT GROUP

Marilyn Heiman, ***Director***
U.S. Arctic Program
mheiman@pewtrusts.org
Philadelphia, Pa. 19103
Tel. 215-575-9050
Washington, D.C. 20004
Tel. 202-552-2000
www.OceansNorthUS.org

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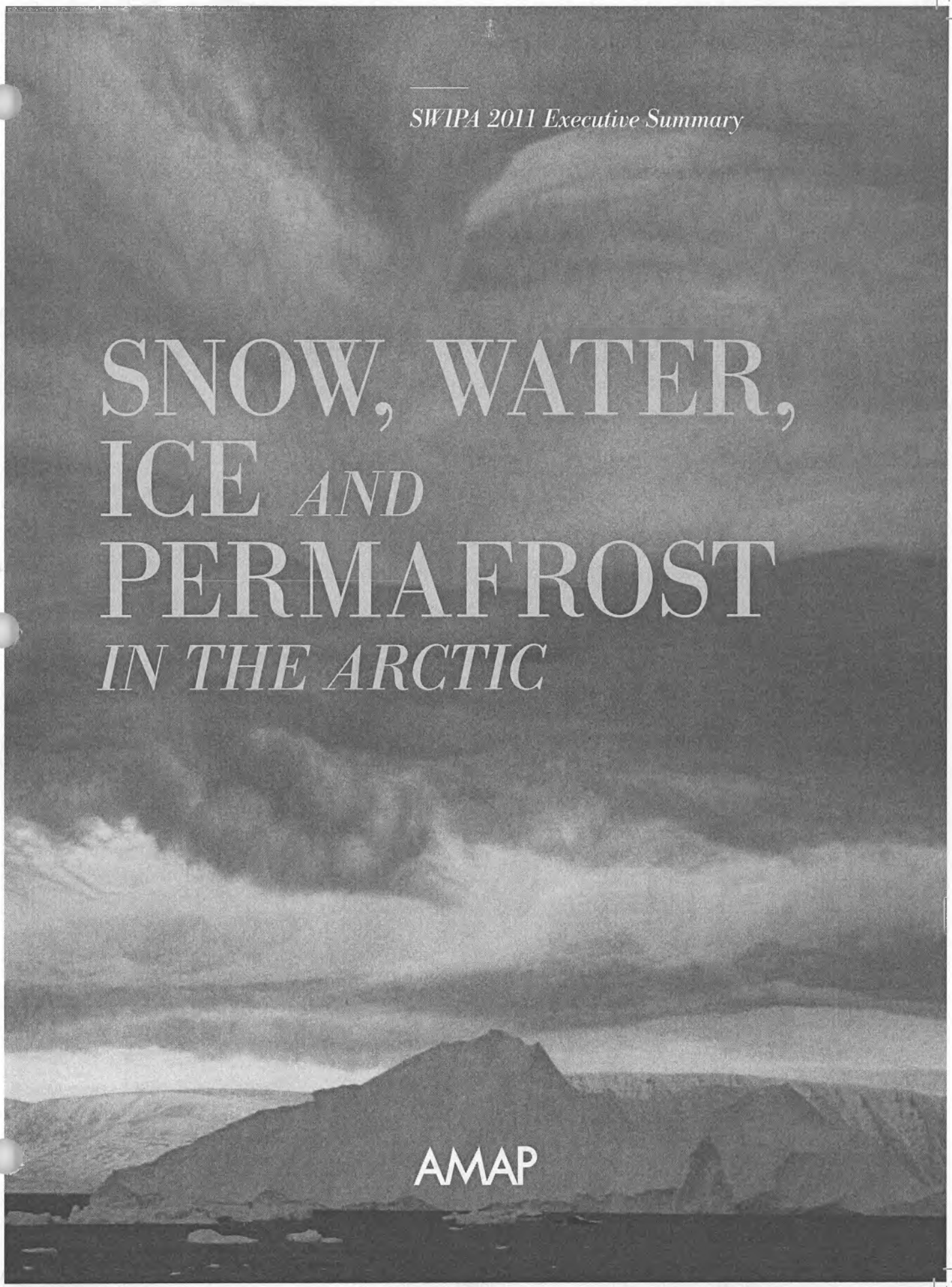
Snow, Water, Ice and Permafrost in the Arctic, SWIPA Executive Summary



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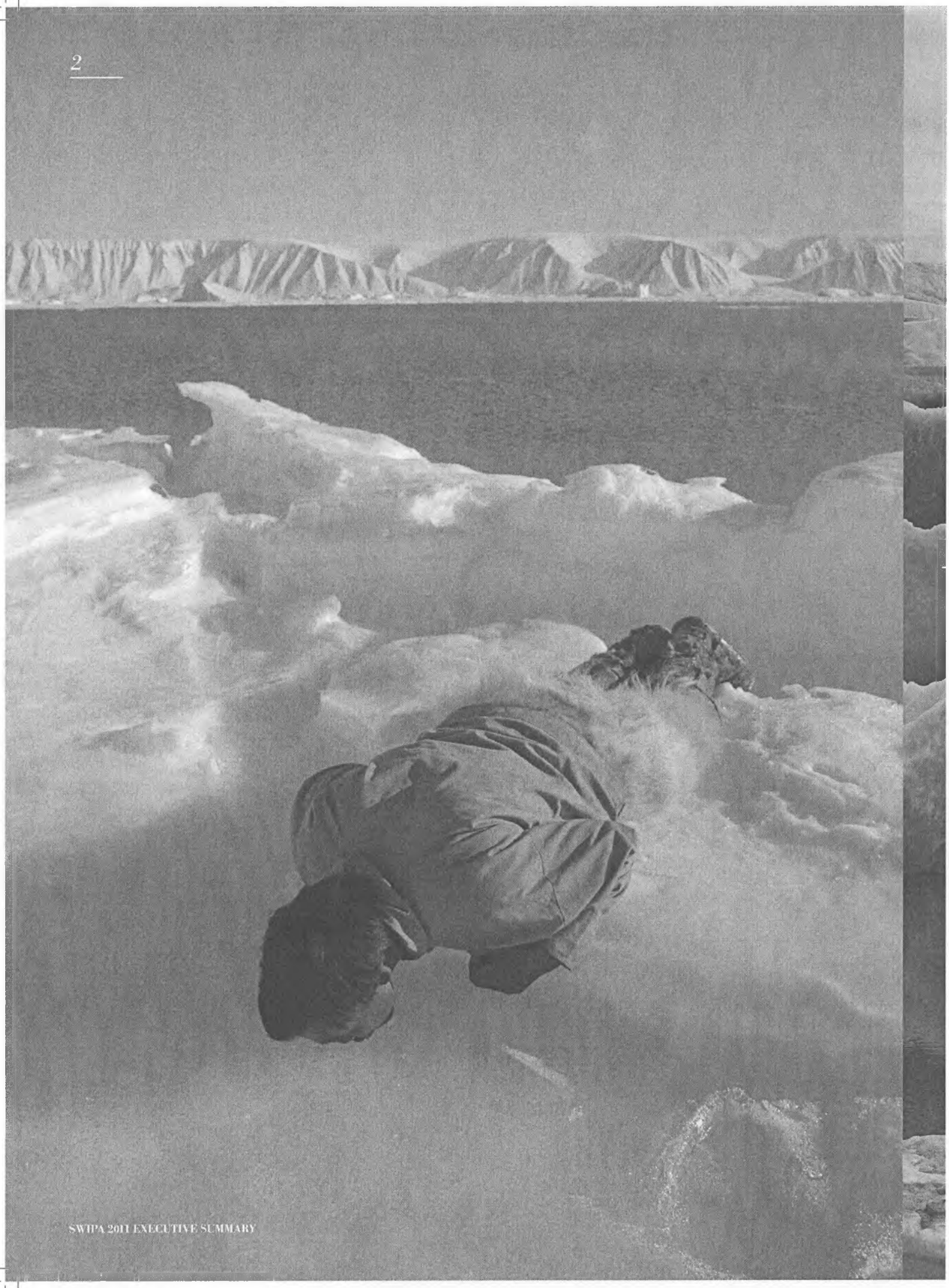
SNOW, WATER, ICE *AND* PERMAFROST *IN THE ARCTIC*

AMAP



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EXECUTIVE SUMMARY AND KEY MESSAGES

SWIPA Summary for policymakers

AMAP's new assessment of the impacts of climate change on Snow, Water, Ice and Permafrost in the Arctic (SWIPA) brings together the latest scientific knowledge about the changing state of each component of the Arctic 'cryosphere'. It examines how these changes will impact both the Arctic as a whole and people living within the Arctic and elsewhere in the world.

'Cryosphere' is the scientific term for that part of the Earth's surface that is seasonally or perennially frozen. It includes snow, frozen ground, ice on rivers and lakes, glaciers, ice caps, ice sheets and sea ice. The cryosphere structures the physical environment of the Arctic. It provides services to humans such as freshwater supplies and transport routes. The cryosphere is an integral part of the climate system, and affects climate regionally and globally.

The SWIPA Assessment follows on from the Arctic Climate Impact Assessment (ACIA), published in 2005. It aims to update the findings from ACIA and to provide more in-depth coverage of issues related to the Arctic cryosphere.

The observed changes in sea ice on the Arctic Ocean and in the mass of the Greenland Ice Sheet and Arctic ice caps and glaciers over the past ten years are dramatic and represent an obvious departure from the long-term patterns.

Some elements of the cryosphere, such as the extent of snow, ice over water, and the dynamics of glaciers and ice streams vary greatly over short timescales (seasonally, or from year to year) and from place to place. Other aspects of the cryosphere, such as the extent of permafrost and large ice sheets, vary and change over decadal time scales and large areas. Distinguishing long-term change from natural variability requires data to be collected at many locations over many years and carefully analyzed. Detecting these cryospheric responses to changing climate presents different challenges and requires long term records as well as high frequency observations.

WHY THE ARCTIC CRYOSPHERE IS CHANGING

The past six years (2005–2010) have been the warmest period ever recorded in the Arctic. Higher surface air temperatures are driving changes in the cryosphere.

Key finding 1

There is evidence that two components of the Arctic cryosphere – snow and sea ice – are interacting with the climate system to accelerate warming.

Key finding 2

The Arctic is warming. Surface air temperatures in the Arctic since 2005 have been higher than for any five-year period since measurements began around 1880. The increase in annual average temperature since 1980 has been twice as high over the Arctic as it has been over the rest of the world. Evidence from lake sediments, tree rings and ice cores indicates that Arctic summer temperatures have been higher in the past few decades than at any time in the past 2000 years. Previously unseen weather patterns and ocean currents have been observed, including higher inflows of warm water entering the Arctic Ocean from the Pacific. These changes are the main drivers of change in the Arctic cryosphere.

In attributing the cause of warming in the Arctic, SWIPA refers to the findings of the Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC). This states that *"Most of the observed increase in global average temperatures since the mid-20th century is very likely* [> 90% probability] *due to the observed increase in anthropogenic GHG* [greenhouse gas] *concentrations".*

Climate-cryosphere interactions may now be accelerating warming

The greatest increase in surface air temperature has happened in autumn, in regions where sea ice has disappeared by the end of summer. This suggests that the sea is absorbing more of the sun's energy during the summer because of the loss of ice cover. The extra energy is being released as heat in autumn, further warming the Arctic lower atmosphere. Over land, the number of days with snow cover has changed mostly in spring. Early snow melt is accelerated by earlier and stronger warming of land surfaces that are no longer snow-covered.

These processes are termed 'feedbacks'. Snow feedbacks are well known. The sea ice feedback has been anticipated by climate scientists, but clear evidence for it has only been observed in the Arctic in the past five years.

A number of other potential feedback mechanisms at play in the Arctic have been identified. These mechanisms can alter the rate or even direction of climate change and associated changes in the cryosphere. Of those feedbacks expected to have strong effects, eight lead to further and/or accelerated warming, and just one leads to cooling. The intensity of feedbacks between the cryosphere and climate are not yet well quantified, either within the Arctic or globally. This lends considerable uncertainty to predictions of how much and how fast the cryosphere and the Arctic environment will change.

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HOW THE ARCTIC CRYOSPHERE IS CHANGING

The extent and duration of snow cover and sea ice have decreased across the Arctic. Temperatures in the permafrost have risen by up to 2 °C. The southern limit of permafrost has moved northward in Russia and Canada.

Key finding 3

The largest and most permanent bodies of ice in the Arctic – multi-year sea ice, mountain glaciers, ice caps and the Greenland Ice Sheet – have all been declining faster since 2000 than they did in the previous decade.

Key finding 4

Model projections reported by the Intergovernmental Panel on Climate Change (IPCC) in 2007 underestimated the rates of change now observed in sea ice.

Key finding 5

The extent and duration of snow cover have decreased throughout the Arctic. The Arctic land area covered by snow in early summer has reduced by 18% since 1966. Coastal areas of Alaska and northern Fennoscandia have seen the strongest decreases in the number of days with snow cover. The change is largely caused by snow melting earlier in the spring. Snow depth has decreased in some areas such as the North American Arctic, but has increased in others such as northern Russia.

Permafrost – permanently frozen ground – underlies most of the Arctic land area and extends under parts of the Arctic Ocean. Temperatures in the permafrost have risen by up to 2°C over the past two to three decades, particularly in colder sites (typical permafrost temperatures range from -16°C to just below 0°C, depending on the location). The depth of soil above the permafrost that seasonally thaws each year has increased in Scandinavia, Arctic Russia west of the Urals, and inland Alaska. The southern limit of the permafrost retreated northward by 30 to 80 km in Russia between 1970 and 2005, and by 130 km during the past 50 years in Quebec.

Ice cover on lakes and rivers in the Northern Hemisphere is breaking-up earlier than previously observed. Studies of sediments in High Arctic lakes indicate that the duration of ice cover on some lakes has declined significantly over the past 100 years. The rates of change in lake and river ice conditions vary across the Arctic, although there are few long-term systematic observations.

Large bodies of ice are melting faster

Net loss of mass from the Greenland Ice Sheet has increased from an estimated 50 Gt per year (50 000 000 000 metric tonnes per year) in the period 1995–2000 to ~200 Gt per year in the period 2004–2008. The current loss (~200 Gt per year) represents enough water to supply more than one billion city-dwellers.

Nearly all glaciers and ice caps in the Arctic have shrunk over the past 100 years. The rate of ice loss increased over the past decade in most regions, but especially in Arctic Canada and southern Alaska. Total loss of ice from glaciers and smaller ice caps in the Arctic probably exceeded 150 Gt per year in the past decade, similar to the estimated amount being lost from the Greenland Ice Sheet.

Arctic sea-ice decline has been faster during the past ten years than in the previous 20 years. This decline in sea-ice extent is faster than projected by the models used in the IPCC's Fourth Assessment Report in 2007. The area of sea ice persisting in summer (polar pack ice) has been at or near record low levels every year since 2001. It is now about one third smaller than the average summer sea-ice cover from 1979 to 2000. New observations reveal that average sea-ice thickness is decreasing and the sea-ice cover is now dominated by younger, thinner ice.

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MORE CHANGE IS EXPECTED

Average Arctic autumn-winter temperatures are projected to increase by between 3 and 6 °C by 2080, even using scenarios in which greenhouse gas emissions are projected to be lower than they have been for the past ten years.

The climate models used for SWIPA do not include possible feedback effects within the cryosphere system that may release additional stores of greenhouse gases from Arctic environments.

Arctic snowfall and rain are projected to increase in all seasons, but mostly in winter. Despite this, Arctic landscapes are generally expected to dry out more during summer. This is because higher air temperatures mean that more water evaporates, snow melt finishes earlier, and water flow regimes are altered.

With increasing snowfall, all projections show maximum snow depth during winter increasing over many areas. The greatest increases (15–30% by 2050) are expected in Siberia. Even so, snow will tend to lie on the ground for 10–20% less time each year over most of the Arctic, due to earlier melting in spring.

Models project continued thawing of permafrost.

Projections show that sea-ice thickness and summer sea-ice extent will continue to decline in the coming decades, although considerable variation from year to year will remain. A nearly ice-free summer is now considered likely for the Arctic Ocean by mid-century. This means there will no longer be any thick multi-year ice consistently present.

Climate model projections show a 10–30% reduction in the mass of mountain glaciers and ice caps by the end of the century.

The Greenland Ice Sheet is expected to melt faster than it is melting now, but no current models can predict exactly how this and other land-based ice masses in the Arctic will respond to projected changes in the climate. This is because ice dynamics and complex interactions between ocean, snow, ice and the atmosphere are not fully understood.

Maximum snow depth is expected to increase over many areas by 2050, with greatest increases over Siberia. Despite this, average snow cover duration is projected to decline by up to 20% by 2050.

Key finding 6

The Arctic Ocean is projected to become nearly ice-free in summer within this century, likely within the next thirty to forty years.

Key finding 7

HOW THESE CHANGES AFFECT ARCTIC ECOSYSTEMS AND PEOPLE

Changes in the cryosphere cause fundamental changes in Arctic ecosystems

Changes in the amount of snow and the structure of the snowpack affect soils, plants and animals. Some species, such as pink-footed goose, benefit from less snow cover in spring. But animals grazing through snow, such as reindeer/caribou, suffer if winter rainfall creates an ice-crust over the snow. This is already happening more often in northern Canada and Scandinavia.

Less snow and faster melting are causing summer drought in forests, wetlands, and lakes supplied by snow melt. Thawing permafrost is also causing wetlands in some areas to drain and dry out, while creating new wetlands elsewhere.

The loss of ice cover over rivers, lakes and seas is changing animal and plant communities in the water.

The loss of large areas of sea ice represents devastating habitat loss for some ice-adapted species, including polar bear, seals, walrus, narwhal and some microbial communities. Many animals, including bowhead whales, depend on tiny crustaceans that thrive near the sea ice. This food source is changing as the ice edge recedes.

These changes to ecosystems directly affect supplies of water, fish, timber, traditional/local foods and grazing land used by Arctic people. For example, it has been suggested that stocks of some sub-Arctic and Arctic-adapted fish species, including commercially important species, could change as sea ice recedes. Uncertainty about changing supplies of living natural resources makes it difficult to plan for the future.

Forestry may benefit from thawing permafrost in areas where there is enough water for trees to grow, but insect pests are increasingly causing problems. Some hunted animals, such as seals and walruses, are declining in numbers as ice conditions change. Others are moving to new locations, so hunters have to travel further to reach them.

Cryospheric change affects Arctic livelihoods and living conditions

Access to northern areas via the sea is increasing during the summer as sea ice disappears; allowing increased shipping and industrial activity. Offshore oil and gas activities will benefit from a longer open water season, although threats from icebergs may increase due to increased iceberg production. The International Maritime Organization is devising new mandatory guidelines for ships operating in ice-covered waters. Sea-ice decline creates challenges for local residents who use the ice as a platform for travel and hunting; these challenges may include travelling farther over uncertain ice conditions and increased hazards.

On land, access to many areas is becoming more difficult as ice roads melt earlier and freeze later and as permafrost degrades. Industrial operations reliant on ice roads will need to concentrate heavy load transport into the coldest part of the year. Shorter seasons where ice and snow roads can be used severely impact communities

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that rely on land transport of goods to maintain reasonable retail costs and ensure economic viability, particularly in northern Canada and Russia. Some land areas become more accessible for mining as glaciers and ice caps recede.

Thawing permafrost is causing increased deformation of buildings, roads, runways and other man-made structures in some areas, although poor design in the past is a contributing factor. New design methods are being developed that consider the likelihood of environmental change. Buildings and other infrastructure are at risk from heavier snow loads and floods caused by the release of ice jams in rivers or sudden emptying of glacial lakes.

Two-thirds of the Arctic coastline is held together and protected by ice. When land-fast sea ice melts earlier and permafrost thaws, rapid erosion can occur. Along the coasts bordering the Laptev and Beaufort seas, coastal retreat rates of more than two metres per year have been recorded. A number of Inuit villages in Alaska are preparing to relocate in response to the encroaching sea.

In the short term, increased glacier melt creates new opportunities for hydroelectricity generation. This has potential benefits for industry. In the longer term, the volume of meltwater will decrease as glaciers shrink, potentially affecting electricity production.

Melting ice and snow release contaminants that have been stored for many years, allowing the contaminants to re-enter the environment. Exposure of people and top predators to contaminants that accumulate in food chains could further increase.

Increased access to the Arctic creates new economic opportunities. Cruise ship tourism is increasing. More people are coming to witness the effects of climate change on Arctic glaciers, for example at the Ilulissat Icefjord in Greenland. Increased tourism may challenge lifestyles and services in local communities as well as increase the demand for effective infrastructure (e.g., air services, marine navigation aids, and other safety measures). Loss of Arctic wildlife and change of scenery may adversely affect the tourist industry in the long term.

Cryospheric change combined with rapid development creates opportunities and challenges for Arctic residents. Traditional knowledge can help to detect change and adapt to it. While traditional knowledge continues to evolve, it is a challenge to ensure that this knowledge is being passed on to younger generations as lifestyles change. Some aspects of traditional knowledge become less applicable as the cryosphere and other components of the Arctic system change even more rapidly and become less predictable.

Changes in the cryosphere cause fundamental changes to the characteristics of Arctic ecosystems and in some cases loss of entire habitats. This has consequences for people who receive benefits from Arctic ecosystems.

Key finding 8

The observed and expected future changes to the Arctic cryosphere impact Arctic society on many levels. There are challenges, particularly for local communities and traditional ways of life. There are also new opportunities.

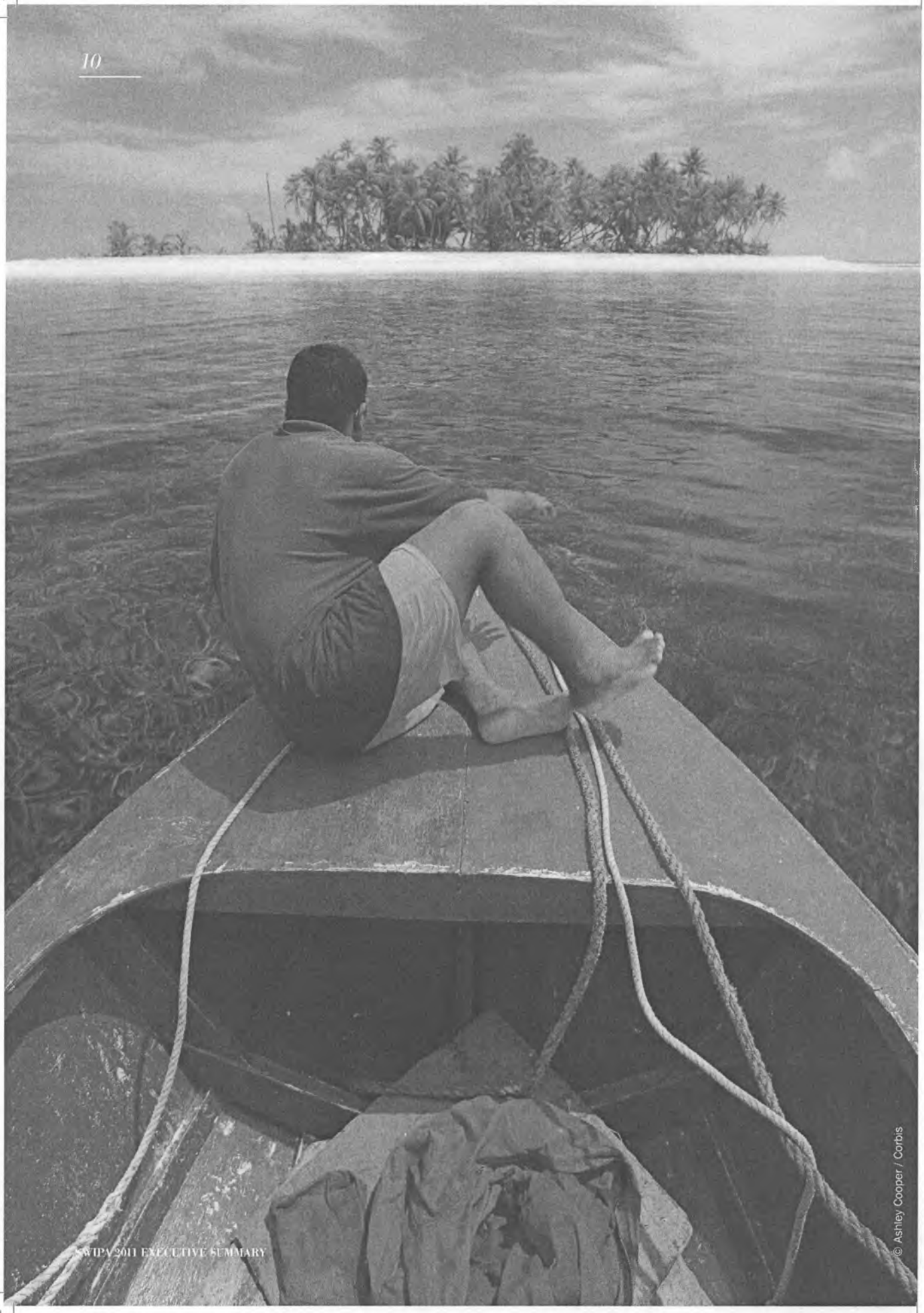
Key finding 9

Transport options and access to resources are radically changed by differences in the distribution and seasonal occurrence of snow, water, ice and permafrost in the Arctic. This affects both daily living and commercial activities.

Key finding 10

Arctic infrastructure faces increased risks of damage due to changes in the cryosphere, particularly the loss of permafrost and land-fast sea ice.

Key finding 11



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WHY CHANGES IN THE ARCTIC MATTER GLOBALLY

Changes in the Arctic cryosphere have impacts on global climate and sea level

When highly reflective snow and ice surfaces melt away, they reveal darker land or ocean surfaces that absorb more of the sun's energy. The result is enhanced warming of the Earth's surface and the air above it. There is evidence that this is happening over the Arctic Ocean as the sea ice retreats, as well as on land as snow melts earlier.

Overall emissions of methane and carbon dioxide from the Arctic could increase due to warming of soils and freshwater systems, and thawing of ancient frozen soil beneath the seabed.

The combined outcome of these effects on global climate is not yet known.

All the main sources of freshwater entering the Arctic Ocean are increasing – river discharge, rain/snow, and melting glaciers, ice caps, and the Greenland Ice Sheet. Recent calculations estimate that an extra 7700 km^3 of freshwater – equivalent to one metre of water over the entire land surface of Australia – has been added to the Arctic Ocean in recent years. There is a risk that this could alter large-scale ocean currents that affect climate on a continental scale.

Melting glaciers and ice sheets worldwide have become the biggest contributor to global sea level rise. Arctic glaciers, ice caps, and the Greenland Ice Sheet contributed 1.3 mm – over 40% – of the total 3.1 mm global sea level rise observed every year between 2003 and 2008. These contributions from the Arctic to global sea level rise are much greater than previously measured.

High uncertainty surrounds estimates of future global sea level. Latest models predict a rise of 0.9 to 1.6 m above the 1990 level by 2100, with Arctic ice making a significant contribution.

Changes in the Arctic cryosphere affect global society

Sea level rise is one of the most serious societal impacts of cryospheric change. Higher average sea level and more damaging storm surges will directly affect millions of people in low-lying coastal flood plains. Sea level rise increases the risk of inundation in coastal cities such as Shanghai and New York.

On the other hand, global economic activity may benefit from cryospheric changes in the Arctic. For example, opening transpolar sea routes across the Arctic Ocean will reduce the distance for ships travelling between Europe and the Pacific by 40% compared to current routes. This could reduce emissions and energy use.

Some unique Arctic species, such as the narwhal, face particular threats as the cryosphere changes. The decline of cryospheric habitats such as sea ice and wetlands over permafrost will impact on migratory species of mammals and birds from elsewhere in the world. These adverse effects on biodiversity are of global concern.

Loss of ice and snow in the Arctic enhances climate warming by increasing absorption of the sun's energy at the surface of the planet. It could also dramatically increase emissions of carbon dioxide and methane and change large-scale ocean currents. The combined outcome of these effects is not yet known.

Key finding 12

Arctic glaciers, ice caps and the Greenland Ice Sheet contributed over 40% of the global sea level rise of around 3 mm per year observed between 2003 and 2008. In the future, global sea level is projected to rise by 0.9–1.6 m by 2100 and Arctic ice loss will make a substantial contribution to this.

Key finding 13

WHAT SHOULD BE DONE

Everyone who lives, works or does business in the Arctic will need to adapt to changes in the cryosphere. Adaptation also requires leadership from governments and international bodies, and increased investment in infrastructure.

Key finding 14

There remains a great deal of uncertainty about how fast the Arctic cryosphere will change in the future and what the ultimate impacts of the changes will be. Interactions ('feedbacks') between elements of the cryosphere and climate system are particularly uncertain. Concerted monitoring and research is needed to reduce this uncertainty.

Key finding 15

Adaptation is urgent and needed at all levels

Cryospheric change affects people at the local level first, and local communities will need to devise strategies to cope with emerging risks.

At national and regional levels, adaptation requires leadership from governments and international bodies to establish new laws and regulations. For example, new fishing regulations will be required as fish stocks change. New standards will need to be developed for construction, particularly in areas affected by thawing permafrost.

Governments will need to invest in transport networks to cope with the shorter ice road season. Search and rescue operations will need to be enhanced to respond to increasing traffic and risks at sea, and accurate forecasts of weather and sea conditions are required to ensure travel safety.

Arctic communities are resilient and will actively respond to cryospheric change. However, rapid rates of change may outpace adaptation capacity. Knowledge and research are needed to foresee how living conditions are likely to change, and to evaluate possible adaptation options. Concerns of indigenous peoples need particular attention in this regard.

Changes in the cryosphere are not the only driver of change in the Arctic. Cryospheric change and climate change occur in the context of societal change, which may be even more challenging. The combined effects of societal, climatic and cryospheric change must be taken into account in adaptation strategies.

Cutting greenhouse gas emissions globally is urgent

Climate change represents an urgent and potentially irreversible threat to human societies. Global climate modeling studies show that deep and immediate cuts in global greenhouse gas emissions are required to hold the increase in global average temperatures below 2°C above pre-industrial levels. Combating human-induced climate change is an urgent common challenge for the international community, requiring immediate global action and international commitment.

Following the ACIA report, published in 2005, Ministers of the Arctic Council acknowledged that *"timely, measured and concerted action is needed to address global emissions."* They endorsed a number of policy recommendations for reducing greenhouse gas emissions, including to *"Adopt ... strategies ...* [to] *address net greenhouse gas emissions and limit them in the long term to levels consistent with the ultimate objective of the UNFCCC* [United Nations Framework Convention on Climate Change]."

The key findings of the SWIPA assessment, especially the rapid and accelerated rates of change in Arctic cryosphere conditions, emphasize the need for greater urgency in taking these actions.

Uncertainty can be reduced by further research

Current monitoring, research and model results provide high confidence that significant changes are occurring in the Arctic cryosphere and that these changes will continue in the future. Some of the observed changes align with expectations but one major component of the cryosphere (sea ice) has reacted faster than anticipated just five years ago. Even so, substantial uncertainty remains, particularly concerning the future timing of

changes, and the effects of interactions (feedbacks) between components of the cryosphere and climate system.

To reduce the uncertainty in future assessments, more robust observational networks are needed. Satellites and airborne measurements have improved the ability to observe some elements of the Arctic cryosphere such as sea-ice extent and snow cover. Monitoring of other key elements of the cryosphere, notably sea-ice thickness, snow depth, permafrost and glaciers, requires surface-based observations.

Many surface-based snow, freshwater ice, and precipitation gauge networks have diminished or have been completely lost, and sites for measuring sea ice, land ice, and physical properties of snow are sparse. Observational networks need to be expanded to provide a robust set of cryospheric data for monitoring, model improvement and satellite product validation.

The biggest unanswered questions identified by this report are:

- What will happen to the Arctic Ocean and its ecosystems as freshwater is added by melting ice and increased river flow?
- How quickly could the Greenland Ice Sheet melt?
- How will changes in the Arctic cryosphere affect the global climate?
- How will the changes affect Arctic societies and economies?

Answering some of these questions requires improved monitoring networks. A better understanding of the complex interactions between the physical, chemical and biological environments in the Arctic is needed. There is a lack of systematically collected information on the effects of cryospheric change on human society.

Communicating about cryospheric change and its effects

The SWIPA assessment documents the importance of climate-induced changes in Arctic snow, water and ice conditions and the profound implications for the local, regional, and global society.

Active communication of this new knowledge, to enhance global, national, and local awareness, will help to ensure that the SWIPA assessment generates benefits for people in the Arctic.

A co-ordinated response to cryospheric change

The combined effects of the changing cryosphere, climate change, and rapid development in the Arctic will create political challenges for Arctic societies, as well as the global community. Traditional livelihoods are most vulnerable to changes in the cryosphere. There is a need for co-operation and co-ordinated effort at all levels, to respond to change and increase the resilience of Arctic ecosystems and societies.

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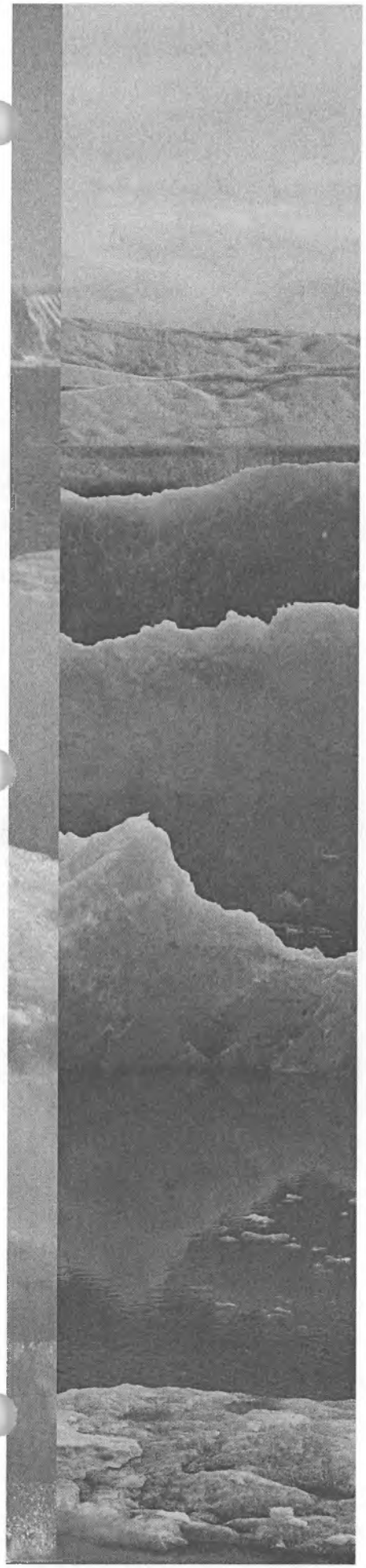

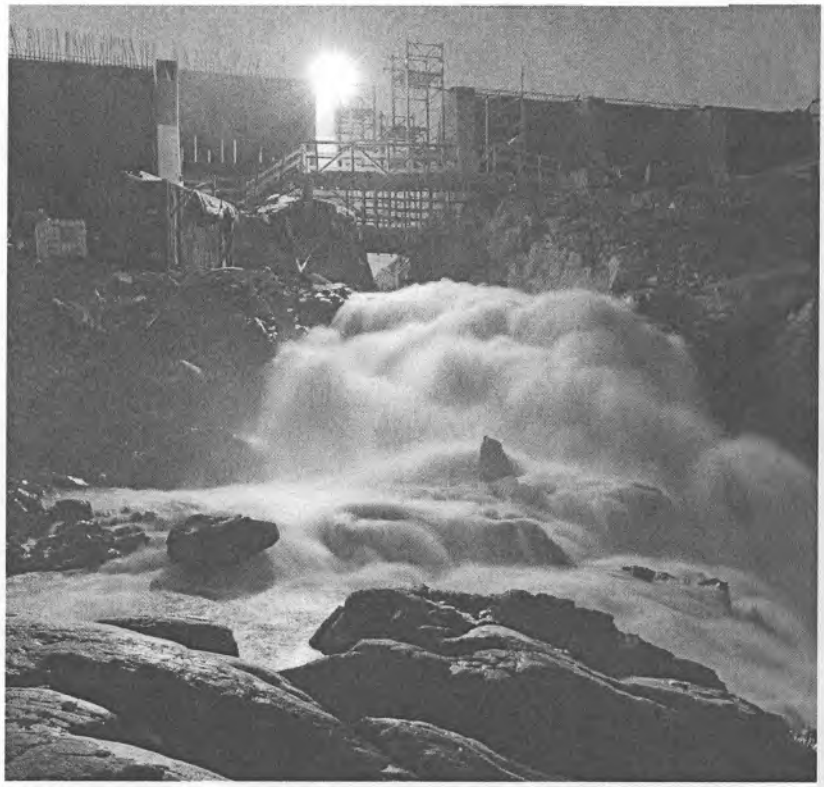

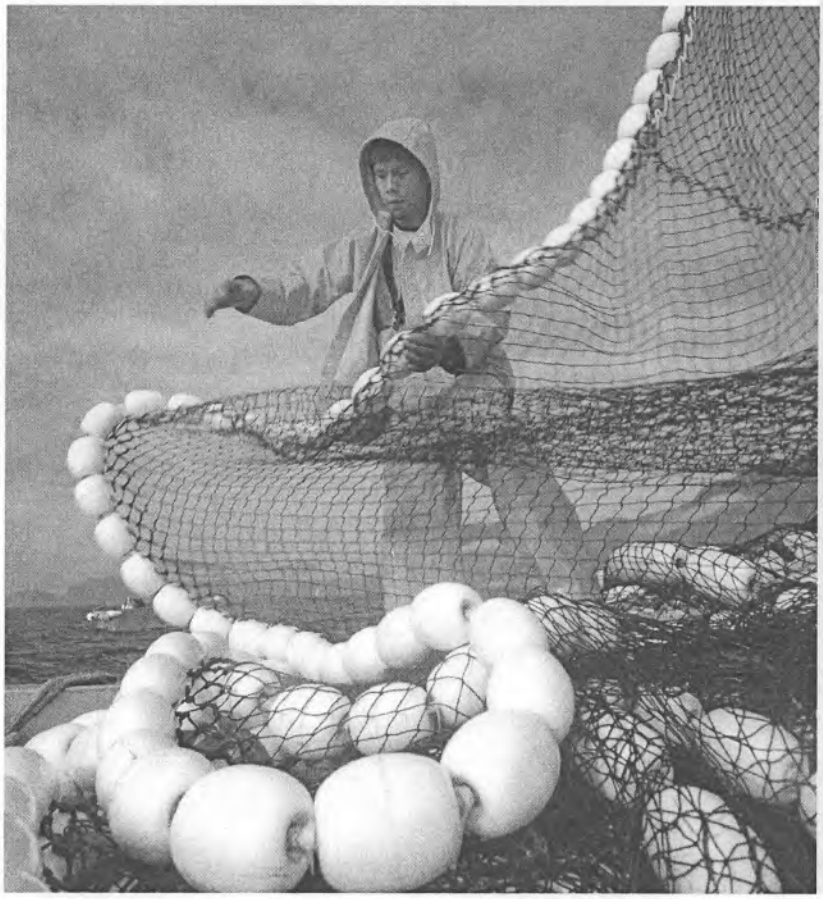

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SWIPA 2011 Executive Summary

This document presents the Executive Summary of the 2011 SWIPA Assessment. More detailed information on the results of the SWIPA Assessment can be found in the SWIPA Scientific Assessment Report and related SWIPA Overview Report that are currently being prepared for publication. For more information contact the AMAP Secretariat.

AMAP Secretariat

Strømsveien 96
P.O. Box 8100 Dep.
N-0032 Oslo
Norway

T +47 23 24 16 32
F +47 22 67 67 06

www.amap.no

ARCTIC COUNCIL

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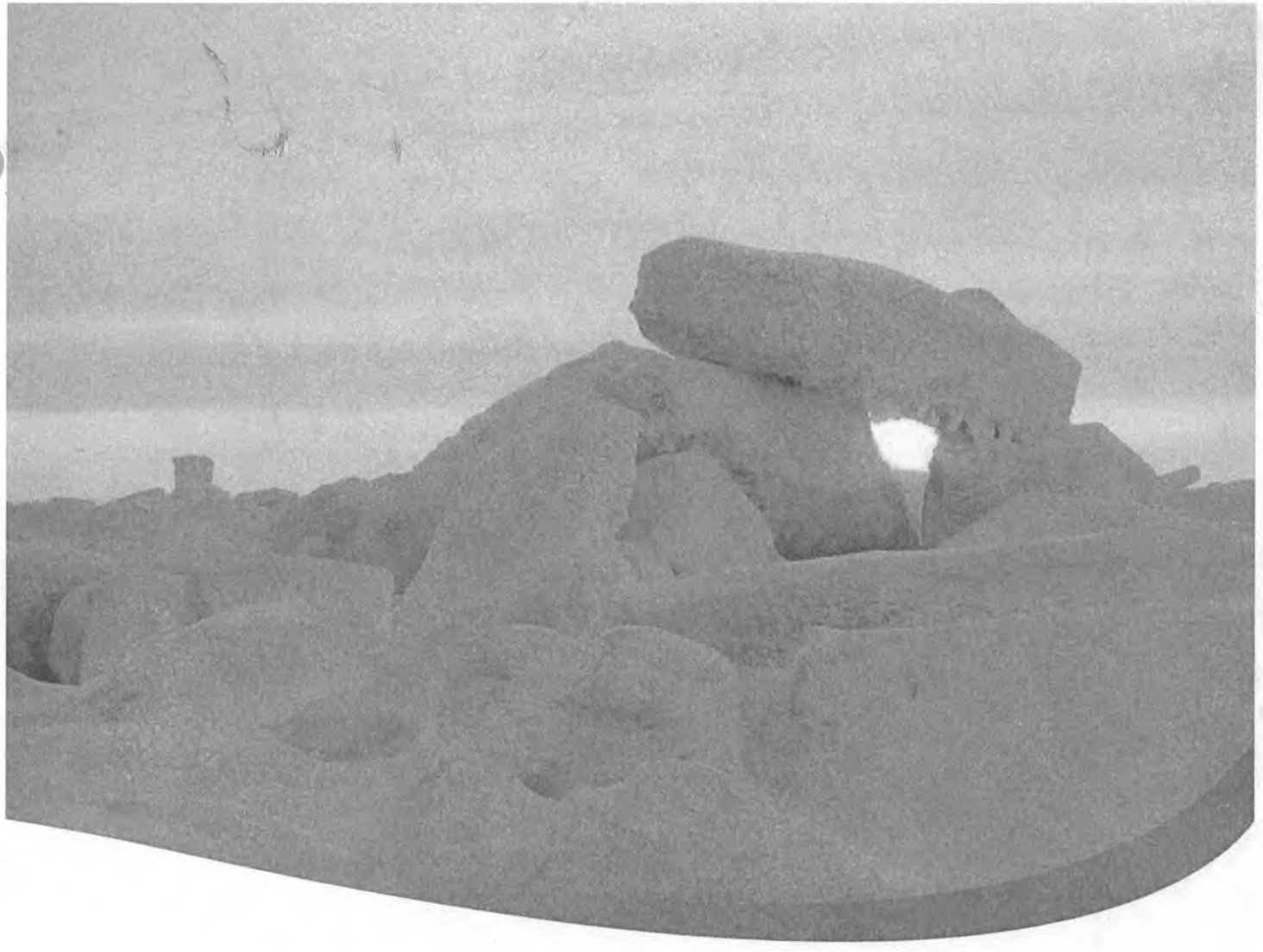
Arctic Council, Arctic Offshore Oil and Gas Guidelines, 2009



ARCTIC COUNCIL

ARCTIC OFFSHORE OIL AND GAS GUIDELINES

2009

The Arctic Council was established in 1996 and succeeded the Arctic Environmental Protection Strategy. It is a high-level intergovernmental forum that provides a mechanism to address the common concerns and challenges faced by the Arctic Governments and the Indigenous Peoples of the Arctic.
The members of the Arctic Council are Canada, Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States of America.
The Permanent Participants of the Arctic Council are:

- Aleut International Association (AIA)
- Arctic Athabaskan Council (AAC)
- Gwich'in Council International (GCI)
- Inuit Circumpolar Council (ICC)
- Russian Association of Indigenous Peoples of the North (RAIPON)
- Saami Council

Observer status in the Arctic Council is open to Non-arctic states, inter-governmental and inter-parliamentary organizations, global and regional non-governmental organizations.

ARCTIC COUNCIL

PROTECTION OF THE ARCTIC MARINE ENVIRONMENT WORKING GROUP

ARCTIC OFFSHORE OIL AND GAS GUIDELINES

April 29, 2009

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Preamble

The Ministers of the Arctic States—Canada, Denmark, Iceland, Finland, Russia, Sweden, Norway and the United States of America— originally adopted the Guidelines at the Fourth Ministerial Conference on the Protection of the Arctic Environment, 11-12 June, 1997 in Alta, Norway by declaring: "**We receive** with appreciation…the "Arctic Offshore Oil and Gas Guidelines" developed under AEPS, and **agree** that these Guidelines be applied."

The 2nd Ministerial Meeting of the Arctic Council 9-10 October 2002 in Inari, Finland recognized the updated version of these Guidelines by the following statement: *"We... endorse the updated Offshore Oil and Gas Guidelines and encourage the concerned stakeholders to apply them."*

The endorsement of these Guidelines recognizes a uniform understanding of the minimum actions needed to protect the Arctic marine environment from unwanted environmental effects caused by offshore oil and gas activities. The Ministers, however, acknowledge that further steps can be taken nationally as a part of the environmental and natural resource management policies of the Arctic States.

The users of these Guidelines will find that all stages of offshore oil and gas activity, are included, with the exception of transportation of oil and gas. The Introduction sets forth the background for the Guidelines and important general concerns. The chapters that follow set forth the specific suggested operational steps to follow when planning for Arctic offshore oil and gas activities.

Neither PAME nor the full Arctic Council has established a single geographic definition of the Arctic. This is left for Arctic states to determine. For the purposes of these Guidelines, the definition of the Arctic is contained in Annex A.

1 Introduction

1.1 Background

The Guidelines were originally written in response to the Report of the Third Ministerial Conference on the Protection of the Arctic Environment (Inuvik, Canada, March 20-21, 1996) which expressed concern regarding the potential impacts related to future increases in offshore petroleum activity in the Arctic. The Report requested PAME *...(to develop) "guidelines for offshore petroleum activities in the Arctic, in particular guidelines for timely and effective measures for protection of the Arctic environment. In this regard, the Ministers welcomed the initiative of the United States to conduct a government designated expert meeting to develop such guidelines, in cooperation, as appropriate, with other AEPS Working Groups"* (Paragraph 2.3.5(ii)).

In addition, the Inuvik Report requests AMAP (Arctic Monitoring and Assessment Program Working Group) to "*...review the feasibility of developing sub-regional cooperative oil- related monitoring and assessment activities, as appropriate.*" (Paragraph 2.1.2.1).

Finally, the Report requests EPPR (Emergency Preparedness, Prevention and Response Working Group) to "*...continue their work on contributing to development of preventative, mitigating and response measures for oil and gas accidental releases in the Arctic*" (Paragraph 2.4.5).

Although PAME had the overall responsibility for developing the 1997 guidelines, they were the result of a group effort and reflect coordination within the Arctic Council working groups that the ministers emphasized in the 1996 Inuvik Report.

The 1997 Guidelines stated in Section 1.7 Periodic Review, "*These Guidelines should undergo periodic review and amendment, as necessary, to take into consideration experiences in the management and control of offshore oil and gas operations. The Guidelines must remain current if they are to support timely and effective measures for protection of the Arctic environment. An Experts Meeting should be held after the third anniversary of the adoption of the Guidelines to review and update them.*"

In 2002 the Guidelines were updated and improved by PAME with the help of EPPR, AMAP, and CAFF (Conservation of Arctic Fauna and Flora Working Group) and with an attempt to incorporate the principles of sustainable development. The 2002 update was greatly assisted by the involvement and comments received from representatives of Arctic, regional and other governments, non-governmental organizations, industry, indigenous people, and the scientific community to provide agreed guidelines for offshore oil and gas activities in the Arctic.

It is acknowledged that a number of legal instruments related to offshore oil and gas activities exist, *e.g.* United Nations Convention on Law of the Sea; the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78); the London Convention 1972; and regional conventions such as OSPAR. Arctic petroleum activities must be conducted in compliance with applicable international law.

Additional guidance and information resources that have relevance to the Arctic Offshore Oil and Gas Guidelines, have been provided by the Arctic Council since 2002, including the Human Health in the Arctic Report (2003), the Arctic Marine Strategic Plan (2004), the Transfer of Refined Oil and Oil Products in the Arctic (TROOP) Guidelines (2004), the Arctic Shoreline

Clean-up Assessment Technique (SCAT) Manual (2004), the Arctic Guide for Emergency Prevention, Preparedness and Response (2008), the Arctic Climate Impact Assessment (2004), the assessment, Oil and Gas Activities in the Arctic—Effects and Potential Effects (OGA, 2009).

1.2 Goals

Purpose of the Guidelines

These Guidelines are intended to be of use to the Arctic nations for offshore oil and gas activities during planning, exploration, development, production and decommissioning

Recommendations on the transportation of oil and gas are found in the OGA, 2008. The Guidelines should be used to help secure common policy and practices. The target group for the Guidelines is thus primarily the authorities, but the Guidelines may also be of help to the industry when planning for oil and gas activities and to the public in understanding environmental concerns and practices of Arctic offshore oil and gas activities. While recognizing the non-binding nature of these Guidelines, they are intended to encourage the highest standards currently available. They are not intended to prevent States from setting equivalent or stricter standards, where appropriate.

Policy development should take into account the domestic situation with respect to political, economic, legal, and administrative conditions. Consideration should be given to macro-economic effects, regional effects, and potential environmental impacts. Such consideration should result in a staged opening plan, and ensure protection of areas of special environmental concern. While these guidelines do not address socio-economic aspects in any detail, nor do they set standards for assessment of potential socio-economic effects of offshore oil and gas activities, these are nonetheless important to consider and integrate into the planning and conduct of exploration and development.

The Guidelines are intended to define a set of recommended practices and outline strategic actions for consideration by those responsible for regulation of offshore oil and gas activities (including transportation and related onshore activities) in the Arctic (see Figure 1 and Annex A). It is hoped that regulators will identify the key aspects related to protection of human health and safety and protection of the environment for the management of offshore activities, while at the same time remaining sufficiently flexible in the application of these management regimes to permit alternative regulatory approaches. It should be recognized that the eight Arctic nations have different systems with different emphases on the division of responsibility between the operator and the regulator. The goal is to assist regulators in developing standards, which are applied and enforced consistently for all offshore Arctic oil and gas operators. Sensible regulation will vary to some degree based upon local circumstances. Thus, it is expected that, based on the outcome of environmental impact assessment procedures, regulators will establish policies such that offshore oil and gas activities are conducted so as to provide for human health and safety and protection of the environment.

Offshore Arctic oil and gas operations may result in a variety of related onshore activities. Individual governments should determine the extent to which these Guidelines apply when evaluating these activities.

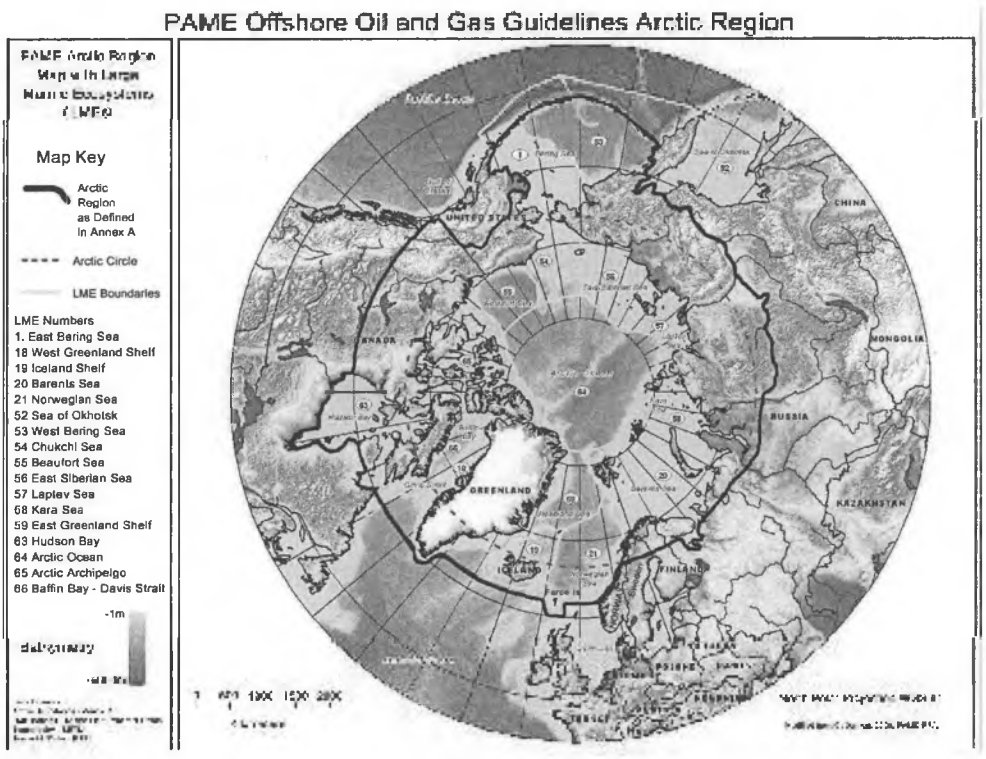

Figure 1 - Arctic Region (the area of application of the Guidelines is described in Annex A)

Goals for Environmental Protection during Oil and Gas Activities in the Arctic Area

Offshore oil and gas activities in the Arctic should be planned and conducted so as to avoid:

- adverse effects on air and water quality that exceed national or applicable international standards or regulations;
- changes in the atmospheric, terrestrial (including aquatic), glacial or marine environments that exceed national or applicable international standards or regulations;
- detrimental changes in the distribution, abundance or productivity of species or populations of species;
- further jeopardy to endangered or threatened species or populations of such species;
- degradation of, or substantial risk to, areas of biological, cultural, scientific, historic, aesthetic or wilderness significance;
- adverse effects on livelihoods, societies, cultures and traditional lifestyles for northern and indigenous peoples; and
- adverse effects to subsistence hunting, fishing and gathering.

1.3 General Principles

Arctic offshore oil and gas activities should be based on the following principles:

Principle of the Precautionary Approach

In order to protect the environment, the precautionary approach as reflected in Principle 15 of the Rio Declaration shall be widely applied by States to oil and gas activities according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Polluter Pays Principle

National authorities should endeavor to promote the internalization of the application of the polluter pays approach as reflected in Principle 16 of the Rio Declaration. The polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

Continuous improvement

All parties should continually strive to improve health, environment and safety by identifying the processes, activities and products that need improvement, and implement necessary improvement measures. The process of identifying what can be improved may be based on mappings and results of analyses, investigation of situations of hazard and accident, or near hazards and accidents, handling of non-conformities, experience from internal follow-up or auditing, or experience gained by others.

Sustainable Development

In permitting offshore oil and gas activities Arctic governments should be mindful of their commitment to sustainable development, including, *inter alia*:

- protection of biological diversity;
- the duty not to transfer, directly or indirectly, damage or hazards from one area of the marine environment to another or transform one type of pollution into another;
- promotion of the use of best available technology/techniques and best environmental practices (See some examples in Annex B);
- the duty to cooperate on a regional basis for protection and preservation of the marine environment, taking into account characteristic regional features and global climate change effects;
- the need to maintain hydrocarbon production rates in keeping with sound conservation practices as a means of minimizing environmental impacts;
- development which meets the needs of the present without compromising the ability to meet the needs of the future;
- integration of environmental and social concerns into all development processes; and
- broad public participation in decision making.

1.4 Existing Effects of Oil and Gas Activities on Environment and Society

Impacts to marine Arctic areas from all human activities within Arctic countries at present mainly affect coastal areas. Effects in offshore areas are mainly due to long-range transport of contaminants by wind and sea currents, and rivers, but also include sediment transport in sea ice.

Some coastal areas of the Arctic may be contaminated by direct runoff from cities, villages, industry or mining, through river discharges, from dumping and from nuclear tests. Hot spots have been identified by the Arctic Council, but few of these are relevant in the context of these guidelines. Based on the results of the Arctic Council assessment AMAP 2002 persistent organic pollutants (POPs) and mercury represent the greatest contaminant related threat to the Arctic environment. While levels of most POPs appear to be declining in response to global restrictions on production and use, a group of new chemicals that includes brominated flame retardants and fluorinated surfactants are being measured at increasing concentrations in the Arctic marine environment. Levels of mercury in the marine environment from long range transport appear to be increasing, particularly in the North American Arctic. At higher trophic levels, both POPs and mercury are found at levels that pose a potential toxicological risk to wildlife. Artificial radionuclide seem to pose only a minimal threat to the environment.

Currently, the vast majority of the Arctic marine environment, away from local natural or anthropogenic sources, is largely pristine with regard to oil hydrocarbons. Physical disturbance due to exploration activities has declined over the last 2 decades due both to a reduction in activities and due to improvements in technology and use of best practices

Climate change presents numerous challenges to arctic marine environments and ecosystems, which are thoroughly discussed in the Arctic Climate Impact Assessment (ACIA 2004). Climate

change will also influence contaminant pathways and processes resulting in changes to current levels in the marine environment. Increased offshore activities may disturb marine life with their presence, noise, and discharges.

1.5 Potential Effects of Oil and Gas Activities on Environment and Society

Natural environment

The Arctic Council Oil and Gas Assessment in 2008 found that a significant threat from offshore oil and gas activities was the risk and potential impact of oil spills in an area of vulnerability to crucial habitats or threatened species However, concentration levels are elevated in some areas from natural sources such as oil seeps and erosion of coal-bearing rock. According to the AC, 2008, the Arctic has high sensitivity to oil spill impacts and the least capacity for natural recovery. During much of the year and under many conditions, response capabilities and methods are limited by environmental conditions, lack of resources capable of responding in a timely manner, and limited technologies for responding to oil spills in ice conditions.

Offshore oil and gas activities may entail considerable inputs of gases to the air from power generation, flaring, venting, well testing, leakage of volatile petroleum components, supply activities and shuttle transportation. These emissions contribute greenhouse gases to the atmosphere and increase the amount of pollutants emitted to the Arctic thus potentially affecting the climate and possibly causing acidification on nearby land. Although not currently widely practiced in the Arctic, discharges of drill cuttings with associated oil and chemicals and discharge of produced water may have acute effects on sea floor flora and fauna and reduce both their abundance and diversity in the immediate vicinity of the installations.

Arctic Council 2008 indicates that Arctic offshore operations currently contribute a very small part of atmospheric or marine contaminants, but an anticipated increase in activity has the potential to increase these.

Discharges of produced water and chemicals to the water column have the potential for acute effects on marine life only in the immediate vicinity of the installations However, according to the AC, 2008, discharge of produced water is not currently routinely practiced the Arctic offshore and if necessary is done in accordance with the guidance of Section 6.1 and Section 6.2.

Good and transparent governance, comprehensive but responsive regulatory regimes, and the use of international standards and practices coupled with evolving advances in technology and best practices have lessened the effects of oil and gas activities over time, including those in the offshore. But risks may arise as conditions change or new areas are explored and developed and evidence also shows that accidents will happen and best practices will not always be followed. Governments should continue to ensure that best practices, including oil spill response mechanisms, are in place before activities begin.

The accelerating loss of polar sea ice has drawn the attention of nations and industry for the possibility of increased oil and gas and shipping activities in their arctic waters. Therefore, all stakeholders share a concern about future oil and gas development in this changing and fragile environment and in dealing with the impacts and stresses both from direct environmental risks and those posed by climate change.

Human environment

Oil and gas activities may have pronounced positive effects on a nation's employment and economy. They also have socio-economic effects, both negative and positive, on local communities and indigenous people. The Arctic Council Oil and Gas Assessment also found that social effects of oil and gas activities, including those offshore, are often greatest at the local level, whereas the economic effects are often shared more widely. The economic value of oil and gas reserves developed will influence the scale of the activities and the magnitude and type of positive and negative effects at the national, regional and local level. Socio-economic effects also vary according to the 'life-cycle' stage of oil and gas activity and tend to be higher and more local at the exploration and construction phase, and stabilize and be more regional in the production stage. Expansion of oil and gas activities across the Arctic has increased the overlap and potential conflict between the industry and traditional land use and ways of life of indigenous people. Industry activity such as seismic surveying, exploratory drilling with associated vessel traffic, facility emplacement, subsequent development drilling, and production and transportation of oil or gas all have some potential for interfering with traditional marine subsistence hunting and fishing activities.

At the same time, in many Arctic countries, indigenous people are becoming active participants in oil and gas activities as decision makers, business owners, and employees. Project planning, environmental assessments and regulations should take into account indigenous and traditional knowledge when addressing local concerns and developing ways to mitigate possible environmental damage and negative socioeconomic effects.

In addition to direct effect of oil and gas activities on indigenous communities, provision should be considered to address secondary and cumulative impacts from oil and gas activities and the possible role of additive effects from other social stressors to the arctic peoples. These could include impacts on human health from changes in diet resulting in an increased risk of diabetes, obesity, hypertension, and cardio vascular disease, or social strain and potential for increased access to drugs and alcohol from contact with outsiders leading to higher risk of social pathologies

1.6 Institutional Strengthening in the Regional Context

Management of Arctic oil and gas activities and their effects on the Arctic offshore and near shore areas requires participation of governments, the public, non-governmental organizations and operators. In order to implement these Guidelines, institutional mechanisms or capabilities are required at the local, national and regional levels to:

- encourage the open, transparent and consistent application of regulatory regimes;
- facilitate strict enforcement of regulatory regimes;
- enable government agencies, local communities and non-governmental organizations to participate as appropriate in environmental management;
- make sure that scientific, technical and indigenous traditional knowledge are available to the processes and are effectively used;
- promote communication between operators, government bodies and communities that is conducted in culturally appropriate ways and in local languages;

- facilitate regional activities and mechanisms that best suit the regional physical, biological and socioeconomic environments, and potential regional impacts;

Efforts to establish effective communication with local residents for all processes involved in oil and gas activities should make sure that:

- technical terms and ideas are clearly presented and are not lost in translation to another language;
- terminology is consistent;
- summaries as well as the complete documents are available in advance of public review and comment meetings; and
- adequate advance notice is given of public consultation meetings that take into account local communities harvesting, hunting and fishing annual schedules

To address the above needs, Arctic States should:

- review their own needs, and regional needs, for institutional strengthening and capacity-building in these areas, and identify priority needs with schedules for addressing them; and
- cooperate in and facilitate bilateral and multilateral initiatives to address the needs, in concert with the public and with oil and gas industry operators.
- develop regional oil spill contingency plans that clearly delineate: response authorities and capabilities; acceptable response actions through pre-approvals and agreements; agreements for sharing expertise and resources

2 Arctic Communities, Indigenous Peoples, Sustainability and Conservation of Flora and Fauna

Offshore oil and gas activities should be conducted so as to protect, and avoid adverse impacts on, living resources and the ecosystems on which they depend; to avoid adverse impacts on the traditional ways of life, resource uses and cultural values of Arctic indigenous communities; and to coordinate with other human activities in the region.

2.1 Living Resources

Measures should be taken as necessary to ensure that Arctic flora and fauna and the ecosystems on which they depend are protected during all phases of offshore oil and gas activities. Special attention - particularly with regard to intrusive activities - is required for species (e.g. fish, birds, whales, seals, polar bears, and other marine mammals), which are resources for human use, particularly by indigenous people, and for special habitats (such as ice-edge zones, coastal lagoons and barrier islands, wetlands, estuaries, bays, and river deltas). Onshore features that should be considered for protection and/or avoidance during offshore exploration and production activities include areas used significantly by waterfowl (such as high-density nesting, brood-rearing, molting and staging areas), caribou (such as major calving and insect relief areas), and by musk oxen. Consistent with the interests of human safety and well-being, a primary governing policy in the Arctic should be the conservation of resources for sustainable use. This includes protection of subsistence hunting, fishing, and gathering.

2.2 Cultural Values

In planning and executing offshore oil and gas operations, necessary measures should be taken, in consultation with neighboring indigenous communities, to recognize and accommodate the cultural heritage, values, practices, rights and resource use of indigenous residents. Arctic States, in cooperation with the oil and gas industry, should address the economic, social, health and educational needs based on equal partnership with indigenous people. All phases of oil and gas activity should avoid disturbance of historic or prehistoric resources including archeological and sacred sites, historic shipwrecks and other potentially important cultural sites.

2.3 Other Human Activity

Offshore oil and gas activities should be conducted in coordination with other human activities in the region, such as tourism, fishing, shipping, and scientific research. There should be a solid understanding of other human uses in the area to forecast potential areas of conflict both annually and seasonally. Advanced information collection and analysis may permit improved consultation and dialogue to proactively avoid conflicts as well as target enhanced socio-economic impact analysis where required. Arctic governments should consider the use of integrated management schemes.

2.4 Arctic States should:

- incorporate local and traditional knowledge into the decision-making process including the initial siting studies and disposition of resource use rights. For example, ethnological expert studies are being used in Russia in which scientific and local knowledge are combined;

- pursue regulatory and political structures that allow for participation of indigenous people and other local residents in the decision making process as well as the public at large;

- urge and, where appropriate, require industry to integrate cultural and environmental protection considerations into planning, design, construction and operational phases of oil and gas activities;

- improve cross-cultural communication methods to ensure full and meaningful participation of indigenous residents including procedures to incorporate local knowledge;

- identify and appropriately manage oil and gas activities in ecologically and culturally sensitive areas; and

- for use in planning and decisions, identify species, which are resources for human use and their ecological requirements, and identify patterns of their use as resources.

3 Environmental Impact Assessment

Environmental impact assessment (EIA) procedures should be used to determine the potential impacts of offshore oil and gas exploration, development, transportation and infrastructure on the environment and human communities so as to inform decision-making. Arctic countries use a variety of methods and approaches. Annex D gives examples of the EIA process in several Arctic countries. Assessments may have a broad scope or be project specific. The responsibility for conducting the EIA or preliminary impact assessments (PEIA) varies from country to country (See Annex D)

Several approaches may be used for environmental assessments with a broad scope.

Examples of these approaches follow:

- regional assessments for oil and gas activities;
- ecosystem based approach;
- integrated oceans and coastal management;
- Strategic Environmental Assessment (SEA);
- regional cumulative impact assessment and studies; and
- land use or spatial planning.

Many of these approaches address common elements. They assess potential environmental impacts on the ecosystem and potential social and economic effects. They include a long-term focus that addresses both effects and planning. They include a discussion of the potential cumulative effects of oil and gas activities with the effects of other activities. They address competing interests.

Assessments should consider alternative development options and any impacts that alternative activities may have, including potential cumulative impacts from other existing and known planned activities.

PEIAs and EIAs should consider, in particular, the following effects (for example contamination, habitat disturbance and alteration) on:

- human society including indigenous ways of life;
- cultural heritage;
- socio-economic systems;
- other human activities (e.g., tourism, scientific research, fishing, and shipping);
- overall landscape (e.g., fragmentation);
- subsistence ways of life (e.g. harvest practices and availability of food supply);
- oil spill preparedness and response in sea ice conditions;

- permafrost and transition zones;
- climate;
- sustainability of renewable resources;
- flora and fauna including marine mammals;
- air, water and sediment quality;
- ports and shore reception facilities;
- Arctic shipping routes;
- ice dynamics;
- human health; and
- the interaction among any of the above.

(See the table showing an overview of offshore activities and potential environmental effects in Annex E.)

Baseline environmental studies should be done on a regional basis to provide information for the EIA process. Regional baseline and monitoring programs should be established prior to activities and may be done as part of the SEA. This is in addition to project specific monitoring as further described in Section 4 (**Monitoring**).

When monitoring biodiversity the best available knowledge, including indigenous and traditional knowledge should be employed. Independent scientific peer review and public input should be used to assure program quality.

Since project impacts may have international effects, it is important that environmental monitoring programs are adequate and intercompatible so that results may be compared from one year to another and from one place to another allowing changes to be measured and trans-boundary effects considered.

3.1 Purpose

A main purpose of the EIA process is to integrate environmental considerations in the overall planning from the beginning. Environmental impact assessment aims at determining potential impacts of offshore oil and gas activities to the Arctic environment, its flora and fauna, abiotic components, and human health, security and well being, and assessing their probability and potential consequences. It does this to help inform decision making authorities at all stages of project review.

3.2 Technique and Process

The EIA process

The EIA process is a series of interactive steps, including feedback mechanisms and quality assurance procedures. Some of the main features are:

Organization:

Responsibility for coordination of the EIA process, including arrangements for logistical and financial support should be with a single organization or harmonized between appropriate entities. A first task of this group should be to define the boundaries of the assessment area and reach agreement on the timetable to be followed.

Scope:

The scope of the assessment should be comprehensive. However, it may be decided that initial assessments should give priority to environmental sectors considered to be most at risk from the planned activities. In the context of offshore petroleum activities this may be for instance particularly sensitive nesting or feeding habitats for seabirds, or spawning grounds for important fish species which may determine whether and how development takes place.

Roles and Responsibilities:

There should be a clear and accepted understanding of roles and responsibilities regarding the EIA process to ensure efficiency and avoid misunderstanding of work to be performed and associated cost requirements in keeping with the scope of the assessment.

Data Quality Assurance:

A system of quality assurance for data and their collection should be in place.

Timetable:

It is essential that the EIA process is performed according to a realistic time table agreed upon at an early stage of the process. The timeframe will vary depending on the extent and type of assessment to be carried out.

Sources of Information:

Data for EIA purposes may be gathered from existing sources (scientific literature, databases, registers, indigenous and traditional knowledge, public hearings and comments, etc.) and necessary additional information may be obtained through baseline investigations or monitoring programs.

Decision/Implementation/Project monitoring/Modification:

There should be a description of monitoring programs to determine effects, assess the effectiveness of mitigation measures and provide any early warning of adverse effects. The programs should be designed with flexibility so they can be modified to respond to unforeseen effects. These programs should be elaborated in a manner consistent with Section 4 **Monitoring**. They should also provide for the possibility of modification of an activity, where warranted. And there should be adequate time to properly conduct studies and digest and assess the scientific content of the resulting reports.

Risk Assessment and Environmental Risk Analysis:

The reason for a risk assessment or analysis is to determine if an action has an acceptable level of risk. Both regulators and industry use the information gathered through an EIA and risk analysis to make decisions on whether a proposed activity or development should go forward as planned, to institute preventative and mitigating measures to reduce risk, or to chose another alternative action.

Prior to carrying out an environmental risk analysis, risk criteria should be defined. The risk criteria should be documented and the regulator and/or operator should update the criteria during the course of operations as appropriate and necessary for enhancing the safety level and as an effort to achieve the objectives defined for the activities. Risk or acceptance criteria must at a minimum incorporate national and international laws and standards. Consultation should also include input from local communities and interested parties for risk criteria analysis. If data is insufficient to define risk criteria, then the risk assessment should also incorporate the precautionary principle as reflected in Principle 15 of the Rio Declaration.

The environmental risk analysis should be initiated as soon as practical to allow time if needed for public consultation. The analysis should be valid for the period of the year the operations will be carried out. If there is uncertainty of the timing of operations, the analysis should be valid for a longer period.

Risk associated with offshore oil and gas activities has two main elements--the risk that an event might happen, such as an oil spill, and the risk that something will be impacted, such as ecologically sensitive areas. A risk assessment should be carried out in order to estimate the risk of an acute oil spill or other event. An environmental risk analysis should be conducted to identify impact sensitivities from an acute spill or event, as well as, spills that result from routine operations, including approved discharge of drilling fluids or cuttings. The analysis of each potentially affected environmental resource should clearly distinguish between the risk of oil spills or other accident and impact severity. The risk of contact in an acute spill does not influence the impact severity. Probabilities related to acute oil spills should be estimated or modeled based on geological studies on resource estimates and distribution, development scenarios, site-specific and regional considerations, exploration and production plans, and historical data. An analysis of response strategies, techniques, and capabilities should be conducted to determine the efficacy and feasibility of oil spill response throughout the year.

The analysis also should identify the need for risk reducing and contingency measures. Requirements stipulated by or in law or regulations, including requirements for risk reducing measures and the operator's safety objectives, should form the basis for defining an acceptable level of risk.

A flow-chart depicting an environmental risk analysis scheme is represented in Annex F.

3.3 Strategic Environmental Assessment (SEA)

A Strategic Environmental Assessment (SEA) is a systematic process for evaluating the environmental consequences of a proposed policy, plan or program initiative in order to ensure they are included and appropriately addressed at the earliest appropriate stage of decision-making. An SEA involves an integrated approach.

An SEA provides decision-makers with information, strategies, and actual and projected environmental effects on a larger scale than an Environmental Impact Assessment (EIA). SEA's wider frame enables policy-makers to anticipate effects on species, habitats and ecological processes that site-specific studies do not necessarily capture. SEA also fits well with current scientific understanding in ecology and biodiversity conservation, which emphasizes the importance of ecosystems, their processes, and a multi-factor, broader analysis over a single-species or single-threat analysis.

The use of SEA is recommended on a regional basis to determine the potential environmental impacts of human activity including opening areas for oil and gas. As part of an SEA it is recommended that all available regional baseline monitoring information be used, as well as meaningful stakeholder and public involvement, and incorporation of indigenous traditional ecological knowledge.

The SEA is an ongoing process and initial analyses should be revised periodically to take into account new information and new developments. One important component of the SEA process is the analysis and tracking of cumulative impacts on a regional basis. This information in turn should be used to adjust polices, and development, accordingly.

A final function of SEA is to identify existing and potential protected areas in the region, as well as sensitive areas of biodiversity and cultural importance. This may include identification of areas where petroleum activities may be modified or prohibited. Some of these areas may already be protected; others are not. In the marine environment, any area with both sea ice and important biodiversity significance should be afforded appropriate levels of protection. This will involve regional spatial planning.

3.4 Preliminary Environment Impact Assessment (PEIA)

A PEIA (or similar process) is a screening level review that should contain sufficient detail to permit assessment of whether a proposed activity may have a significant impact and should include:

- a description of the proposed activity, including its purpose, location, duration, and intensity;
- consideration of alternatives to the proposed activity and any impacts that the activity and its alternatives may have, including consideration of cumulative impacts in the light of other existing and known planned activities;
- a determination whether significant impacts, that would require further assessment, are likely to occur; and
- consideration of input from early engagement with local communities potentially impacted from the development

3.5 Environmental Impact Assessment (EIA)

An EIA should be based on the best available information and include:

- a description of the reference/initial state of the area where the activity is to take place and identification of baseline data needs;
- an environmental risk analysis of potential impacts and a risk analysis of potential spills from

the activity. This should delineate pollution sources, transport mechanisms (including trajectories), routes and duration of exposure to species or habitats of concern;

- identification of oil spill response methods, and their respective limits of operation and tradeoff evaluations under varying environmental conditions (oil type, seasonality, ice conditions, etc.);
- the best available time series data;
- a description of the proposed activity, including its purpose, location, duration, and intensity. This includes the physical characteristics of the proposed activity and its land use requirements during construction and operation phases. It should state the main characteristics of the development process proposed, including type and quantity of materials to be used;
- the estimated type and quantity of expected residues and emission (including air, water, soil, vibration, light, heat and radiation pollution);
- the forecasting methods used to assess effects on the environment and any limitations
- on models due to lack of data, in undertaking the assessment;
- based on the above, an identification of the area of potential impact;
- the likely significant effects, direct or indirect and an evaluation of their spatial and temporal scales;
- the likelihood of transboundary impacts;
- potential socio-economic effects and the effects on traditional ways of life of indigenous people;
- a description of the measures proposed to avoid, reduce or rectify identified potential significant adverse effects, taking into consideration the recovery and regenerative capacity of the Arctic;
- an accounting with the principles of conservation biology, including disturbance and cumulative effects;
- other development options, and where authorities prepare the analysis, this may include the alternative of no action. This discussion should include an evaluation of the different alternatives and the reasons for choosing the selected activity;
- a summary in non-technical language, assisted with figures and diagrams, of the information specified above. If need be, other means of displaying this information, based on cultural heritage of the local and indigenous residents should be prepared;
- an assessment of all associated sources of noise, including seismic or other testing equipment, vessels, aircraft, drillships, drilling operations, and ice-breaking equipment and their potential effects on fish, marine mammals, and other wildlife including cumulative effects;
- an assessment of human health effects involving a systematic consideration of public health status baseline and analysis of oil and gas activity; and

- integrate the results of the Arctic Climate Impact Assessment and other research into the evaluation of possible impacts of oil and gas activities and infrastructure in the Arctic Ocean.

3.6 Consultations and Hearings

Consultation is an effective dialogue between and amongst regulators, potential operators and stakeholders. In general, consultation should commence at the planning stage and continue throughout the lifetime of a project. It ensures transparent interaction and minimises potential risks for all parties. Consultation also provides a mechanism to resolve disagreements and provide appeal rights to all parties. Consultation is generally thought of in terms of public hearings, but it can also work effectively through informal discussions, focus group and key interviews and questionnaires. There is no single, standard approach to consultation, however some guiding principles promote effective consultation. These include:

- effective consultation is two-way;
- identifying and building relationships with potential consultees can take considerable time;
- consultation programmes are integral to project planning and decisions making;
- there are limits to the consultation process; and
- consultation should be open and transparent

Collection and review of information from publicly available sources and stakeholders is important and continuous through the life of a project. Such information, including vital indigenous and traditional knowledge can enhance the understanding of the project on all sides, including its social setting, the stakeholder community and the issue and values that are important to those stakeholders.

To ensure that various deliberative processes protect social and environmental values, timely release and dissemination of critical information to potentially affected parties is essential. In order to ensure that local communities are informed and involved in all appropriate phases, alternative methods for communicating information such as translation into indigenous languages, multimedia, radio, TV, public meetings, etc. should be explored.

States should consult and cooperate with the indigenous peoples concerned through their own representative institutions in order to understand and integrate their needs and concerns with any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources, such as oil and gas.

4 Environmental monitoring

4.1 Aims and Objectives

The operator should carry out environmental monitoring to ensure that the basis for decision-making and the knowledge about the marine environment are sufficient to maintain acceptable environment conditions as a result of petroleum activities. Sufficient information should be obtained to see that all pollution and disturbance caused by the activities is detected, mapped, assessed and alerted so that necessary measures can be implemented.

Environmental monitoring implies systematic and regular examinations to document the state of environmental resources, describe the risk of pollution and disturbance and keep a check on their effects on marine resources.

Marine environment means sea, coast, shore, seabed, water column and environmental resources.

Environmental resource means naturally occurring or natural biotic and abiotic components which may include one or more species, biotopes and/or types of nature in a marine environment.

Environmental monitoring entails:

- establishing a basis for identifying environmental responses and trends;
- mapping of critical conditions and parameters for risk, transportation and spreading of pollution;
- measuring possible effects of disturbance and noise on marine habitats and organisms
- mapping of impact on environmental resources;
- helping to identify and assess geological and engineering hazards;
- assessing whether the observed environmental impacts are in line with the forecasted and accepted environmental impacts identified in the EIA; and
- compiling information to aid future decisions about where, when, how and if oil and gas activities should be allowed to occur.

Environmental monitoring should measure physical, chemical, and biological conditions that may impact or be impacted by the activities being conducted. Before activities commence, environmental monitoring should begin with a comprehensive baseline investigation, which should incorporate existing information, and comprise as a minimum all monitoring sites and variables planned to be used in the long term monitoring program. The environmental monitoring program should continue through the decommissioning and reclamation phases.

Environmental monitoring should preferably be conducted so as to distinguish impacts due to oil and gas activities from other relevant sources. Environmental monitoring should be carried out regionally and be integrated so that interactions between multiple activities may be more easily detected. The type of monitoring conducted depends on the specific type of activity anticipated and the nature of the environment that could be affected.

Priority monitoring should comprise the following areas during all phases of oil and gas activities to assess and minimize or mitigate adverse effects:

- environmental accounting of emissions to air, discharges to water and sea floor and emissions of noise;
- natural and industrial hazards in the region of activities including seismic and extreme weather and ice events;
- physical disturbance to sea floor, benthic communities, fish, ice edge communities and the sea shore, and effects on species populations, distribution and migration routes;
- levels of contaminants such as heavy metals, total hydrocarbons, polyaromatic hydrocarbons, phenol, barium, and POP's in bottom sediments and the water column;
- and their effects on living marine resources, seabirds and other wildlife, with particular attention to vulnerable life stages and areas of critical habitat;
- effects of petroleum activities on local human populations, subsistence access and harvest and other human activities;
- environmental effects on the integrity of the infrastructure;
- subsistence hunting and fishing activities such as the timing, position of harvest, search areas, and species, to aid in conflict avoidance; and
- acoustic monitoring of marine mammals in case of potential significant impact.

The type and content of environmental monitoring will vary depending on the phase of the activity. Exploratory drilling and production activities will demand different monitoring emphasis.

Environmental monitoring programs should be reviewed on a regular basis to determine whether the results they are yielding indicate a need for changes in operational practices (for example, as a result of failing to achieve the initial hypotheses set out in the EIA or because of unforeseen impacts). Programs should also be reviewed to determine whether they should continue, be modified or terminated. Ultimately, the length and breadth of environmental monitoring programs will be determined by the scale and duration of offshore oil and gas activities and the immediate or longer-term impacts.

The main emphasis of the baseline survey and/or EIA should be to make a complete inventory of environmental resources that may be affected by the planned petroleum activity and identify resources, areas or uses particularly sensitive to the various phases of the petroleum activities. Some resources may be sensitive to acute or continuing discharges/emissions even at sub-lethal concentrations. Both types may have effects on local biological communities, directly or indirectly through effects on the ecosystems.

Programs for identification and understanding of spatial and temporal distribution of biota particularly sensitive to pollution/discharges and emissions from petroleum activities should not only include adult stages and established communities (e.g. seabird feeding grounds, shoreline communities) but also early stages in the life cycle of plants and animals including larval stages, which may be more vulnerable to oil and chemicals than adult stages, if they are spatially or temporally relevant. Such programs should also consider acute and long-term chronic exposures. Therefore, not only vulnerable species should be identified prior to setting up a monitoring

program, but particularly sensitive life stages should also be identified.

4.2 Environmental monitoring methods

Environmental monitoring of trends in levels of contaminants in sediment, water, ice/snow and biota has been the traditional way of monitoring impacts of pollutants on environment. This is still the backbone of most monitoring programs, since reliable trend data are needed both to document changes in the environment as the result of the activities and as a basis for the prediction of future changes.

Monitoring should not only measure the level of potential pollutants in environmental compartments, but also the potential effects these might have on living resources. These effects may be monitored by recording changes in biodiversity over time or by measuring effects on single indicator species. Such methods, including the use of biological indicators, could give early warning of negative changes in the environment. Methods for monitoring effects should be an integrated part of monitoring programs.

The monitoring programs should not only be centered around field monitoring, but also include laboratory experiments and combinations of laboratory experiments and field studies whenever relevant.

4.3 Standards and Practices for Environmental Monitoring

Monitoring standards and practices for environmental monitoring should be established for all phases of offshore petroleum activities, including offshore seismic operations and marine transportation. Environmental monitoring activities should occur before any activity in the area, during drilling, development, production, decommissioning, and reclamation, as well as during transportation of oil, gas, supplies and personnel.

Most monitoring should have a long-term perspective showing developmental trends, and should form the basis for predicting what impacts to expect in the years to come. Monitoring surveys should be more frequent during the first years of investigation until the main impacts and trends are clarified and then as frequent as necessary in subsequent years. Environmental accounting and budgeting should be part of the monitoring system, showing the type and quantity of chemicals and substances that are used and discharged, what environmental impacts have been monitored, and what might be expected in subsequent years.

Requirements for monitoring should be defined in each country's legal and regulatory framework.

Environmental monitoring should start with a baseline survey establishing pre-activity population structure, distribution and size; habitat status; and existing level of contamination in the environment and biota. This information is essential if previous introductions of the contaminant in question have already taken place either naturally or from human activity. Usually, environmental monitoring will be the chemical measurement of the level of the contaminant in the air, water, ice/snow, sediments, or biological tissue. The levels found are then compared to applicable criteria such as baseline data or appropriate standards. The ultimate goal, however, must be to measure the effects of contaminants on organisms.

Monitoring of contamination levels related to petroleum activities should take into account the source of the contaminant, the potential routes of transport (e.g., aqueous, particulate, or air borne) and the potential pathways for bioaccumulation. Besides the contaminant in question and the particular processes that might be involved, other considerations may include: wind strength

and gustiness; ocean currents; relevant river flow; precipitation; air temperature; ocean temperature; sea ice conditions and movement; water depth; sea surface state; subsurface geology; and other resources affected.

Data from environmental monitoring should be harmonized in collaboration with AMAP and could be collected and stored in Arctic database repository, such as Circumpolar Biodiversity Network and GINA (Geographical Information Network Alaska), Arctic Ocean Observatory, and others, where it would be available freely to all national environmental protection and monitoring authorities and to other users.

Whenever appropriate, operators should consider local indigenous populations for contractual monitoring activities as well as drawing upon indigenous and traditional knowledge for the identification of historical environmental extremes and trends. Establishment of cooperative relationships with resident indigenous communities for biological sample collection, environmental observation and monitoring, should be pursued.

Results have shown that air emissions from the offshore installations may have an impact on nearby land areas and the results of any monitoring of these impacts should be included in updated monitoring guidelines.

For an example of guidelines for environmental monitoring of oil and gas activities refer to the OSPAR Convention (see references).

Air quality monitoring should include identification and reporting of all air pollution sources, emissions of priority air pollutants including nitrogen oxides, carbon monoxide, volatile organic compounds, PAHs, ozone, etc. and hazardous and toxic substances.

4.4 Following up environmental monitoring

Results of environmental monitoring should also be utilized by regulators in compliance audits and on-site regulatory supervision as the basis for requiring any modification, postponement, or shut-down of operations or specific components of an operation and also as a basis of revising legislation when necessary. Monitoring activities can be conducted in conjunction with environmental audits to verify that the equipment and procedures associated with an operation are functioning within design parameters and will not lead to any significant impact on the environment.

Authorities should use environmental audits to verify that the results of monitoring are used by the petroleum companies and reflected in their environmental strategy (see Annex H, Examples of Generalized Monitoring Plans).

Results from environmental monitoring should be used by regulators in evaluating whether the legislation and specific requirements that apply is adequate and sufficient, and take action to change this if needed.

5 Safety and Environmental Management

Two basic regulatory approaches are available for dealing with the safety and environmental aspects of offshore Arctic oil and gas operations. They are: (A) a performance-based system and (B) a prescriptive approach.

(A) In the performance based approach, the regulator sets specific quantifiable goals but does not specify how the operator must meet these goals. This system allows the operator the flexibility to specify how they intend to comply with a regulatory body's mandate that operations be conducted safely and in an environmentally sound manner. There are a variety of approaches available to the operator to meet the intent of this alternative, including the use of technical standards, company guidelines, "safety case" initiatives, or combinations of the above.

(B) The prescriptive approach to regulation is based on a series of specific regulatory requirements, which typically represent minimal expectations on behalf of the regulatory body. This approach can be complemented by a performance-based program. Under the prescriptive system, a regulatory body normally develops requirements addressing all phases of offshore operations. The requirements are typically developed from a series of existing standards, practices, guidelines, and procedures. Compliance with these requirements are normally evaluated by a regulatory body through review and evaluation of a series of plans, permits, and related documents and through a system of field based inspections and evaluations.

Either regulatory approach, performance or prescriptive, can be modified to form a 'hybrid" system of regulation, composed of appropriate elements from both regimes. Such a system of regulation may represent a viable alternative for a regulatory body to consider adopting due to the systems' ease of operation and flexibility.

Today, there has been significant interest by both the offshore oil and gas industry and the various regulatory bodies to adopt, when applicable, appropriate international standards as a component of a regulatory system (performance, prescriptive, or hybrid). Use of these international standards addresses the fact that more often than not, regulators are regulating a global industry and there is value in using global standards wherever practical.

In either approach, before oil and gas activities are approved, regulatory bodies should require the operator to demonstrate financial capacity to carry out all aspects of the operation, including responding to environmental emergencies and decommissioning of facilities. This should also include the proven ability to adequately clean up oil spills.

There are many similarities between the two systems of regulation. An important management tool to assist the operator in meeting the regulatory objectives of either system, eliminating unsafe behavior, and achieving continual improvement in safety and pollution prevention practices is defining and communicating a culture focus on safety and environmental performance to the workforce and ensuring that they are fully motivated to implement it through a management system. This philosophy can also be applied to a hybrid regulatory program. See Annex G.

Management Systems

Proper planning to address the environmental sensitivities of a project and to ensure safety of the work force is essential. Whether required by the regulator or conducted voluntarily within industry, environmental and safety planning should be contained in a formal management system. Often referred to as EMS (Environmental Management System), HSEMS (Health and Safety and Health Environmental Management System) or SEMP (Safety and Environmental Management Program) these systems focus attention on the influences that human behaviour and organization have on accidents. Various types of management system documents have been developed around the world with applicability to the offshore oil and gas industry. These include; American Petroleum Institute (Recommended Practice 75), the International Organization for Standardization (ISO 14000 and 9001 series) and Oil and Gas Producers (OGP) and UNEP/OGP publications.

These systems all have as a common and central feature a cyclic process involving sequential consideration of:

- policy and strategic objectives;
- organization, resources and documentation;
- risk evaluation and risk management;
- planning;
- implementation and monitoring; and
- auditing and review

Each step of the cyclic process requires leadership and commitment by the implementing body and the principal aim of the system is to deliver continual environmental, safety and health performance. This is assessed by periodic audit or review of a management system's performance to ensure that necessary components are in place and that they are effective.

The key elements of a management system can be described as follows:

5.1.1 Policy and Strategic Objectives

The operator's management should define and document its safety and environmental policies and strategic objectives and ensure that these:

- have equal importance with the operator's other policies and objectives;
- are implemented and maintained at all organizational levels;
- are publicly available;
- commit the operator to meet or exceed all relevant regulatory and legislative requirements;
- commit the operator to reduce the risks and hazards to health, safety and the environment (HSE) of its activities, products and services; and

- provide for the setting of safety and environmental objectives that commit the operator to continuous efforts to improve performance.

The operator should also take steps to ensure that all contractors engaged in operations are also able to meet the requirements of the operator management system and applicable laws and regulations.

A more detailed and specific list of possible objectives is set out in Annex G.

5.1.2 Organization, Resources and Documentation

Successful management of safety and environmental matters is a line responsibility, requiring the active participation of all levels of management and supervision. This should be reflected in the organizational structure and allocation of resources. The operator should define, document and communicate - with the aid of organizational diagrams where appropriate - the roles, responsibilities, authorities, accountabilities and interrelations necessary to implement the HSEMS and meet regulatory responsibilities. The operator should also stress and encourage individual and collective responsibility for safety and environmental performance to all employees. It should ensure that personnel are properly trained, competent, and have necessary authority and resources to perform their duties effectively.

5.1.3 Evaluation and risk management

The operator should maintain and implement procedures to identify systematically the hazards and potential effects, which may affect or arise from project inception through to decommissioning and disposal. Procedures should be maintained to evaluate (assess) risk and potential effects from identified hazards against screening criteria, taking into account probabilities of occurrence and severity of consequences for:

- People;
- Environment; and
- Assets.

The operator should maintain procedures to select, evaluate and implement measures to reduce risks and effects throughout the project. Risk reduction measures should include both those to prevent incidents (*i.e.* reducing the probability of occurrence) and to mitigate chronic and acute effects (*i.e.* reducing the consequences). In all cases, risks should be reduced to a level deemed as low as reasonably practicable, reflecting amongst other factors, local conditions and circumstances, the balance of costs and benefits and the current state of scientific and technical knowledge.

5.1.4 Planning

The operator should maintain, within its overall work program, plans for achieving environmental objectives and performance criteria. These plans should include:

- a clear description of the objectives;
- designation of responsibility for setting and achieving objectives and performance criteria at each relevant function and level of the organisation;
- the means by which they are to be achieved;

- time scales for implementation;
- programs for motivating and encouraging personnel towards a suitable HSE culture;
- mechanisms to provide feedback to personnel on environmental performance;
- processes to recognise good individual and team environmental performance; and
- mechanisms for evaluation and follow-up.

The operator should develop, document and maintain and review plans and procedures for responding to emergencies. These plans and procedures should reflect site-specific characteristics. In order to assess effectiveness of response plans, the operator should maintain procedures to test emergency plans by scenario drills and other suitable means at appropriate intervals. Plans should be revised and updated as necessary in light of experience gained. Plans should be available to the affected communities and the public at large.

5.2 Compliance Monitoring, auditing and verification

Compliance monitoring, which include carrying out audits, inspections and verifications, are key activities for the authorities when it comes to following up the petroleum activities in the Arctic.

Compliance monitoring may be carried out within a variety of organizational frameworks. For example, the recommendations of the European Parliament and Council provides for minimum criteria for environmental inspections in the European Union (EU).

The regulatory supervision should cover all stages of design, fabrication, installation, operations and removal of offshore installations. It should address all relevant parts of the operating company's management systems, such as procedures for ensuring compliance with legislation, licences, permits, and approved plans, as well as how the carrying out of activities are documented and reported. The regulatory supervision should also encompass the company's systems for pollution control and environmental monitoring, drilling and well operations techniques, production, and pipeline operations.

Representatives of the regulatory agencies should have the legal base to take appropriate action in case of violations, noncompliance, or if the operator fails to react adequately to dangerous situations. These actions can include issuing warnings, injunctions, shutting down specific operation, a complete shut-down of the installation, withdrawal of environmental licence or permit, or initiating prosecution by the relevant authority.

Authorized and qualified representatives from the regulatory agencies should have the legal base to access the installations and to see all relevant documentation and equipment at any time. The operating company shall provide for, as far as practical, the accommodation and necessary transportation.

Compliance monitoring may be carried out regularly as a part of a programme, or unscheduled in response to complaints, in connection with the issuing, renewal or modification of an authorisation, permit or licence, or in the investigation of accidents, incidents and occurrences of non-compliance. The frequency and extent of such activities should be decided by the regulatory agencies.

The regulatory agencies should establish plans for these supervisory activities. The extent and the issues to be covered should be based on the relevant regulatory requirements, the previous

experience with the operators' compliance, environmental and geologic conditions, the type of activity carried out by the operator, the type of technology applied, reported accidents and incidents, and general knowledge regarding the operator and its ongoing activities. The plans should be available to the public.

Procedures should be maintained for compliance monitoring to:

- determine whether environmental management system elements and activities conform to requirements in the legislation, and are implemented effectively;
- examine line management systems and procedures, field operations, internal compliance monitoring practices, and data to see if they fulfill the company's environmental policy, objectives, and performance criteria;
- review incident reporting and remedy schemes in relation to incidents that have occurred;
- find out how identified current and potential environmental problems have been dealt with by the operator and how this is reflected in the environmental management system;
- determine compliance with relevant legislative and regulative requirements;
- identify areas for improvement, leading to progressively better environmental performance; and
- formulate the conclusions in a report, which must be well documented.

Reporting and evaluation of compliance monitoring activities

The reports from compliance monitoring activities should include the following information:

(a) legal basis for carrying out compliance monitoring;

(b) background for carrying out the specific monitoring activity;

(c) issues covered during the inspections or audits;

(d) non-compliances or deviations found, as well as other observations;

(e) requirements regarding correcting non-compliances or deviations, including time lines and needs for reporting back to the authorities; and

(f) listing parties taking part in the inspections or audits.

The reports should be available to the public.

To prevent illegal cross-border environmental practices, the coordination of inspections with regard to installations and activities which might have transboundary impact should be encouraged.

6 Operating Practices

6.1 Waste Management

Offshore oil and gas activities produce a variety of wastes in the form of aqueous and solid discharges and atmospheric emissions that need to be managed to avoid air and water pollution, smothering of benthic communities, and contamination of materials and food sources. Waste management should be included in the overall planning from the beginning and combined with pollution prevention measures. Prevention and elimination of these discharges and emissions, which pose pollution threats to the Arctic environment, should be a targeted goal of regulatory activity. New technology makes this goal achievable in some situations. Arctic governments should set discharge standards.

The operator should to the extent possible avoid generation of waste. Any waste generated should be handled in an environmentally and hygienically adequate manner. Solid waste should not be discharged into the sea.

The operator should prepare a plan connected to waste, including possibilities for waste reduction, waste segregation, reuse, recycling, energy recovery or treatment. The need for enhanced onshore infrastructure should be looked into.

Transfer of pollutant from one media to another should be avoided, based on risk assessment.

Examples of Recommended Preventative Management Techniques:

- consider no discharge of the main waste streams at the planning and construction stage, in particular drilling waste and produced water;
- reduce waste at the source by process modification, material elimination, material substitution, inventory control and management, improved housekeeping, and water recovery;
- reuse of materials or products such as chemical containers, and oil-based or synthetic-based drilling fluids;
- recycle/recovery by the conversion of wastes into usable materials and/or extraction of energy or materials from wastes such as recycling scrap metal, recovery of hydrocarbons from tank bottoms and other oily sludge, burning waste oil for energy, and the use of produced water for enhanced recovery;
- reduce toxicity of effluents through the careful selection of drilling fluids and chemical products used in separation equipment and wastewater treatment systems;
- perform radiation surveys of equipment and sites to prevent or minimize the spread of Naturally Occurring Radioactive Materials (NORM); and
- where NORM-scale formation is anticipated, use scale inhibitors to minimize or prevent the buildup of radioactive scale in tubulars.

Management Techniques for Drilling Wastes and Production Effluents

Waste from Drilling Activities

Drilling wastes in the form of residual drilling fluids and cuttings comprise the principal wastes generated during well drilling. Initially, a determination needs to be made on whether or not to prohibit discharge based on the nature/volume of the discharge and its effect on the environment. In certain areas, due to identification of environmentally sensitive areas drilling fluids and cuttings may need to be managed in a manner that will prevent discharge. In areas where discharge is permitted, the method of disposal should be based upon careful consideration of drilling fluid formulation and specific environmental conditions at the site.

Where water-based drilling fluids are employed, additives containing oil, heavy metals, or other substances with negative ecotoxicological properties should be avoided or removed prior to discharge. Persistent and toxic substances should be avoided. Criteria for the maximum allowable concentration of harmful or hazardous substances should be established. If the option of land disposal is used, then both the properties of the drilling fluid and the environmental conditions at the proposed disposal site should be carefully considered to determine acceptability of the disposal site. This is particularly important in the arctic where creation of a disposal site on land may lead to greater environmental damage.

Environmental considerations favor the use of non oil-based drilling fluids for drilling. In shallow portions of a well, saltwater and saltwater with clay are often used as the primary drilling fluid and the cuttings and residual fluids can generally be safely discharged into the marine environment.

Discharge to the marine environment should be considered only where zero discharge technologies or reinjection are not feasible. Based upon site-specific biological, oceanographic and sea ice conditions, risk assessment methods should be used to determine whether the discharges should be at or near the sea floor or at a suitable depth in the water columns to keep impact on marine life as low as possible. These discharges should be considered on a case-by-case basis.

Where the use of non-aqueous fluids is required, for example in highly deviated wells or in certain geological formations, operators should ensure that the content of harmful or hazardous components is as low as possible, and that fluids are recycled as far as practicable. Disposal of cuttings contaminated with such fluids should be assessed on the basis of a comparative assessment of alternatives, including re-use of the material, injection into geological formations and discharge on to the sea bed taking into account possible impacts on the sea and other environmental compartments.

Spent oil-based or synthetic-based drilling fluids can often be reconditioned and recycled. Injection into disposal wells or encapsulation of reserve fluid pits containing drilling fluids and cuttings, including those with acceptable levels of NORMs, and other pumpable wastes, are potential disposal techniques. Where geological conditions permit, reinjection of wastes into the reservoir achieves a significant reduction of discharges to the marine environment of cuttings and drilling fluids. Management of down-hole disposal will require diligence to ensure that wastes do not migrate into unsealed or undesirable stratigraphic zones and that well integrity is maintained. Stabilized burial at approved onshore disposal sites is another alternative.

Production Waste Discharges

During production, produced water can be properly treated and discharged or may be reinjected. Other fluids, which are brought to the surface in connection with completion, work over, well

treatment or production, may be mixed with waste waters, unless those waters are identified as hazardous waste at the time of injection. In most cases they can be commingled with produced water for treatment and discharged within acceptable limits or reinjected.

Produced water treatment should be taken into account in the design phase and when significant modifications in operations are carried out. As characteristics of production water differ from one platform to another, there is no single system that can be applied successfully to all offshore platforms. Therefore, a site-specific combination of technologies should be employed based on the characteristics of produced water such as droplet size, stability of emulsion, ratio of droplets/dissolved hydrocarbons, and the presence of other substances such as corrosion inhibitors, solids, and naturally occurring substances.

Regulators and the industry should give consideration to the options for reduction and possible elimination of produced water discharged to the sea through the application of BAT, for example, injection, down hole separation or water shut-off. The focus should be on reducing the volume of discharges of produced water with the highest loads of oil and other substances.

Regulators and industry should ensure that BAT and BEP are implemented on each platform and that BAT and BEP are regularly reviewed. In addition, regulators and industry should ensure that new offshore platforms or major modifications to existing platforms should consider design changes that minimize discharges, and preferably aspire to produced water not being discharged at all.

Produced sand containing elevated levels of naturally occurring radioactive material should be re-injected, encapsulated, or removed from the site and stored in a safe and environmentally sound manner that is carefully controlled and whose risks and circumstances have been properly evaluated. Management of these wastes will require diligence to ensure that radioactive wastes taken to shore are handled and disposed of in accordance with applicable international law and in an appropriate and approved manner. Radioactive materials should be transported in approved containers with proper labeling, which identify the substance and its special transport and handling requirements. Appropriate record keeping and proper notification for shippers should be maintained.

Deck wash and chemical/fluid releases are another concern to the marine environment, especially where oil-based drilling fluids are in use. A facility plan should be developed to address these potential conditions and methods of spill control and leak minimization should be incorporated into facility design and maintenance procedures. These plans, minimization efforts and controls shall be applied to, but not limited to, material storage areas, loading and unloading operations, oil/water separation equipment, wastewater treatment, waste storage areas, and facility runoff management systems.

All washdown waters, hydrocarbon contaminated rainwater and deck wash, and machinery drainage space fluids should be either processed through an oil-water separator prior to overboard discharge, meeting MARPOL 73/78 requirements, or equivalent, or injected where possible.

Fluid Waste from Well-Testing

There may be oil or water containing oil which will not be completely incinerated when flaring during well testing. The regulators must determine whether this may be discharged into the sea, and if so, the quality of the fluid which is allowed discharged. One possibility is to allow discharge after treatment, if the quality of the water is similar to the discharges from produced water or drainage water.

Solids and Domestic Wastes

Disposal of solid and domestic wastes should be done in conformity with international law, such as MARPOL 73/78, and national legislation.

Sanitary Waste

Sanitary wastes such as sewage and gray waters should be processed according to international or local government standards prior to discharge into the marine environment. Processing in an acceptable sanitary waste treatment unit will generally properly treat waste streams prior to discharge.

Hazardous Waste Handling and Disposal

The most effective way of protecting human health and the environment from the dangers posed by hazardous wastes is to ensure the reduction of their generation to a minimum in terms of quantity and/or hazard potential. Minimizing the generation of hazardous wastes requires the implementation of environmentally sound low-waste technologies, recycling options, good housekeeping and management systems. Necessary measures should be taken to ensure that management of hazardous wastes is protective of human health and the Arctic environment.

The availability of adequate disposal facilities should be ensured prior to allowing an activity to generate hazardous wastes. Hazardous wastes requiring transport to a disposal site should be packaged, labeled, and transported in conformity with generally accepted and recognized international rules and standards in the field of packaging, labeling, and transport. Due account should be taken of relevant internationally recognized practices. Transported hazardous wastes should be accompanied by a movement document from the point at which movement commences to the point of disposal.

6.2 The use and discharge of chemicals

The use and discharge of chemicals from the oil and gas industry should be strictly regulated to avoid or reduce possible negative effects on the marine environment.

The amounts of chemicals used and discharged should be as low as possible.

All substances in chemical preparations should be tested for their ecotoxicological properties such as potential for bioaccumulation, biodegradation rate and acute toxicity. The tests should be performed by laboratories that are approved in accordance with established international standards, for example, OECD's principles for good laboratory practice (GLP) or equivalent.

Biodegradability

The substance should if possible be tested in accordance with established standards, for example, the seawater test OECD 306 "Biodegradability in Seawater" or equivalent.

Bioaccumulation

Chemicals that consist of several substances should be tested for the individual organic substance's bioaccumulation potential. The substances should be tested according to established standards, for example, OECD standards or equivalent. For substances where standardised tests are not applicable, as for surfactants, a calculation or a scientific evaluation of the bioaccumulation potential may be performed.

Acute toxicity

Inorganic and organic chemicals should be tested for acute toxicity. Toxicity tests specified in the OSPAR *Protocols on methods for testing of chemicals used in the offshore industry* may be used.

Assessing chemical risk

The operators should ensure that risk evaluations are done based on the chemicals' intrinsic properties, time, place and amounts of discharge, and also other conditions of significance for the risk. The operator should choose the chemicals which according to environmental risk evaluations poses the lowest risk of harming the marine environment.

The operator should have plans to ensure that hazardous chemicals are substituted with substances which pose less risk of harm to the environment. The plans shall give a description of which chemicals are prioritized to replace, and when this can take place.

Chemicals should be stored in a safe and prudent way.

6.3 Emissions to air

Air emissions associated with oil and gas exploration and production activities can be generally categorized as arising from three activities: (1) the combustion of fuels for power generation; (2) emissions arising directly from the production, treatment, storage or transportation of produced oil and gas, and (3) flaring of gas.

Energy efficiency

Overall emissions reductions can best be achieved through programs that emphasize energy efficiency and conservation in all activities, exploration (survey and exploratory drilling), development (construction and drilling), production, and transportation. Such programs can also encourage the use of energy effective technology (turbines with high power efficiency, waste heat recovery units when heat demand, dry low emission turbines etc.)

Policy instruments to reduce emissions/discharges from petroleum activities

The regulators can apply terms and conditions when awarding licenses, as requirements connected to EIAs, in emission or discharge permits, and/or in production permits. Such terms may include taxes on emissions of CO_2 and NOx.

Using such economic measures may be used to enhance power generation efficiency and reduce emissions.

Emissions from flaring

If associated gas is flared, this may be a significant source of emissions to air. To reduce the amount of gas flared from an offshore installation is beneficial both from and environmental point of view, but also can help avoid potential waste of resources and reservoir energy.

There may be a need for specific licenses or permits covering flaring of gas. Flaring permits can be issued after a thorough assessment of environmental considerations and evaluations in accordance with technology, economy, resources, safety, infrastructure, jurisprudence etc. The regulators should early in the process of awarding licenses specify what the operators must expect with regard to limiting flaring of associated gas. Some gas may be utilized for power production

at the installation, but if a large amount of gas is produced, possible solutions may be injection into the reservoir or export through pipelines. Every effort should be made to flare only where necessary for safety purposes.

The planning and execution of activities regarding flaring reduction is extremely time consuming and cost intensive. This has to be taken into account in the early phases of deciding on the production strategy of the field. Technologies that could be used for reducing emissions from flaring may be *closed flare* technology and/or *flare gas recovery* systems.

VOC emissions

Offloading and storage of oil is an emitting source of volatile organic compounds. Emissions of such non methane volatile organic components (nmVOC) can be significantly reduced by applying technologies for nmVOC recovery. These can be condensation, absorption or adsorption technologies, and can be installed at storage ships and shuttle tankers.

Best Available Techniques (BAT)

All large combustion plants offshore (both existing and new) should apply integrated prevention and reduction of pollution. This implies application of Best Available Techniques (BAT). Regulators should refer to BAT when discharge limits are set in the discharge permits, and reflect what levels of reduction can be achieved without a definite resolution on what technology to use. Instructive reference documents (see reference) for guidance on what to consider as BAT has been developed. These reference documents will inform the relevant decision makers about what may be technically and economically available in order to improve the industry's environmental performance and consequently lead to environmental improvements. The reference documents can be considered as guidelines for considerations regarding BAT.

When making plans for development of new fields, it is important to take into consideration the need to reduce emissions to air. It is important that operators inform the regulators on BAT considerations at an early stage in the development. The operator should as early as possible, for example in the EIA document that BAT has been considered (e.g Dry Low Emission turbines, power co-ordination, and waste heat recovery if heat is needed).

6.4 Design and Operations

Offshore oil and gas activities should make use of the best available and safest technologies as appropriate and be conducted in a manner to minimize impact on the environment. Operators should identify technologies and procedures to be employed for each step of the process from prospecting to exploration, development, production, platform decommissioning, and site clearance. Regulators should examine technologies and procedures proposed for use by operators and their adequacy to ensure that they are appropriate for the Arctic.

Of primary importance is the need to ensure that wells remain under control at all times during drilling, well-completion, production, and well-workover operations. This capability must be maintained even while operating under extreme conditions.

When planning an offshore oil and gas operation, a risk analysis may be used as a tool to identify potential hazards and prevent personal injuries, loss of human lives, and pollution of the environment. Criteria used for conducting such an analysis should be based on local regulatory requirements, local environmental conditions in the area of operation, and the planned operational activity.

A risk analyses should:

- address prevention of injuries, loss of human life, and pollution of the environment;
- include risk criteria that has been defined prior to conducting the analysis and document the evaluations forming the basis of the acceptance criteria;
- be used to follow the progress of activities in planning and implementation;
- identify risk that has been assessed with reference to the acceptance criteria, form the basis of systematic selection of technical operational and organizational risk to be implemented;
- be updated on a continuous basis and included as part of the decision making process; and
- systematically follow-up implemented risk reducing measures and assumptions made in the analysis to ensure safety within the defined criteria.

Technology

Offshore platforms and other structures used for oil and gas activities in the Arctic should be designed, built, installed, maintained, and inspected to ensure their structural integrity taking into account the site-specific environmental conditions. Standards exist for the construction of fixed offshore platforms, including those constructed of steel and concrete; mobile offshore drilling units; and floating production, storage and offloading units (FPSOs). (FPSOs should be double hulled). Standards, such as those under the International Organization for Standardization (ISO), are under development for offshore artificial islands including those constructed of sand, gravel and ice. In iceberg-prone areas, provision should be made for the emergency removal of removable installations.

Employment of effective well control technology and practices including incident drills and exercises will lower the risk of blowouts and unintended release of other hazardous substances. Blowout preventers and related equipment should be suitable for operation in subfreezing conditions. Drilling fluids, well casing programs, cements, emergency well shut-in procedures and well safety programs should also be suited to Arctic conditions including moving ice and possible subsurface permafrost.

Pipelines should be installed, operated, and maintained in a manner that minimizes disturbance of sea floor habitat and does not unreasonably interfere with other uses of the sea floor in the area. Pipelines should be installed only after a thorough survey of the seafloor for hazards or cultural resources. Design of offshore Arctic pipelines should follow recommended practices such as those from Det Norske Veritas or the American Petroleum Institute and take into account factors such as thaw settlement, near shore strudel scouring, and ice keel gouging. Pipe properties, instrumented internal inspection techniques, leak detection systems and techniques, cathodic protection, and preventive maintenance must also be considered in the design of Arctic pipelines.

Procedures

Procedures relevant to the special conditions in arctic areas should be worked out as a part of the operator's management system.

Operators should submit a summary of the proposed project at the outset, followed by more detailed information prior to the initiation of each major activity, such as the drilling of a well. The application should describe all procedures to be employed, including those necessary to prevent harm to life and the marine environment. Special attention should be paid to operations in

offshore areas underlain by permafrost.

Safe work procedures should be developed for all phases of the proposed operations, including construction activities, transportation, equipment operation and maintenance, safety tests and drills. For example, well-control exercises should be conducted regularly for each crew to develop an adequate level of response proficiency to conditions threatening a blowout. Exercises should cover a wide range of situations. As appropriate, procedures should also be developed to ensure that hot work, welding, burning, cutting, and other operations with the potential to cause ignition of flammable vapors are conducted safely. Safe work procedures may also be developed for cold work such as use of radioactive material, trenching and excavating, and work on fire suppression, gas detection or emergency shutdown devices. These procedures may include issuance of a work permit.

Procedures should be developed to protect personnel from the toxic effects of hydrogen sulfide, if it is encountered during drilling and production.

Decommissioning, and site clearance are discussed in Section 8 (**Site Clearance and Decommissioning**). Operators shall incorporate into the design of an installation needed measures to ensure that removal of the installation can be accomplished without causing significant impacts on the environment.

6.5 Human Health and Safety

Threats to human health and safety including unsafe working conditions are factors contributing to accidents that could lead to environmental pollution. Possible threats or hazards affecting the health and safety of personnel in Arctic offshore oil and gas activities take many forms and comes from multiple sources. Principal sources include, but are not limited to, the harsh Arctic environment, the structural integrity of the installation, blowouts, fire and explosions, equipment failure, the transfer of personnel and supplies, and drilling, production, well completion, and workover operations.

All offshore activities should be conducted in a safe and skillful manner and equipment maintained in a safe condition for the health and safety of all persons and the protection of the associated facilities. All necessary precautions should be taken to control, remove, or otherwise manage any potential health, safety or fire hazards.

Management System and Work Procedures

One way to manage potential risks is through the use of an appropriate management system. A management system or plan should address the identification of potential hazards, the evaluation of risks to the health and safety of personnel and procedures to eliminate or reduce health and safety risks (See 5.1 **Management Systems**). Management plans should:

- identify and recognize significant health and safety risks;
- evaluate significant health and safety risks;
- plan and implement actions/procedures to manage risks;
- review and test preparedness and effectiveness on a regular basis;
- establish clear lines of communication with personnel;

- provide training to personnel;
- identify appropriate personnel protection equipment; and
- communicate contents of the management plan to all personnel.

Operators should ensure that all contractors pursue established safe working environment objectives. Safe working procedures should be established for all persons, including contractors, to ensure safe working conditions for all offshore activities. In addition work permits may be required for specific work activities including hot work, cutting, and welding (see 6.4 **Design and Operations**).

Another useful tool to consider in the management or elimination of risks is through the use of a Health, Safety and Environment (HSE) Committee. HSE Committee meetings could be held to ensure that critical safety and environmental control information is communicated to all parties throughout offshore operations. HSE meetings would coordinate among the operator, contractors, and employees to ensure a mutual understanding of potential hazards in working environment. Meetings would allow employees an opportunity to express safety concerns to be addressed by the operator.

Control of Materials

Materials specifications, inventories, separation, confinement, and handling of toxic or hazardous materials that can affect human health and safety should be determined, documented, labeled, and communicated to appropriate person and addressed (see 6.1 **Waste Management**).

6.6 Transportation of supplies and transportation infrastructure

Offshore transportation by air and water should be planned and carried out in a manner to eliminate or minimize adverse impact on the environment. The sections in these guidelines on management systems, monitoring programs and planning for emergencies should be applied, with adaptations where necessary, to transportation activities. Information gathering and mitigation measures identified at the environmental assessment stage of project planning should be fully utilized for minimizing the environmental impacts associated with transportation of supplies and people to and from offshore operations. For example, it may be necessary to select routes, frequency, flight altitudes and/or the time of voyages to avoid impact on wildlife or the harvesting of wildlife by area residents.

The planning and implementation of supply routes involves many considerations beyond environmental impacts. The system of transportation consists of supply bases, routes and mode. Procedures involved are the safe handling of cargo and safe navigation. All these elements must be carefully evaluated and accounted for prior to the field development. Transportation of supplies, infrastructure and crude oil, shall therefore be an integrated part of the environmental impact assessment outlined in these Guidelines.

Where roads are required, ice roads, which create seasonal rather than permanent physical barriers to animal movements, may be preferable to permanent roads.

Planning and environmental studies should be done to ensure the use of water from lakes or rivers to make ice roads will not significantly affect important freshwater habitat, including habitat for migratory birds.

Ship-based transportation of supplies to offshore oil and gas installation are to be carried out

under the administration of those requirements and guidelines laid down in the Safety of Life at Sea Convention, including in particular Chapter IX pertaining to the International Safety Management (ISM) Code, The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), and the International Convention on the Prevention of Pollution from Ships (MARPOL 73/78), among others. The basis of the ship owners management system should include guidelines, codes and relevant international conventions to safeguard those additional requirements of the harsh environment of the Arctic such as those established by the Marine Environment Protection Committee (MEPC) and Maritime Safety Committee (MSC) of the International Maritime Organization.

Supplies

In maintaining the activity of an oil or gas installation in every aspect, supplies of many categories are involved:

- supplies for maintaining production;
- supplies for installation maintenance and safe operation; and
- supplies of domestic use.

Storage, packaging and operational procedures of handling are to be as in accordance with general rules of safe practice and to recommendations of the product manufacturer.

Supply base, routing and installations

Prior to field development, it is necessary to plan infrastructure required to serve the needs of the installation. In addition to systems for handling the production, a system is also required to secure sufficient and safe supply. Beside the installation itself, the main elements of such infrastructure are the supply bases and sea-routes. The location of such bases is often decided on the basis of compromises in which the requirements for safe transportation must compete with other possibly conflicting alternatives. This calls for an even closer focusing on safe routing. An Arctic land-offshore transport routing system might cover more than one field and therefore must be reliable. To assure safe operations, sufficient care must be taken regarding both climatic and environmental seasonal variations. In order to account for these factors, one should evaluate the possible need for ice handling and management procedures (integrated in the field operational plans if feasible) covering the installation, and the route as well as the supply base.

6.7 Training

Trained operator and contract personnel are the key to safe and environmentally sound oil and gas activities. Appropriate training plans, programs, and practices addressing offshore Arctic oil and gas activities should be established and implemented for these personnel in accordance with their duties and job responsibilities. (Refer to Section 7, **Emergencies**, for information concerning response training).

All personnel should be provided with training on basic safety and environmental issues and procedures specific to the offshore environment prior to assuming their duties. This training should provide personnel with the necessary skills and knowledge needed to conduct their jobs in a safe manner, provide for health and safety of all persons, and protect the environment.

Training programs should provide instruction on the operation of equipment, offshore operating practices, offshore emergency survival and fire fighting, local or regional regulatory

requirements. It should include Arctic cultural, social, and environmental concerns including marine mammal interactions as dictated by an individuals' job responsibilities. Where appropriate, indigenous and traditional knowledge should be used in training programs.

Supervisory personnel should have a thorough knowledge of the operations and the operating procedures for which they are responsible. Individuals responsible for drilling, well completion, or workover operations should be properly trained in well control. Individuals responsible for production operations should be properly trained in production safety system operations.

A person designated by the operator to be in charge of the offshore operation should have a thorough knowledge of the operations and the operating procedures they are responsible for, and training in the following areas as appropriate:

- leadership and command ability;
- communication skills;
- team building;
- crisis management; and
- installation specific emergency training.

Periodic refresher training should be provided to personnel as appropriate. As required, procedures should be developed to monitor the effectiveness of training programs.

7 Emergencies

Arctic States that are party to the International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC 1990) and/or the International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978, Annex I – regulations for the prevention of pollution by oil), are required to ensure that operators have oil pollution emergency plans and that these plans are carried on board installations.

7.1 Preparedness

Operators should establish and maintain emergency preparedness so that the mitigation of an incident will be carried out without delay in a controlled, organized, and safe manner. Risk analyses should be carried out in order to identify the accidental events that may occur and the consequences of such accidental events. Hazardous situations and accidents should be defined for the operations in question. An analysis should be carried out to design the emergency preparedness requirements so as to meet the specific circumstances of the operation. Such an analysis should include oil spill response strategies, techniques, and capabilities. The emergency preparedness required for the operation should be incorporated in the design and modification of the oil and gas installation, and for the selection of equipment. The performance requirements expected of both standby vessel and ice roads in emergencies should also be defined. This should include design criteria, equipment and manning requirements for standby vessels and design criteria and construction and maintenance requirements for roads. Emergency preparedness should be part of the safety and environmental program to ensure its integration into all phases of the operation in question.

Preparedness relating to oil pollution should ensure that the source of any oil pollution is first secured, and any release is effectively contained and collected near the source of the discharge as quickly as possible. Particular attention should be paid to response contingencies in ice conditions, where oil spill response, including containment, may require a range of techniques depending on the condition of the ice. The preparedness should also address protection of public health, environmental resources including shorelines, ice and water interfaces, and economic and cultural resources. The health and safety of all persons who may be involved in an incident (e.g., local populations and their representatives, responders, volunteers, etc.) should be a predominant consideration, and should be integrated into the overall emergency preparedness regime.

The communication within the emergency preparedness organization should ensure effective administration and control of all response resources when abnormal conditions and emergencies occur. The means of communication and their use should ensure unambiguous and effective transmission of information.

A key factor in preparedness is ensuring that personnel involved in the response are trained and instructed in their roles and duties.

Preparedness planning of the operator should include co-ordination with any relevant municipal, local, state or federal emergency response plan.

Governments are responsible for oversight including national emergency contingency planning. Governments should also make appropriate arrangements that facilitate international coordination and cooperation.

7.2 Response

Contingency Planning

The contingency planning process is one of the key best management practices for evaluating the environmental effects of the response operation. Through the planning process, response options (e.g., no response, dispersant use, in situ burning, or mechanical recovery) can be fully evaluated under varying weather and ice conditions to decide ahead of time which options may be most successful in minimizing the effects of a spill and subsequent clean-up operations. By conducting this risk assessment through a multilateral contingency planning process such issues as disturbance to marine mammal migration from response, including ice-breaking activities can be evaluated in the context of each response measure and/or a combination of response measures. Through a multilaterally developed plan, response options would be vetted through the countries in preparation for an incident. The plan should establish training schedules so that response organizations are exercised periodically, and communicate on a regular schedule.

A multilateral Arctic response plan would delineate regional response zones, clearly identify the lead response group for each region and identify response groups to cascade in to help with the response. The plan would identify roles and responsibilities, would be maintained so contacts could be made effectively given an incident, and would identify response capabilities (personnel, equipment, platforms, communication, infrastructure, etc.) for each region.

Emergency Response Plans

Refer to the EPPR Field Guide for Oil Spill Response in Arctic Waters for a practical introduction to oil spill response. Emergency response plans should address abnormal conditions and emergencies that can be anticipated during the oil and gas operation being carried out, including:

- personnel injury or loss of life;
- loss of well control, or release of flammable or toxic gas;
- fire, explosion or other emergencies that may occur;
- damage to the oil and gas installation;
- loss of support craft including aircraft;
- spills of oil or other pollutants; and
- hazards unique to the operation including ice encroachment; uncontrolled flooding of the installation; loss of ballast control or stability; pipeline leaks or ruptures; vessel collision; and heavy weather and difficulties with support facilities such as ice roads, aircraft or shuttle tankers.

Contents of Emergency Response Plans

An emergency response plan should contain at least the following elements:

- a description of the response organization, clearly stating its structure, roles, responsibilities and decision-making authorities;

- policies and procedures for responding, including a summary of equipment to combat the particular condition or emergency situation, clearly stating the make and type of equipment, its capacity, location, type of transport, field of operation and operational procedures and training for operating staff. The procedures should include each key person's duties, when and how the emergency equipment is to be employed, and the action to be carried out. Policies should state measures for limiting or stopping the event in question and conditions for terminating the action. The procedures should be designed so as to be expedient to use for the emergency;

- a description of the alarm and communication systems, including notification criteria, reporting procedures and policies regarding government notification. Primary and secondary communication facilities among operational components should also be identified;

- Alert Criteria, whose procedures should list precautionary measures to secure the well and evacuate personnel in the event of damage from severe weather, sea, ice, erosion or other event;

- On-Site First Aid - List available backup medical support, medevac facilities and other emergency facilities, such as emergency fueling sites. Also describe required survival equipment, including extreme weather survival gear, alternate accommodation facilities, and emergency power sources; and

- Relief Well Arrangements - The operator should outline his immediate response to a well control incident or blowout. Also, the operator should demonstrate the availability of the necessary equipment, and support systems to be utilized.

- Designated response operation center to coordinate response actions; and

- "Emergency response contact list" in order to identify who and how key responders to an emergency are to be contacted.

Oil Spill Response Plan

Operators should be required to have site-specific or operator-specific plans. An oil spill response plan addresses an oil spill volume based on relevant well data, catastrophic loss of a tank ship or barge, or damage to a pipeline. The Plan should be supplemented by resource sensitivity maps arranged sequentially by month for those areas identified by spill trajectories as being potentially exposed to oil pollution. The plan should also describe the process for its development, which should include involvement by response entities, both government and private, health officials, scientists, local populations that may be affected, wildlife experts, trustees of resources, and anyone else who may be affected or who may have a role in the response. Operators should allow the opportunity for public review and comment of the Plan.

The oil spill response plan should include, in addition to the items described above, the following:

- a brief description of the operation;

- a description of remote sensing systems in order to detect and monitor oil spills;

- a description of the site, water depth, seasonal constraints, and logistical support;

- references to all environmental support material that would be relevant to establish cleanup priorities;

- details of the operator's capability in using real time wind and current data to implement an oil spill trajectory model both for open sea and for ice-infested areas;
- a map depicting sensitive areas to be protected;
- a description of cleanup and containment strategies required for shoreline and ice-covered areas;
- a description of alternative cleanup strategies such as the use of dispersants, in situ burning, and no response;
- a strategy to respond to small spills from the installation, shore base or loading operations;
- provisions for transport, storage, and disposal of recovered oil and oil contaminated materials;
- spill response crew relief & logistics; and
- a list or inventory of spill response equipment and their measured efficiency when used as expected in the plan.

Operators should have access to oil spill countermeasures equipment. The oil spill response plan should itemize equipment on-site for immediate containment purposes. The plan should also provide details of oil spill equipment and resources that are not onsite but will be mobilized in the event of a spill; the details should include type of equipment, required resources, logistics and timing of mobilizing the equipment to the site.

The oil spill response plan should include the qualifications and training of personnel responsible for the management of oil spill responses. It should clearly define their authority to take actions to respond to such emergencies.

A national preparedness and response system should be developed on the basis of protecting the health and safety, the environment, and the socio-economic interests of the nation's citizens.

Oil spill response plans must take the existence of ice conditions into account. Broken ice conditions make it difficult to respond to oil spills with conventional mechanical response equipment because oil can be trapped in melting or freezing ice and require the coordinated application of a suite of response strategies. Through ice movement and drift, oil can be carried a long distance from the original site of the spill. Deployment of oil tracking buoys in the ice can aid in maintaining knowledge of the position of the oil. Where ice conditions exist, oil spill response plans must outline the strategies to be used, list the equipment to be deployed, and techniques to be implemented including for tracking oil in ice and for alternative response measures.

Exercises and Drills

To enhance response capabilities, response organizations should conduct regular safety and emergency response drills during which trained workers and emergency responders carry out regular exercises. Drills include desk-top exercises and actual equipment and operational deployment exercises. Such drills should be conducted by operators as well as by relevant government authorities in their areas of responsibility, such as coast guards for marine spills.

Ice Management Plan

Where there may be pack ice, drifting icebergs or ice islands at the operational site, the operator should develop an ice management plan that provides for the protection of the installation.

The Plan should include details regarding ice detection, ice surveillance, data collection, forecasting and reporting of ice encroachment, multiyear ice hazards, ice loading, and structural loading. If required, the Plan should also include details of ice avoidance or ice deflection, including forecasting oil-in-ice drift.

The Plan should include alert criteria and alert procedures to ensure a totally effective mobilization of all relevant emergency preparedness resources, including procedures for moving the installation. Measures for danger limitation should be implemented when a hazardous situation occurs in order to prevent its developing into an accident situation.

Emergency Preparedness Maintenance

All the established technical, operational and organizational measures that make up the emergency preparedness of the individual activity, as well as, the actual equipment should be maintained in order to keep up a state of effective emergency preparedness.

Oil spill response exercises should be carried out on a scheduled basis allowing responders to use actual equipment. In addition, a communication exercise in response to an emergency should be conducted on a scheduled basis. Exercises should be reviewed to ensure compliance with all requirements relating to emergency preparedness. Any deviation should be identified and corrected immediately; the causes of such deviation should be identified. In accordance with the safety and environmental program, emergency preparedness work should be verified and documented.

Measures should be taken to update the established emergency preparedness based on continuous evaluation of experience, technological development and new knowledge.

8 Decommissioning and Site Clearance

Decommissioning is an integral part of the life cycle of an offshore project. Plans for decommissioning should be incorporated at the design phase of a development and reviewed again when the facility is no longer needed for its current purpose. These plans should involve both technical considerations and financial provisions required to undertake the activity and any post-abandonment clearance and/or monitoring work.

A decommissioning plan should be site- and condition-specific and should take into account sound science and field experience and balance environmental, safety, health, economic and technological factors as well as any constraints imposed by intergovernmental agreements. It is noted that those Arctic States that are Contracting Parties to the OSPAR Convention have agreed to a binding package of measures (via OSPAR Decision 98/3) which generally prohibits disposal of installations at sea, but which allows for derogation from this prohibition in a limited number of instances. These include leaving in place the footings of a large steel jacket platform (with a jacket weight in excess of 10,000 tons) as well as a broad exemption for gravity-based concrete structures for which leaving in place and/or disposal at a designated site may be considered.

Other Arctic States will need to take into account the provisions of the London Convention (1972) or the 1996 Protocol to that agreement where full or partial disposal at sea (including toppling and leaving in place) is considered. For both the 1972 and 1996 agreements, Contracting Parties to the London Convention (1972) have adopted specific guidelines for disposal of platforms.

In addition to these agreements dealing with the special case of disposal of platforms, the International Maritime Organization has adopted "Guidelines and standards for the removal of offshore installations and structures on the continental shelf and in the Exclusive Economic Zone" (Resolution A.672(16))" which govern safety of navigation. Amongst other things, the guidelines state that for structures placed on the seabed after 1998, complete removal should be feasible.

Decommissioning plans should be developed in consultation with the competent authorities and stakeholders, including indigenous residents, fishing groups and other interested parties. The decommissioning plan should address both the facilities and the environment. (The London Convention (1972) Waste Assessment guidance is a useful reference in this regard.) Abandoned wells should be plugged and sealed. Pipelines may be removed, or cleaned flushed and left in space either on the seabed, if they will not interfere with other uses of the sea, or trenched. Removal of facilities should consider potential impacts on the site, including noise (as from the use of explosives), physical disturbance of communities established during the life of the facility and demobilization routes.

Site clearance and post decommissioning monitoring programs are important aspects. These will ensure that with the exception of facilities purposely left in place that the site is clear of debris and that no obstacles are left that might interfere with other uses of the site. Post decommissioning monitoring can also be used to assess the recovery of the production site. Where an artificial island has been constructed as a platform for drilling or construction, it may be appropriate to allow natural processes to return the site to its former configuration.

Development of a trust fund that can be used to decommission the infrastructure when its production life is over should be considered.

9 Abbreviations and Definitions

Accident: A sudden, unplanned, unintentional and undesired event or series of events that causes physical harm to a person or damage to property, or which has negative effects on the environment.

ADD: International Arctic Environmental Data Directory http://www.grida.no/add/

AEPS: Arctic Environmental Protection Strategy

AMAP: Arctic Monitoring and Assessment Program, a working group under the Arctic Council. http://www.amap.no/

API: American Petroleum Institute http://www.api.org

Arctic Ocean Observatory (AON) is an integral part of the SEARCH (Study of Environmental Arctic Change) program, as an initiative for the United States National Science Foundation International Polar Year (IPY) to improve observational capabilities in the Arctic. The Cooperative Arctic Data and Information Service (CADIS) supports AON by providing portal for data discovery, provide near-real-time data delivery, a repository for data storage, and tools to manipulate data. http://www.arcus.org/search/aon.html

BAT: Best Available Technology/Techniques

BEP: Best Environmental Practice

BOP: Blowout Preventor--Safety system that quickly closes a well in the course drilling to avoid blowouts.

CAFF: Conservation of Arctic Flora and Fauna-- a working group under the Arctic Council. http://www.caff.is/

Circumpolar Biodiversity Network: An initiative of the Circumpolar Biodiversity Monitoring Program by the Conservation of Arctic Fauna and Flora (CAFF) Working Group of the Arctic Council providing data-management structures and a Web-based data portal for the synthesis, analysis, and dissemination of biodiversity information. http://arctic-council.org/working_group/caff

Chemicals: A generic term for both chemical substance and/or mixture of substances (see definition for 'mixture of substances').

Chemical Substance: A chemical element and chemical compound of several elements, naturally or industrially produced.

Chemical waste: Oil/fuel residues, empty chemical and paint packaging, all kinds of chemical waste (solid and liquid) and all kinds of paint and solvents.

Contamination: concentrations of naturally occurring substances enhanced by man's activities or the occurrence of synthetic substances in the environment at concentrations that do not give rise to adverse effects;

DNV: Det Norske Veritas, Classification, Consulting and Certification Society. http://www.dnv.com/

EIA: Environmental Impact Assessment

EMS: Environmental Management System

Emergency: An unplanned event which has caused injury, loss or damage or which is an actual or potential threat to human life, the environment or the installation and has made it necessary to deviate from the planned operation or suspend the use of standard operating procedures.

EPPR: Emergency Preparedness, Prevention and Response a working group and program of the Arctic Council. http://eppr.arctic-council.org/

FPSOs: Floating production, storage and offloading units.

GINA: The Geographical Information Network Alaska, run by the University of Alaska Fairbanks provides a framework for organizing and sharing geographic data and technology among Alaska, the arctic and world communities. http://www.gina.alaska.edu/

GLP: Good laboratory practice as defined in the Organisation for Economic Co-operation and Development

Hazard: A physical situation with a potential for causing human injury, damage to property, negative effects on the environment or a combination of these. British Standards BS 8800 definition--A source or a situation with a potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these.

Hazard Analysis: The identification of undesired events that lead to the materialisation of a hazard, the analysis of the mechanisms by which these undesired events could occur and usually the estimation of the extent, magnitude and likelihood of any harmful effects.

Hazard Identification: (British Standards BS 8800) The process of recognising that a hazard exists and defining its characteristics.

HSEMS: Health, Safety, and Environmental Management System

HSE: Health, Safety and Environment

ISM: International Safety Management Code in Chapter IX of the Safety of Life at Sea Convention. http://www.imo.org/

ISO: International Organization for Standardization. http://www.iso.ch/

IMO: International Maritime Organization. http://www.imo.org/

Impact: an alteration to the natural environment arising from the activity in question

Incident: A sudden, unplanned, unintentional and undesired event or series of events having the potential of causing physical harm to a person or damage to property, or which has negative effects on the environment. British Standards BS 8800 definition—An unplanned event which has the potential to lead to accident.

London Convention 1972: The International Maritime Organization Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972. http://www.imo.org/

London Protocol 1996: The International Maritime Organization Proticol to modernize and replace the London Convention of 1972. http://www.imo.org/

MARPOL: International Convention for the Prevention of Marine Pollution. 1973, 1978. MARPOL-Annex I, IV, V and Annex VI. International Maritime Organization http://www.imo.org/

MMS: United States Department of the Interior, Minerals Management Service. http://www.mms.gov/

MSC: Maritime Safety Committee of the International Maritime Organization. http://www.imo.org/

MEPC: Marine Environment Protection Committee of the International Maritime Organization http://www.imo.org/

nmVOC: Non methane volatile organic components.

NORM: Naturally Occurring Radioactive Materials

OECD: Organisation for Economic Co-operation and Development. http://www.oecd.org/home/

OGP: International Association of Oil and Gas Producers http://www.ogp.org.uk/

OPRC: International Convention on Oil Pollution Preparedness, Response and Cooperation (1990) http://www.imo.org/

OSPAR: Oslo Paris

PAME: Protection of the Arctic Marine Environment http://www.pame.is/

PEIA: Preliminary Environmental Impact Assessment

Performance Standard: A statement, which can be expressed in qualitative or quantitative terms, of the performance required of a system, item of equipment, person or procedure, and which is used as the basis for managing the hazard e.g. planning, measuring, control or audit - through the life cycle of the installation.

Petroleum activity: is in this context used for all activities being an integrated part of oil and gas activities, including shuttle transportation of petroleum, supply transportation etc.

Pollution: the introduction by man, directly or indirectly of substances or energy into the marine environment which results, or is likely to result in hazards to human health, harm to living resources and marine ecosystems, damage to amenities or interference with other legitimate uses of the sea.

POP: persistent organic pollutants

Risk: The probability that physical harm to persons will be suffered or negative effects on the environment or that damage to property will occur as a consequence of exposure to a hazard.

Risk Analysis: (United Kingdom Health and Safety Executive, Offshore Research Issue 134/DEC01) The estimation of risk from the basic activity "as is"

Risk Assessment: (Lloyds Register Definition) The quantitative evaluation of the likelihood of undesired events and the likelihood of harm or damage being caused together with the value judgments made concerning the significance of the results. (British Standard BS 8800 Definition) The overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable or acceptable. (United Kingdom Health Safety Executive (HSE), Offshore Research Issue 134/DEC01) A review as to acceptability of risk based on comparison with risk standards or criteria, and the trial of various risk reduction measures.

Risk Management: (United Kingdom Health Safety Executive (HSE), Offshore Research Issue 134/DEC01) The process of selecting appropriate risk reduction measures and implementing them in the on-going management of the activity.

Safety: freedom from unacceptable risks to, personal harm, damage to property, or environmental pollution.

Safety of Life at Sea Convention: International Convention for the Safety of Life at Sea (SOLAS), 1974. http://www.imo.org/Conventions/

Safe Job Analysis: A review of the work situation, in which the job is broken down into sub-activities. Possible elements of danger associated with each sub-activity are considered as well as how/which risk reducing measuring should be established.

SEA: Strategic Environmental Assessment--a systematic process for evaluating the environmental consequences of a proposed policy, plan or program initiative in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision-making on par with economic and social considerations.

SEMP: Safety and Environmental Management Program

UNEP: United Nations Environmental Program

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Environmental Protection Agency. Regulation and enforcement of waste, oil and hazardous discharges and air emissions and monitoring. National: www.epa.gov. Region 10 (including Alaska): http://www.epa.gov/Region10/.

National Oceanic and Atmospheric Administration. Marine mammal and fisheries management, protection, permits, and research. National: http://www.noaa.gov/. Fisheries Alaska Region: http://www.fakr.noaa.gov/http://www.fakr.noaa.gov/.

National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Marine Spill Response and Restoration web site: http://response.restoration.noaa.gov/index.html

U.S. Army Corps of Engineers. Offshore dredging and dumping permits. Wetlands protection. National: http://www.hq.usace.army.mil/hqhome/.http://www.hq.usace.army.mil/hqhome/.

Alaska:

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U.S. Coast Guard. Offshore oil and hazardous spill response and coordination. Also search and rescue, security and law enforcement. National: http://www.uscg.mil/. District 17 (Alaska): http://www.uscg.mil/D17/

U.S. Department of Transportation. Regulates aspects of offshore pipelines and production platforms. National: http://www.dot.gov/. DOT Pipeline and Hazardous Materials Safety Administration: http://www.phmsa.dot.gov/pipeline.

State of Alaska. Responsible for marine areas to 5 kilometers from shore. Departments of Environmental Conservation, Natural Resources, Fish and Game, Transportation and Public Facilities, Public Safety, Labor and Workforce Development, and Revenue are responsible for offshore leasing, permits, research, spill response, revenue management, economic resource analysis, environmental protection, safety, inspections and enforcement. State: http://www.state.ak.us/. DNR: http://www.dnr.state.ak.us/. DF&G: http://www.adfg.state.ak.us/. DEC: http://www.dec.state.ak.us/. DR: http://www.revenue.state.ak.us/. DTPF: http://www.dot.state.ak.us/. DPS: http://www.dps.state.ak.us/. DLWD: http://www.labor.state.ak.us/.

Canada:

Department of Indian and Northern Affairs Canada http://www.ainc-inac.gc.ca/index-eng.asp

Fisheries and Oceans Canada www.dfo-mpo.gc.ca/

Natural Resources Canada www.nrcan-rncan.gc.ca/

Environment Canada www.ec.gc.ca/

Geological Survey Canada www.gsc.nrcan.gc.ca

Yukon Energy Mines and Resources www.emr.gov.yk.ca/

Inuvialuit Joint Secretariat, Canada www.jointsecretariat.ca/

Norway:

Regulations relating to health, environment and safety in the petroleum activities on the Norwegian Continental Shelf are the responsibility of:

The Petroleum Safety Authority Norway (PSA) http://www.ptil.no/

The Norwegian Pollution Control Authority (SFT) http://www.sft.no/.

The Norwegian Social and Health Directorate (NSHD) http://www.shdir.no/

The Norwegian Petroleum Directorate (NPD) http://www.npd.no/

Russia:

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Well Control and Production Safety Training March 31, 2008 NTL 08-N03

Supplemental Bond Procedures Well Control and Production Safety Training March 31, 2008 August 28, 2008 NTL 08-N07 MMS Alaska Region Notices to Lessees and Operators (NTL's) http://www.mms.gov/alaska/regs/regs.htm

10.4 Thematic Areas

The use and discharge of chemicals

References ecotoxicity testing:

Biodegradability:

- Marine BODIS test (for insoluble substances), modified ISO 10708
- Marine CO2 Headspace test, modified ISO/TC 147/CS 5/WG 4 N182

Bioaccumulation

The substances should be tested according to OECD 117 "Partition Coefficient (n-octanol/water), High Performance Liquid Chromatography (HPLC) Method" or OECD 107 "Partition Coefficient (n-octanol/water): Shake Flask Method".

Toxicity:

- Skeletonema costatum, ISO 10253
- Acartia tonsa, ISO 14669
- Scophtalamus maximus; Part B in the OSPAR Protocols on Methods for the testing of Chemicals Used in the Offshore Oil Industry, 2006. Sheepshead minnow is accepted as an alternative species.
- Corophium sp; Part A in the OSPAR Protocols on Methods for the Testing of Chemicals Used in the Offshore Oil Industry, 2006. Required if the chemicals absorb to particles (Koc>1000) and/or sink and end up in the sediments (e.g. surfactants)

Alaska Offshore Projects

Shell Offshore Inc Beaufort Sea Project
http://mms.gov/alaska/ref/ProjectHistory/Shell_BF/BF.HTM

BP Beaufort Sea Liberty Project
http://mms.gov/alaska/ref/ProjectHistory/Liberty/Liberty.HTM

BP Beaufort Sea Northstar Production Project
http://mms.gov/alaska/ref/ProjectHistory/Northstar/Northstar.HTM

BP Beaufort Sea Sandpiper Project
http://mms.gov/alaska/ref/ProjectHistory/Sandpiper/Sandpiper.HTM

Alaska Geological and Geophysical Permits
http://www.mms.gov/alaska/re/recentgg/recentgg.htm

Alaska Five Year Lease Plan 2007-2012
http://www.mms.gov/5-year/

Alaska Lease Information
http://mms.gov/alaska/lease/lease.htm

Alaska Active Leases
http://mms.gov/alaska/lease/hlease/LeasingTables/detailed_active_leases.pdf

Alaska Oil Spill Risk Analysis (OSRA)
http://www.mms.gov/eppd/sciences/esp/programs/osra.htm

MMS Alaska Offshore Oil and Gas Public Hearings 1975-2007

http://mms.gov/alaska/ref/Hearings1.htm

Alaska Petroleum Resource Assessment Reports

http://mms.gov/alaska/re/reports/rereport.htm

2006 Outer Continental Shelf Oil and Gas Assessment Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

2006 Oil and Gas Assessment of North Aleutian Basin Planning Area Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

Engineering and Economic Analysis of Natural Gas Production in the Norton Basin Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

2006 Assessment, Undiscovered Resources, Alaska Federal Offshore Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

Economic Study of the Burger Gas Discovery, Chukchi Shelf, Northwest Alaska, December 2004
http://mms.gov/alaska/re/reports/rereport.htm

Undiscovered Oil and Gas Resources, Alaska Federal Offshore, December 2000 Update Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

Prospects For Development of Alaska Natural Gas: A Review as of January 2001 Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

Undiscovered Oil and Gas Resources, Alaska Federal Offshore, as of January 1995 Petroleum Resource Assessment Reports
http://mms.gov/alaska/re/reports/rereport.htm

Alaska General Information Sources

MMS Alaska Scientific Information Transfer Meetings Proceedings
http://mms.gov/alaska/ess/itm/ITMINDEX.htm

Arctic Oil Spill Response Research
http://www.mms.gov/tarprojectcategories/arcticoilspillresponseresearch.htm

Arctic Safety Projects Including Ice Mechanics
http://www.mms.gov/tarprojectcategories/ice.htm

Alaska Oil Spill Response Research Final Reports http://mms.gov/alaska/fo/osrrRpts.htm

Alaska Offshore Exploratory Well Information
http://mms.gov/alaska/fo/OCSExploratoryWells.HTM

Alaska Production from OCS Alaska Arctic
http://mms.gov/alaska/fo/northstar/ns_production.pdf

Alaska Traditional Knowledge
http://mms.gov/alaska/native/tradknow/index.htm

Alaska Biological Opinions & Evaluations
http://mms.gov/alaska/ref/Biological_opinions_evaluations.htm

Alaska Environmental Impact Statements (EIS) & Environmental Assessments (EA)
http://mms.gov/alaska/ref/EIS_EA.htm

Alaska Laws & Regulations, Memorandum of Understanding, Notices to Lessees
http://mms.gov/alaska/regs/regs.htm

ANNEX A - Definition of the Arctic

Canada:

Canada has defined its Arctic area to include the drainage area of the Yukon Territory, all lands north of 60 degrees North latitude and the coastal zone area of Hudson Bay and James Bay.

Kingdom of Denmark

The Arctic area within the Kingdom of Denmark is the Faroe Islands and Greenland, which is the world's largest island on which stands 9% of the World's ice cap.

Finland:

In Finland the Arctic Area is defined as the territory north from the Polar Circle.

Iceland:

Iceland has defined the whole of Iceland to be within the Arctic area.

Norway:

Norway does not have any formal definition of the Arctic. For the purposes of the Arctic Oil and Gas Guidelines, 62 degrees North in the Norwegian Sea areas north shall be used as the southern delimitation of 62 degrees North form the Arcticthe Arctic area. This is in line with the AMAP Assessment delimitation.

Sweden:

Sweden does not have any formal delimitation of the Arctic but has, for the purpose of the Arctic Council, accepted the Arctic Circle as the southern delimitation of the Arctic area.

Russian Federation:

In accordance with the draft Law of the Russian Federation "On Zoning of North Russia", the Arctic areas of North Russia include:

- All lands and islands of the Arctic Ocean and its seas;
- Within the Murmansk region: Pechenga district (coastal areas of the Barents Sea including populated centers located on Sredniy and Rybachiy Peninsulas, as well as Liynakhamareye populated center, and the town-type settlement of Pechenga) Kolsk district (territories administered by the Tyuman and Ura-Guba rural government bodies), Lovozersk district (territory under the Sosnovsk rural government body), territory administered by the Severomorsk municipal government, and closed administrative-territorial entities of Zaozersk, Skalistiy, Snezhnogorsk, Ostrovnoy, and the city of Polyarniy with populated centers administratively Attached to it;
- Nenets autonomous national area – all territory;
- Within the Komi Republic – city of Vorkuta, within areas managed by it;
- Within the Yamal-Nenets autonomous national area; Priural, Tazov, and Yamal District, and territories and administered by the Salekhard and Labytnang Municipal governments;
- Taimyr (Dolgan-Nenets autonomous area) – all territory;

- Within the Krasnoyarsk territory – areas administered by the Norilsk municipal government;
- Within Sakha Republic (former Yakutia): Allaikhov, Anabar, Bulun, Nizhnekolym, Olenek and Ust-Yan district;
- Chuckchi autonomous national area – all territory;
- Within the Koryak autonomous area -- Olutor district.

United States of America:

All United States territory north of the Arctic Circle and all United States territory north and west of the boundary of formed by the Porcupine, Yukon and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain.

ANNEX B - Definition of Practices and Techniques

Criteria for the Definition of Practices and Techniques mentioned in Paragraph 3(b)(i) of Article 2 of the OSPAR Convention

BEST AVAILABLE TECHNIQUES (BAT)

1. The use of the best available techniques shall emphasise the use of non-waste technology, if available.

2. The term "best available techniques" means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be given to:

   (a) comparable processes, facilities or methods of operation which have recently been successfully tried out;

   (b) technological advances and changes in scientific knowledge and understanding;

   (c) the economic feasibility of such techniques;

   (d) time limits for installation in both new and existing plants;

   (e) the nature and volume of the discharges and emissions concerned.

3. It therefore follows that what is "best available techniques" for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

4. If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be applied.

5. "Techniques" include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.

BEST ENVIRONMENTAL PRACTICE (BEP)

6. The term "best environmental practice" means the application of the most appropriate combination of environmental control measures and strategies. In making a selection for individual cases, at least the following graduated range of measures should be considered:

   (a) the provision of information and education to the public and to users about the environmental consequences of choice of particular activities and choice of products, their use and ultimate disposal;

   (b) the development and application of codes of good environmental practice which covers all aspect of the activity in the product's life;

   (c) the mandatory application of labels informing users of environmental risks related to a product, its use and ultimate disposal;

   (d) saving resources, including energy;

(e) making collection and disposal systems available to the public;

(f) avoiding the use of hazardous substances or products and the generation of hazardous waste;

(g) recycling, recovery and re-use;

(h) the application of economic instruments to activities, products or groups of products;

(i) establishing a system of licensing, involving a range of restrictions or a ban.

7. In determining what combination of measures constitute best environmental practice, in general or individual cases, particular consideration should be given to:

(a) the environmental hazard of the product and its production, use and ultimate disposal;

(b) the substitution by less polluting activities or substances;

(c) the scale of use;

(d) the potential environmental benefit or penalty of substitute materials or activities;

(e) advances and changes in scientific knowledge and understanding;

(f) time limits for implementation;

(g) social and economic implications.

8. It therefore follows that best environmental practice for a particular source will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

9. If the reduction of inputs resulting from the use of best environmental practice does not lead to environmentally acceptable results, additional measures have to be applied and best environmental practice redefined.

ANNEX C-Environmental Assessment Flowchart

Phase	Procedure	Activity	Responsible
Opening of new area for petroleum activities	***PEIA*** ⇓ hearing ⇓ ***EIA*** ⇓ hearing ⇓ opening ⇓ Baseline survey	Environmental survey Impact assessment Regulations	Authorities
Exploration	***EIA*** in Particularly Sensitive Areas Risk assessment Contingency planning and emergency response	Seismic Drilling	Operator/Authorities
Development	***EIA*** ⇓ Permission for discharge ⇓ Risk assessment Contingency planning and emergency response	Construction activities Transportation Drilling	Operator/Authorities
Production	***Monitoring*** Risk assessment Contingency planning and emergency response	Drilling Discharges to water Air emissions Transportation	Operator/Authorities/ Third Party
Decommissioning	***PEIA/EIA*** ***Monitoring***		Operator/Authorities

ANNEX D-Examples of the EIA Process from some Arctic Countries

The EIA process for the Faroe Islands:

Prior to inviting applications for exploration and production licences, the possible impact on navigation, fishing and other commercial activities, and on nature, environment and any other effects on the community from the exploration and production activities shall be assessed.

Regional Environmental Impact Assessments have been carried out for the areas covered by the first and second Faroese licensing rounds. The Regional EIAs were funded by the oil companies involved in the Faroese area.

Before approval for any drilling operations, the operator, as part of the drilling application, must submit a site specific Environmental Impact Assessment (EIA).

The EIA Process for Greenland Offshore Oil and Gas Activities:

Opening of new areas for exploration

In connection with the opening of frontier areas with technologically challenging conditions the Greenland Home Rule's Bureau of Minerals and Petroleum develops a strategic environmental impact assessment (SEIA) as part of the basis of decision in relation to granting licences to the international oil and gas industry. The SEIA identifies knowledge and data gaps, highlights issues of concern, makes recommendations for mitigation and planning and identifies restrictive and mitigative measures and monitoring requirements that must be dealt with by the companies applying for oil and gas licences in Greenland.

However it is the responsibility of the license holding companies to prepare environment impact assessment's (EIA) for their specific activities. This company initiated EIA must include the full life cycle of activities: exploration, field development, production transport as well as decommissioning. The EIA must be updated and further developed when needed e.g. when going from exploration to production phase, or if there is a change in the plans presented in the initial EIA.

An important source of information to the license holding companies when preparing their EIA's is the strategic environmental impact assessment developed by the Greenland Bureau of Minerals and Petroleum.

The Bureau of Minerals and Petroleum has developed a guideline how to prepare an environment impact assessment directed towards the international oil industry. In developing this guideline, information on the requirements to EIA's related to oil and gas exploration and exploitation in other Arctic countries has been studies. Furthermore, the guideline is based on the 'Arctic Offshore Oil & Gas Guidelines' issued by the Arctic Council and on the 'OSPAR Guidelines for Monitoring the Environmental Impacts of Offshore Oil and Gas Activities.

The EIA process for Norwegian offshore oil and gas activities:

Before areas are opened for licensing, an extensive EIA must be carried out. This EIA is similar to a Strategic Environmental Assessment (SEA). The process is initiated and funded by the authorities. The SEA, in addition to results from projects carried out as background for the assessment, may lead to an integrated management plan being issued.

Integrated management plans should take into account activities in all sectors in the relevant area, like the fishing sector, oil and gas sector and transportation sector. In Norway, a large number of governmental institutions, consultants and research institutes, NGOs and other stakeholders are involved. The intention is to be aware of any potential conflicts between different users of the area, and to ascertain sustainable development and protection of sensitive resources.

The Ministry of the Environment is responsible for the administration and coordination of integrated management plans.

According to the Norwegian Petroleum Act, EIAs have to be carried out for each new development. The work is carried out and funded by the operators. The responsible authority is the Ministry of Oil and Energy.

EIAs has been carried out regionally in two regions, the North Sea and the Norwegian Sea. Awarding new licences within these areas lead to updating of the regional EIA.

All EIAs/SEAs in Norwegian waters have a stepwise development similar to the one shown in the flowchart in Annex C.

The EIA Process for U.S. Offshore Oil and Gas Activities:

United States law requires an environmental review process for major actions that are proposed, approved, regulated, or funded by federal agencies under the National Environmental Policy Act of 1969. In the United States an EIA is called an Environmental Impact Statement (EIS). Federal regulations implementing this law require that the EIS be integrated early with the planning for proposed activities. For the offshore oil and gas program, the Minerals Management Service (MMS) initiates the EIS process early in the planning for proposed Five-Year Oil and Gas Leasing programs, proposed lease sales, and requests from industry to approve oil and gas plans or permits. The MMS assumes full responsibility for funding and development of the EIS.

The EIS for the proposed Five-Year OCS Oil and Gas Leasing Program analyzes alternative leasing configurations in all regions of the U.S. Outer Continental Shelf. This EIS is broader in scope and has less detailed analysis than the subsequent EISs that are prepared for lease sales in particular regions. An EIS may also be prepared to provide site-specific analyses for individual development proposals. The scope, level of detail, and issues of concern for each EIS are tailored to the actual proposal. The programmatic EIS examines issues broadly, while a development plan EIS focuses on more immediate, geographically focused concerns. In all cases, EIS analyses are intended to address only those issues that have a bearing on the decision at hand. For example, only the Five-Year Oil and Gas Leasing Program EIS discusses alternative energy sources, while a development plan EIS would analyze alternative pipeline routes within a particular area.

The EIA Process for Canadian Offshore Oil and Gas Activities:

Environmental assessment

Primary authorization for an oil and gas industry activity in Canada's Arctic offshore is by the National Energy Board (NEB) under the *Canada Oil and Gas Operations Act* (COGOA), while Indian and Northern Affairs Canada is responsible for the issuing exploration, significant discovery and development licenses under the *Canadian Petroleum Resources Act*. Efforts are underway to design a pilot, multistakeholder regional environmental assessment process for the Beaufort Basin. This study is being considered in anticipation of renewed investment in hydrocarbon exploration in the Beaufort over the next decade and is expected to inform and simplify downstream project-level assessments and regulatory decision while also contributing critical information to support integrated management for the Beaufort region.

Prior to issuing an authorization under COGOA, the project must undergo an environmental assessment conducted in accordance with the provisions of the applicable environmental assessment regime(s). Due to the settlement of land claim agreements, different environmental assessment processes apply in various regions of the northern Canada. For example, in the Inuvialuit Settlement Region which encompasses a large portion of the offshore area, the environmental assessment processes under the Western Arctic Claim (Inuvialuit Final Agreement) and the *Canadian Environmental Assessment* Act, apply. To the east in the Nunavut Settlement Area, Article 12 of the Nunavut Land Claims Agreement outlines the sole environmental assessment process applicable to the area.

Under the *Canadian Environmental Assessment* there are three types of environmental assessment - screening, comprehensive study, and review by a mediator or independent panel. Environmental assessments of hydrocarbon exploration activities are normally carried out as screenings. Where the responsible authority, after reviewing a screening report, determines that a project is likely to cause significant adverse environmental effects that cannot be mitigated and justified in the circumstances or where there is uncertainty about the environmental effects or public concern so warrants, the responsible authority must refer the project to the Minister of the Environment for subsequent referral to a mediator or review panel. Certain activities known to have a high likelihood of generating significant adverse environmental effects are identified in the *Comprehensive Study List Regulations* under CEAA. Once a decision is made to continue the environmental assessment of a project listed in the regulations as a comprehensive study, the project cannot be later referred to a mediator or panel. Certain offshore hydrocarbon production projects are listed in the *Comprehensive Study List Regulations*.

In the Inuvialuit Settlement Region there are two levels of environmental assessment.

The Environmental Impact Screening Committee is responsible for screening all proposed developments which may negatively impact the environment and/or Inuvialuit wildlife harvesting. If the Environmental Impact Screening Committee determines that significant negative environmental impacts or significant negative impacts to present or future Inuvialuit wildlife harvesting may result from the proposed development, the committee will refer the proposed development to the Environmental Impact Review Board. The Environmental Impact Review Board will establish a review panel to carry out a public review of the developer's environmental impact statement in accordance with their procedural guidelines. The Environmental Impact Screening Committee also has the ability to refer the proposed development to another review body for further assessment if it determines that another review process will adequately encompass the requirements of the process established under the Inuvialuit Final Agreement. The *Canadian Environmental Assessment Act* also applies in the Inuvialuit Settlement Region, and opportunities to ensure cooperative or harmonized EA processes are exercised on a case-by-case basis.

In the Nunavut Settlement Area, there are two levels of assessment; screenings and reviews. The Nunavut Impact Review Board is responsible for conducting screenings and reviews of proposed physical works or activities. During a screening, the Nunavut Impact Review Board evaluates a proposal to determine whether it may have significant adverse effects on the ecosystem, wildlife habitat or Inuit harvesting activities; or whether it may have significant socio-economic effects or cause significant public concern. If the Board determines further review is required, the project is either referred back to the Board or to a Federal Environmental Assessment Panel for a detailed public review of the project proposal. A Nunavut Impact Review Board review under Part 5 of the Nunavut Land Claims Agreement involves a more thorough evaluation of the proponent's project proposal and environmental impact statement taking into account any potential ecosystem and socio-economic impacts. A review under Part 6 of the Agreement is conducted by a federal environmental assessment panel appointed by the Minister of the Environment and is reserved for projects that are transboundary in nature, or involve matters of important national interest.

Russian Environmental Impact Assessment:

According to regulations on the assessment of impacts of planned economic and other activities, an environmental impact assessment (EIA) report must be prepared by the proponent of a planned project. Under the Federal Law on Ecological Expertise, the EIA report and any other relevant materials must be reviewed by an ecological expert commission under a relevant State organization and approved before a license or other permit may be issued for the project or activity.

An EIA is conducted in three main steps:

1. A preliminary EIA, in which the developer must prepare and submit to State authorities a document containing a general description of the planned activity and its purposes, possible alternatives, and other required information. The developer must also inform the public, carry out a preliminary consultation with interested parties, and conduct an initial assessment after the collection of basic environmental information.

2. The developer undertakes the EIA, considering alternatives for achieving the purposes of the activity, and prepares a draft EIA report. The developer must also provide the public with the opportunity to become familiar with the draft EIA report and to comment on it, and must subsequently inform the public of the decisions made, accounting for the comments and proposals submitted.

3. Public review of the EIA report. The developer is required to conduct public consultations on the planned activity and to keep a record of the issues on which possible disagreements between the public and the developer arise. There are specific rules concerning the period over which the draft EIA report must be available for public consultation.

The next stage comprises review of the EIA, as part of the project materials for the proposed activity, by an expert commission under the authorized State environmental agency; this includes determination of compliance with environmental, technological, and legal requirements. There is also a possibility for public environmental review by appropriate public organizations.

State environmental review is required before approval of the development may be given. The review is based on a presumption of potential environmental hazard of the planned activity. It is conducted by a commission of independent experts who review the composite nature of the EIA of the planned activity and its implications, as well as the reliability and completeness of the information presented for review. There are requirements for openness and responsiveness to public opinion in the conduct of this review. Materials reflecting public opinion must be forwarded to the expert review commission during the process of preparing their conclusions.

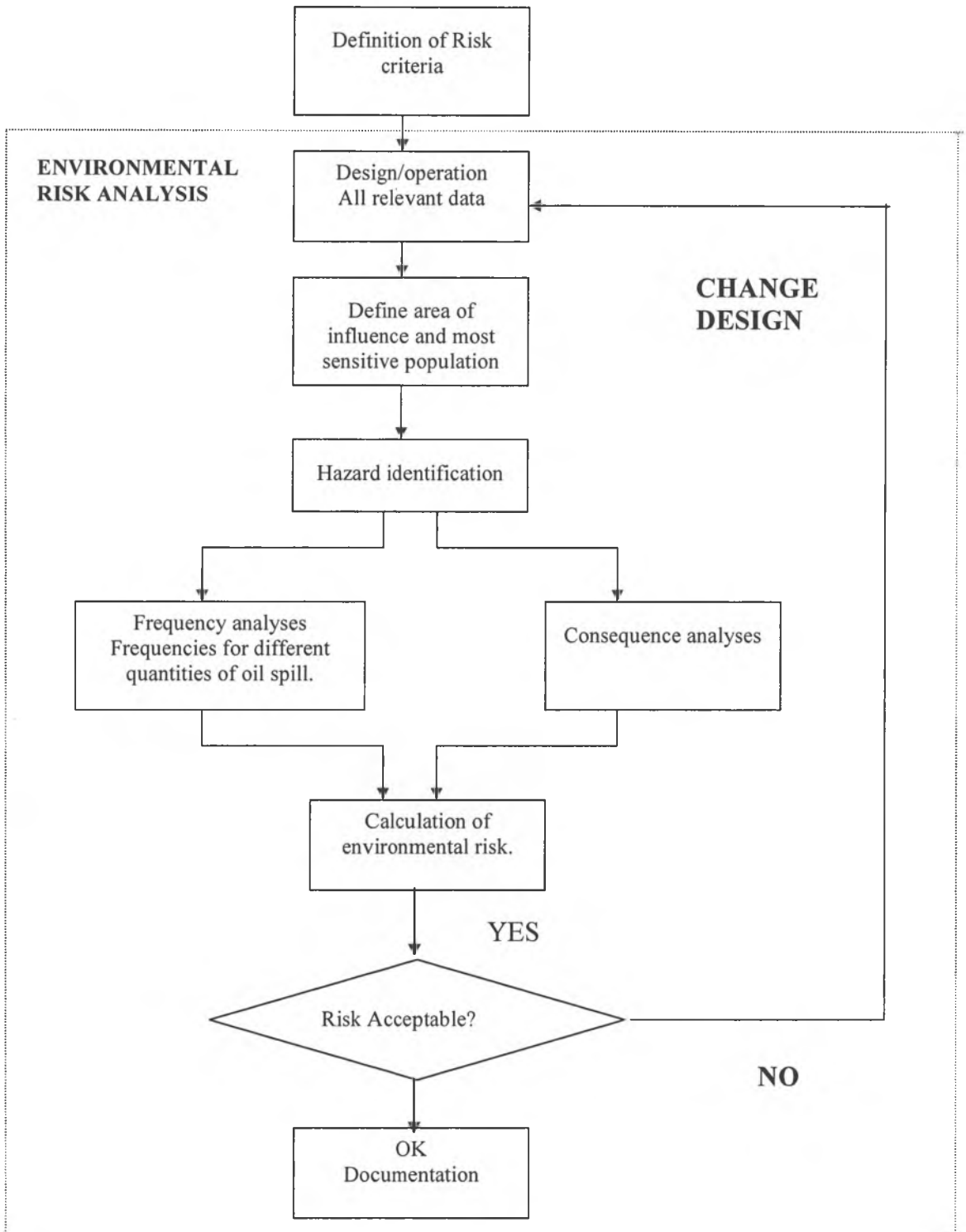
The proponent of a project must pay in advance for the State environmental review according to procedures provided for by the authorized State body conducting the review.

A positive conclusion of the environmental expert review is a necessary pre-condition for constructing or re-constructing any industrial site and is, in a sense, a building permit from environmental authorities.

ANNEX E-Overview of offshore activities and potential environmental effects

Activity	Possible Causes	Potential environmental effects
Evaluation		
Seismic activity	Noise	Effects on fish, sea birds and marine mammals such as avoidance behavior.
Exploration		
Rig emplacement	Dredging, filling, anchoring, and/or rig set-down.	Seabed disturbance.
Drilling	Discharges of drill cuttings, drill fluids, excess cement, platform drainage, household discharges and emissions of exhaust gases. Discharges from supply vessels, helicopter transportation, etc.	Predominantly local effects on living resources.
	Risk of blowouts.	Potential effects on living resources such as birds and marine mammals, as well as susceptible areas of the coastal zone.
Development and production		
Facility and pipeline installation	Potentially more dredging, filling and anchoring.	Long and short-term seabed disturbances.
	Extended risk of blowouts and oil spills.	As under exploration, but more extensive in both the water column and air.
Drilling	Discharges of produced water. Emissions of gases.	Potential effects on the reproduction of fish and possible contribution to climate effects, acidifying effects, etc.
Production	Spills, discharges and emissions connected to transportation (tankers, supply vessels, pipelines etc.).	Additional risks of effects on the marine environment and atmosphere.
Decommissioning and reclamation		
Removal of installations	Cutting piles containing oil and chemicals, dredging, air emissions, noise, etc.	Seabed disturbance, possible effects on fish, sea birds and marine mammals.
Leaving artificial islands or partial installations in-place	Exposed Biophilic substrate or surfaces.	Development of habitat for fish, mammals and/or birds.

ANNEX F - Environmental Risk Analysis Flow Diagram



ANNEX G - Company Safety, Environmental Policies and Objective

Detailed elements that may be incorporated in to company safety and environmental policies and objectives

- Competent personnel are used during planning and implementation of the separate phases, including design, fabrication and installation and operation
- The operator's personnel and those of any Contractors are provided with necessary training
- Lines of responsibility, authority and communication are clearly defined and understood;
- Risk evaluation should be a part of the project management strategy in order to establish and maintain an acceptable level of health Safety and Environmental protection for the personnel and the environment;
- No activity should be performed unless and acceptable level of HSE protection can be maintained;
- Management of discharges should be achieved through the application of Best Available [Techniques/Technology]
- Experiences from arctic operations should be integrated into specifications, functional requirements, standards and procedures;
- Safety evaluations should be undertaken both prior to start-up and in subsequent phases of the operation;
- Administrative systems are established for the control of all documentation in all phases of the operation;
- Purchase documents and specifications should contain Quality Assurance requirements;
- Contractor's Quality Assurance systems should be evaluated and assessed and be the subject of regular audits;
- The quality of supplied and materials should be documented;
- Quality Assurance and Quality Control during operations should function effectively and corrective action should be taken when quality control indications deviation from specification;
- Operational programmes should be prepared and compiled with relevant regulations and their functional capability should be subject to verification;
- Specifications for repairs should be established and specifications provide sufficient basis and requirements for their execution;
- Temporary equipment may be installed and operated in a secure way and in accordance with established specifications;
- Modifications should not reduce the degree of safety originally specified;
- An emergency preparedness system should be established and maintained so hat necessary measures can be activated effectively and authorities involved notified;
- Administrative decisions made be the supervisory personnel are communicated effectively to the personnel and contractors;
- There should be continuous control and monitoring of all aspects of the working environment with regard to health safety and environmental risks and that necessary actions are implemented
- There should be continuous control and monitoring of the danger of pollution of the external environment and that personnel at all times will perform their tasks in such a way that pollution is avoided ;
- Both operator and contractor personnel should be made aware of the potential danger of accidents and inherent health and pollution aspects and they are given necessary information, training and exercises.

ANNEX H-Example of a Generalized Monitoring Plan

Region	Installation	Phase	Type of investigation	Part of environment	Elements to be included	Frequency
		planning for development				
		development	baseline	Seabottom and other as relevant	inventory of biota, contaminants	every year and as frequent as necessary, depending on the type of activity
		production	monitoring	Seabottom and other as relevant	physical disturbance, biota, contaminants	every year and as frequent as necessary
		Decommissioning	monitoring	Seabottom Water column, as relevant	levels of contaminants and effects on biota, as relevant	during operations and once at reclamation phase
Region II						
	Inst. 1					
	Etc					
	Etc					
	Etc					
Etc	National shelves should be divided into regions where monitoring of the individual installations is coordinated. Regional monitoring of the water column is coordinated for the entire shelf of each country.					

Photo credits:
Northstar Island BPs Production platform in the Beaufort Sea (MMS Alaska);

Polar bears near the Encana's McCovey exploration drilling rig Beaufort Sea 2003 (Randy Howell MMS Alaska);

Ice and low sun at Steel Caisson Drilling (SDC) platform McCovey prospect Beaufort Sea 2003 (Randy Howell MMS Alaska).

The Steel Caisson Drilling platform at the McCovey prospect Beaufort Sea 2003 (Randy Howell MMS Alaska).

PAME

Protection of the Arctic Marine Environment

Borgir, Nordurslod / 600 Akureyri / ICELAND
Tel: +354 461 1355 / Fax: +354 462 3390
Email: pame@pame.is / Homepage: www.pame.is

ARCTIC COUNCIL

Christine Hess

From: Bob Pawlowski [BPawlowski@denali.gov]
Sent: Friday, March 11, 2011 10:06 AM
To: Christine Hess
Subject: FW: INFO: Naval Studies Board releases

Christine:

Another reference to be aware of.

Bob
-----Original Message-----
From: St.John, Courtney CIV OPNAV, N2/N6F54B [mailto:courtney.st.john@navy.mil]
Sent: Friday, March 11, 2011 7:10 AM
Subject: INFO: Naval Studies Board releases

Dear TFCC Colleagues,

On March 10, the National Research Council's Naval Studies Board released a report "National Security Implications of Climate Change for U.S. Naval Forces." We are pleased that Task Force Climate Change was consulted in the development of this report and it will be an essential tool as we continue our efforts. Below please find a press release with more details. The report may be accessed from this website: http://www.nap.edu/catalog.php?record_id=12914.

All the best,
Courtney St. John

Courtney St. John.
Climate Change Affairs Officer, Task Force Climate Change.
Office of the Oceanographer of the Navy.
202.762.0576.
courtney.st.john@navy.mil
courtney.stjohn@navy.smil.mil

greenfleet.dodlive.mil/climate-change/
facebook.com/NavyTFCC

New Report Focuses On Climate Challenges To Naval Forces (NAVY NEWS SERVICE 10 MAR 11) ...
Bob Freeman, Office of the Oceanographer of the Navy Public Affairs

WASHINGTON -- The National Research Council of the National Academies released the "National Security Implications of Climate Change for U.S.
Naval Forces" report, March 10.

The newly-released study was commissioned by Chief of Naval Operations Adm. Gary Roughead in 2008, and indicates that the most moderate trends in climate change, if continued, will present new national security challenges for the U.S. Navy, Marine Corps, and Coast Guard. "This report represents the most detailed and analytical look at the impact of climate change on naval forces to date," said Rear Adm. David Titley, the Navy's senior oceanographer and

director of Task Force Climate Change. "It provides superb guidance for long-term strategic planning and investment considerations."

Acknowledging that the timing and severity of climate change impacts are not fully understood, the report recommends that naval leadership "adopt a risk analysis approach for dealing with climate change uncertainties."

The study addresses both long-term and short-term implications, and identifies areas for action for naval leadership, providing findings and recommendations for each area.

The first recommendation of the report is for naval leadership to continue their advocacy for accession to the United Nations Convention on the Law of the Sea, an international agreement that codifies the rights and responsibilities of nations in their use of the seas.

Although the U.S. helped draft the convention, signed the 1994 Agreement on Implementation, and adheres to the provisions of the law, it has not yet ratified the convention. The Navy and the Department of Defense have been long-time advocates for ratification.

Another recommendation of the study is that naval forces prepare for new mission requirements due to the opening of international and territorial waters in the Arctic Ocean as the sea ice continues to decrease. It identifies the Arctic as a place where "recent climate change may have the most immediate and obvious implications for maritime operations."

The recommendations include increasing Arctic operations and training for the Navy and Marine Corps; engaging the Joint Chiefs of Staff to ensure the most effective command structure with respect to the Arctic; and supporting U.S. Coast Guard initiatives to define future icebreaker requirements.

Recognizing that the opening of the Arctic Ocean will present increased technical challenges to naval forces, the report recommends increasing research and development efforts to address operational shortfalls and "increase priority for extending modern navigation, communications, and charting coverage to include the Arctic region."

In regards to global climate change, the study also highlights the probability of increased humanitarian assistance and disaster response missions related to the changing environment. It cites amplified stress on vulnerable nations due to "more severe or frequent droughts, floods, storms, and other events with negative consequences for food and water supplies, possibly leading to even greater stress on the expanded human population."

These same challenges will impact U.S. allies and their militaries.

Since no single nation can be fully prepared to respond to all climate contingencies, the report recommends fostering enhanced partnerships with "long-standing allies and non-traditional partners alike."

The report singles out NATO, saying "developing climate change response capabilities within the NATO alliance could strengthen global climate change response capabilities and the alliance itself."

Rising sea levels and increased storm surges will present significant challenges to naval coastal installations, and the report suggests naval forces should carefully assess facility vulnerabilities and consider potential risks when renovating existing or planning future infrastructure.

Finally, the study supports investment for additional research and development that will have implications for future naval force operations and capabilities. It specifically recommends investment in contributions to a global ocean observing system and the development of climate forecasting models that incorporate data from land, ocean, atmosphere and ice, to provide reliable predictions decades out.

The authors of the report expressed the opinion that both the Navy's Task Force Climate Change and Task Force Energy were providing strong leadership on these issues across the Navy and the Department of Defense, adding that "both task forces are well positioned in capability and credibility to continue their strong contributions."

"The findings and recommendations of this study will help ensure that U.S. naval forces are able to adapt to a changing climate and fulfill any mission assigned by the president throughout this century," said Titley. "It's all about being ready in tomorrow's world."

5-YEAR CMSP TIMELINE (AS OUTLINED IN THE FRAMEWORK)

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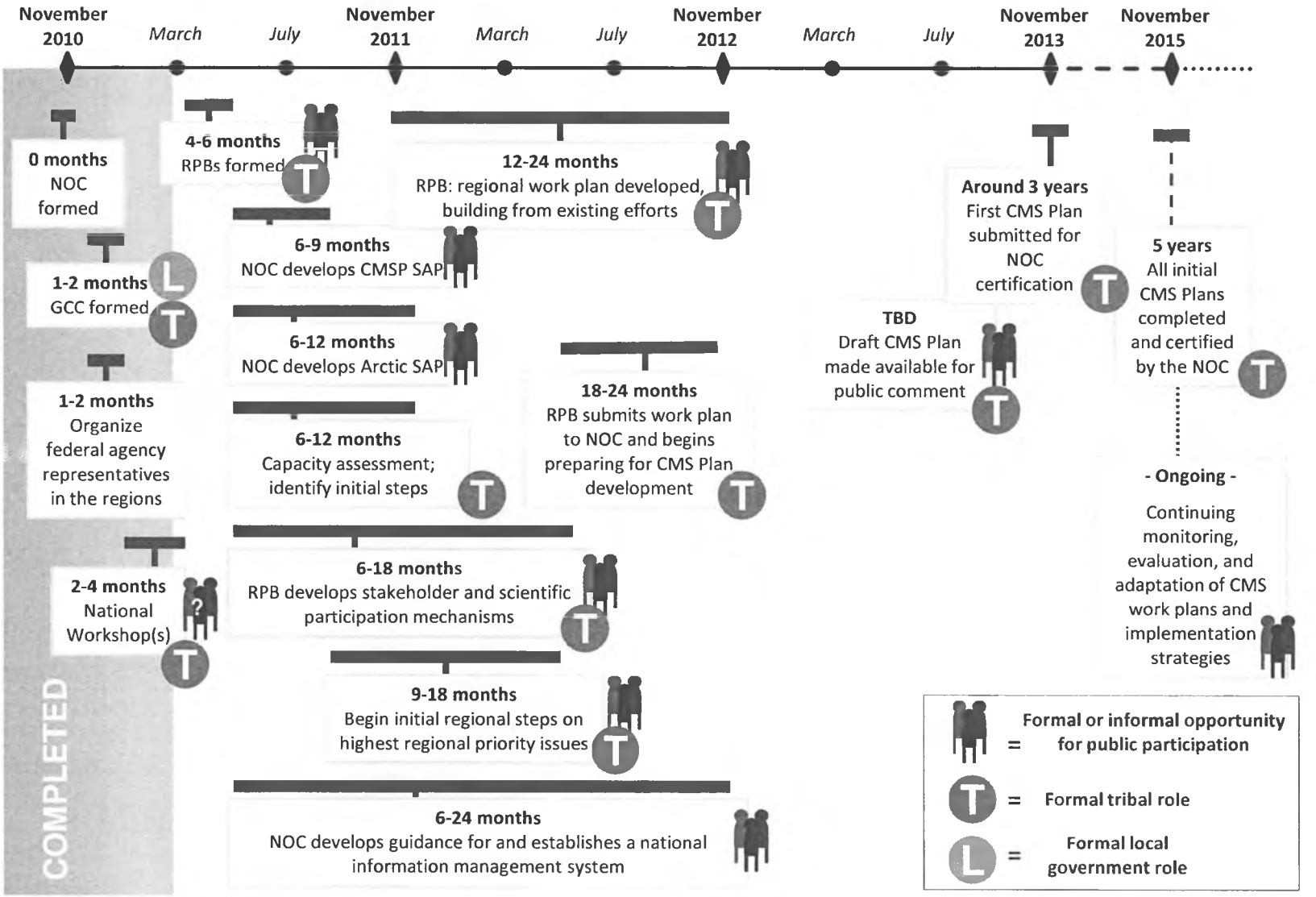

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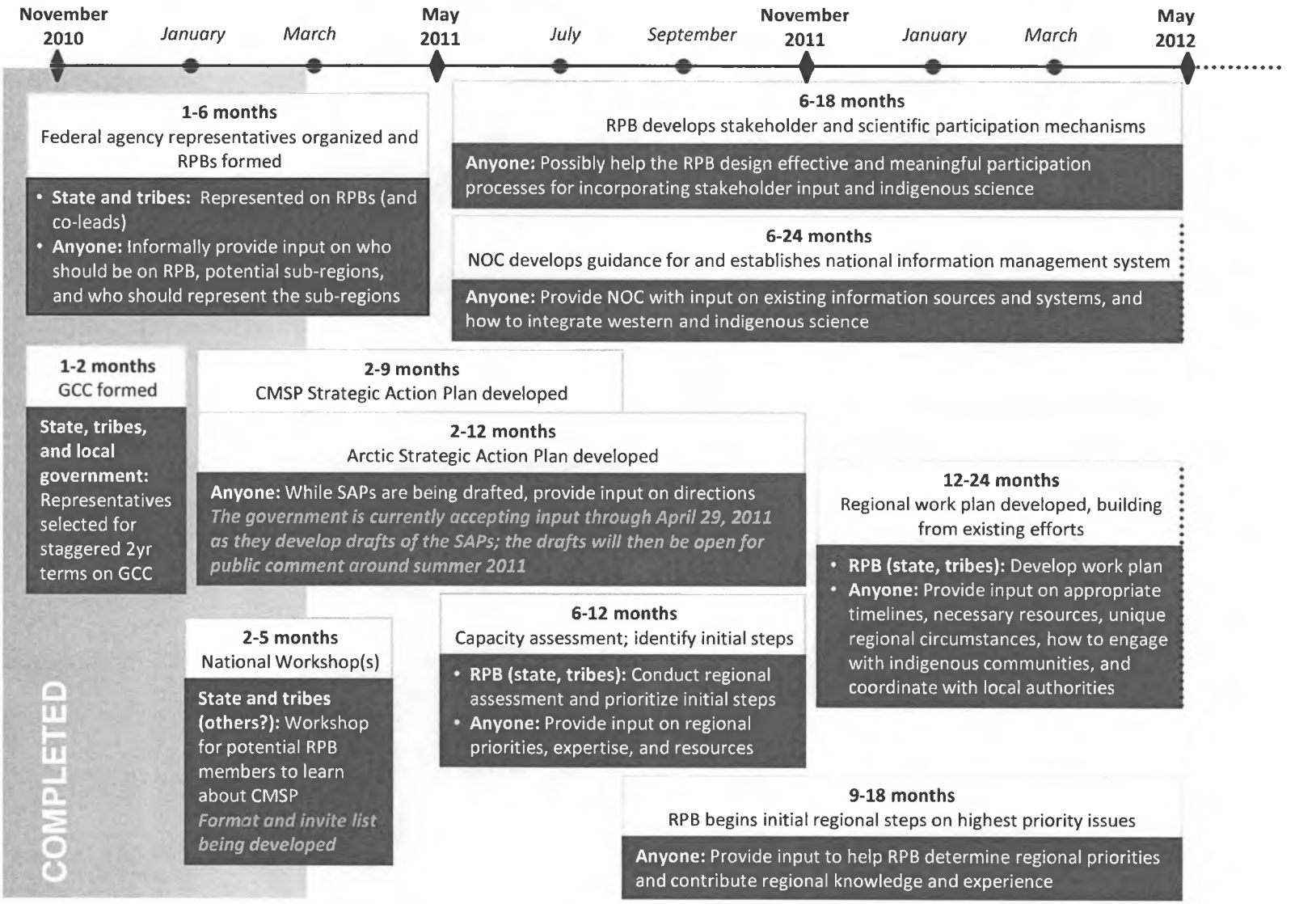

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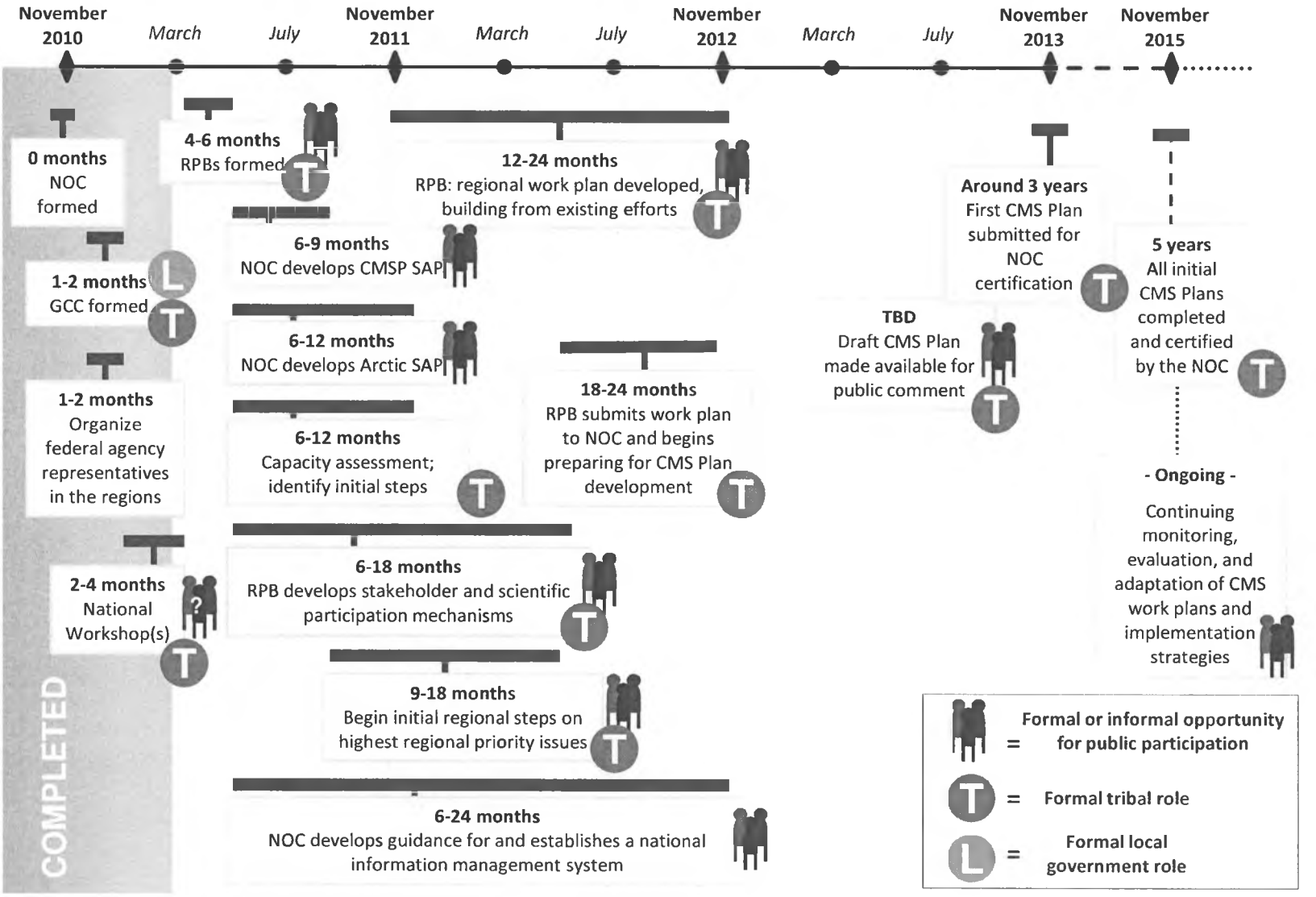

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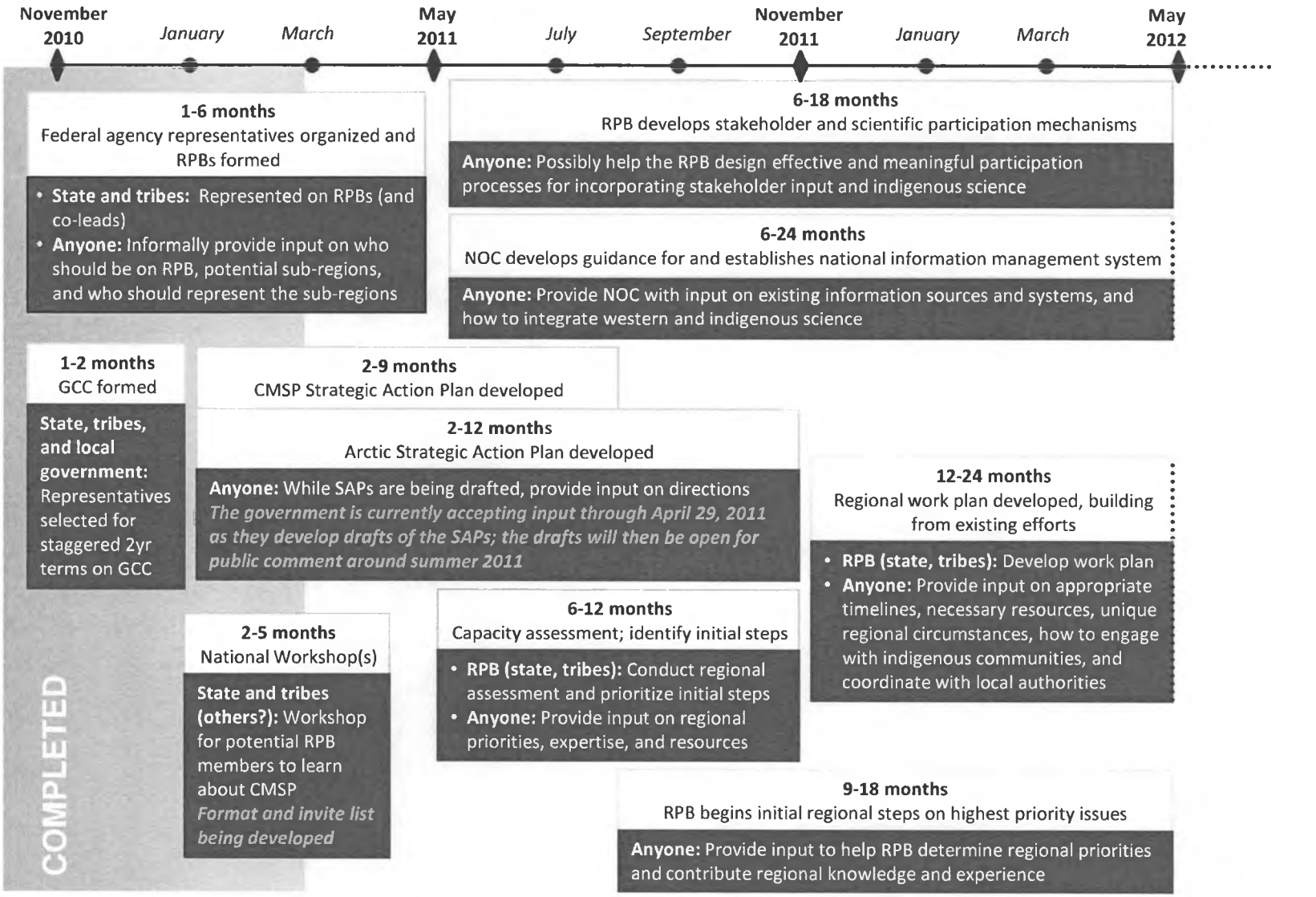

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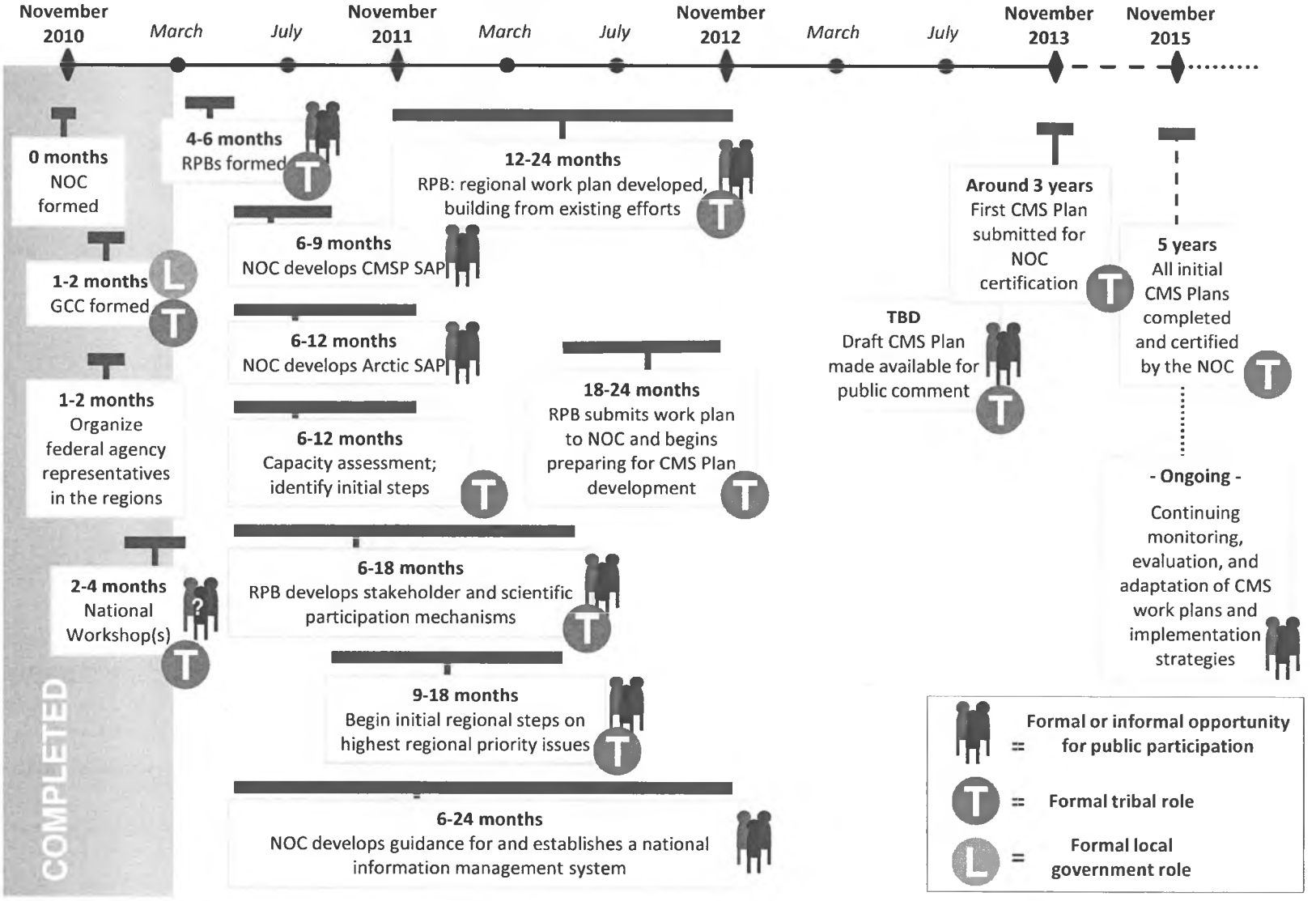

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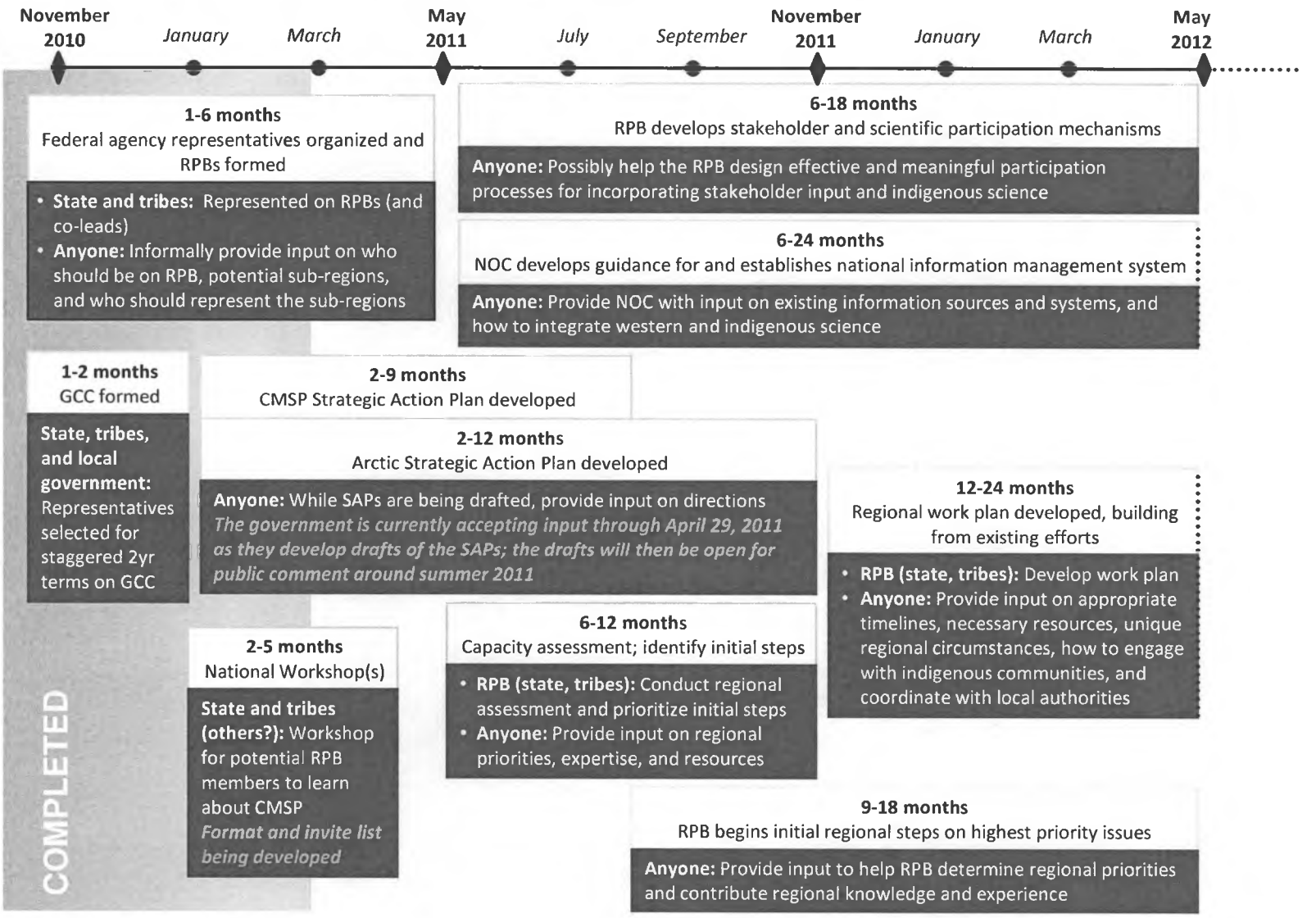

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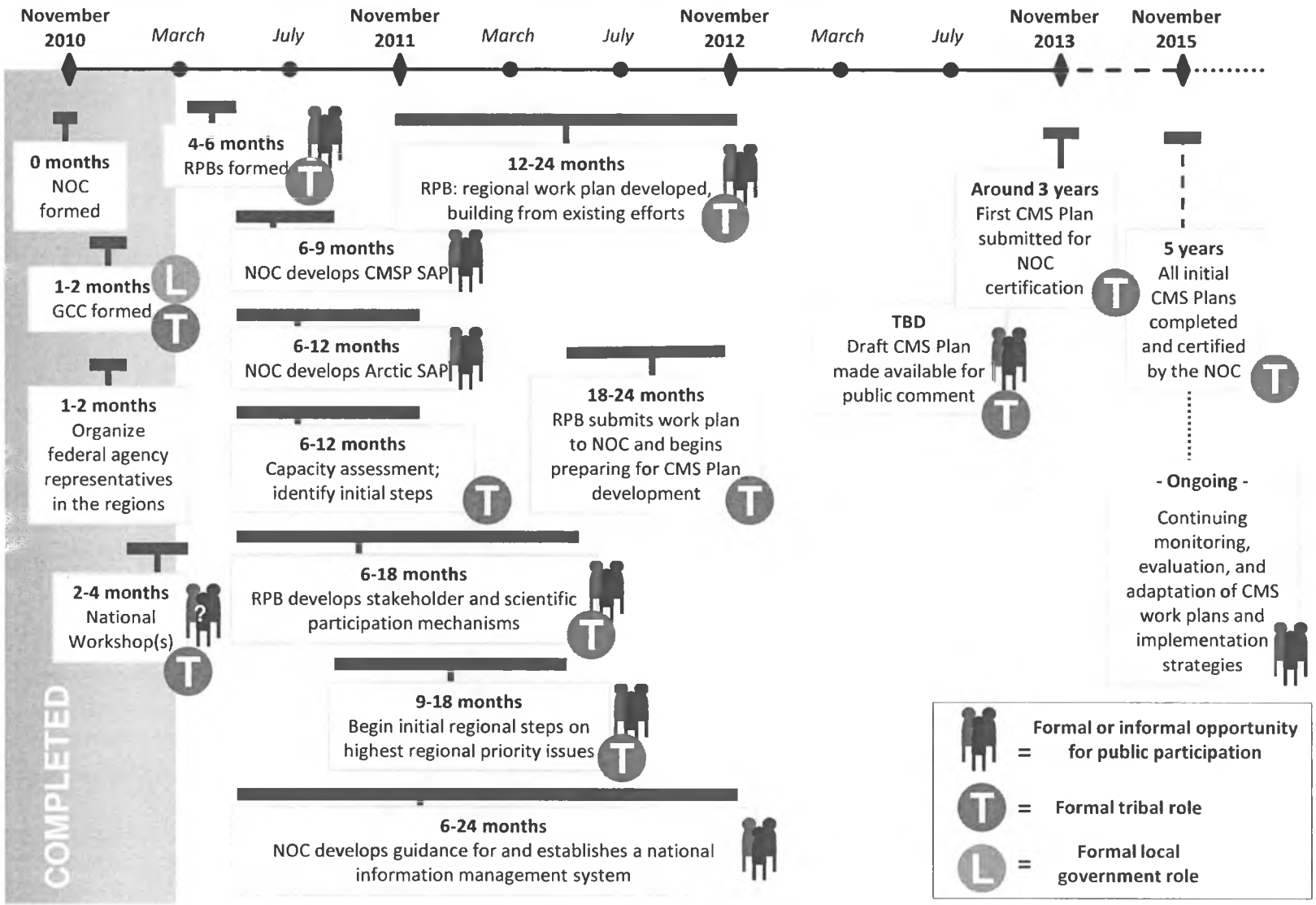

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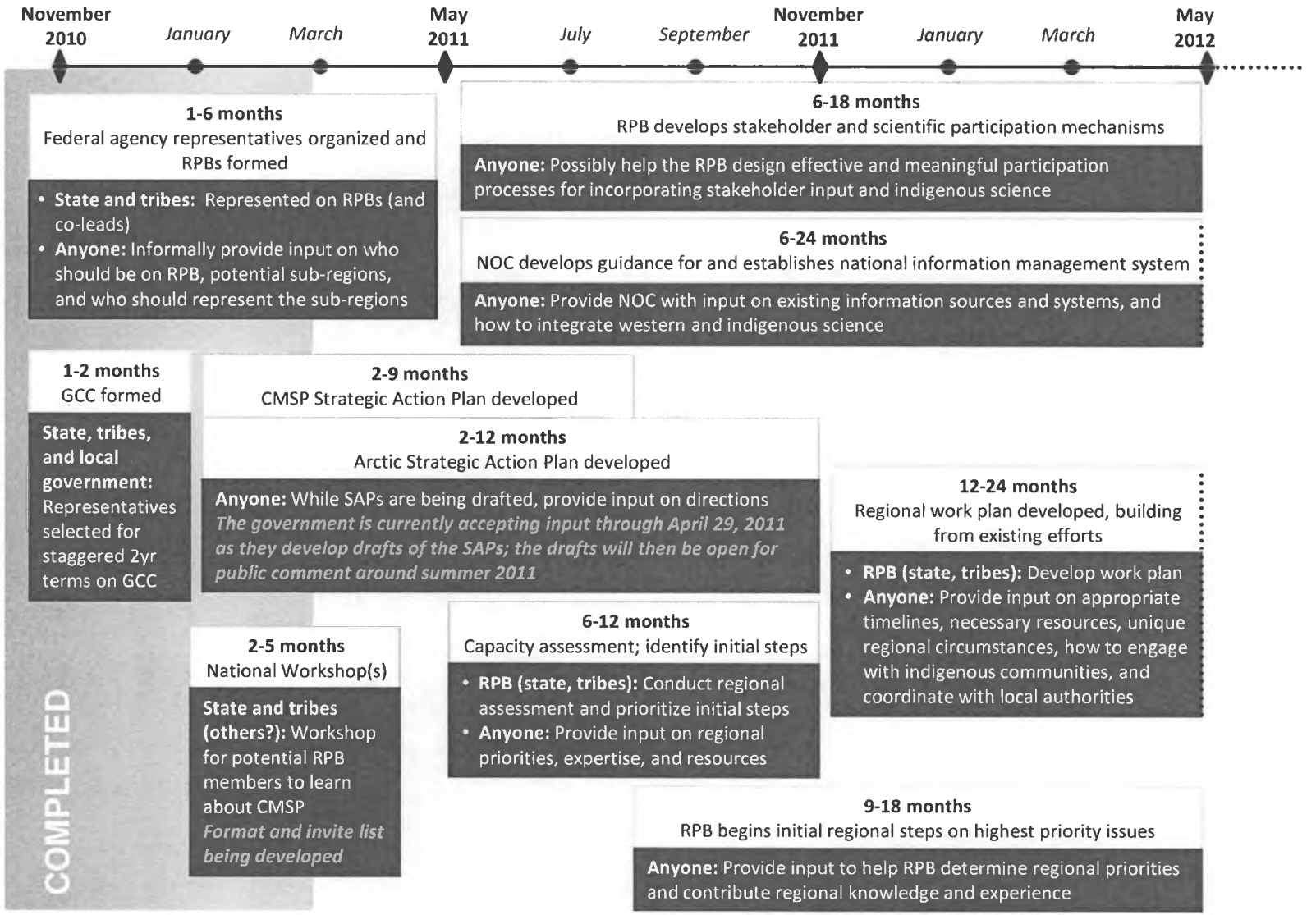

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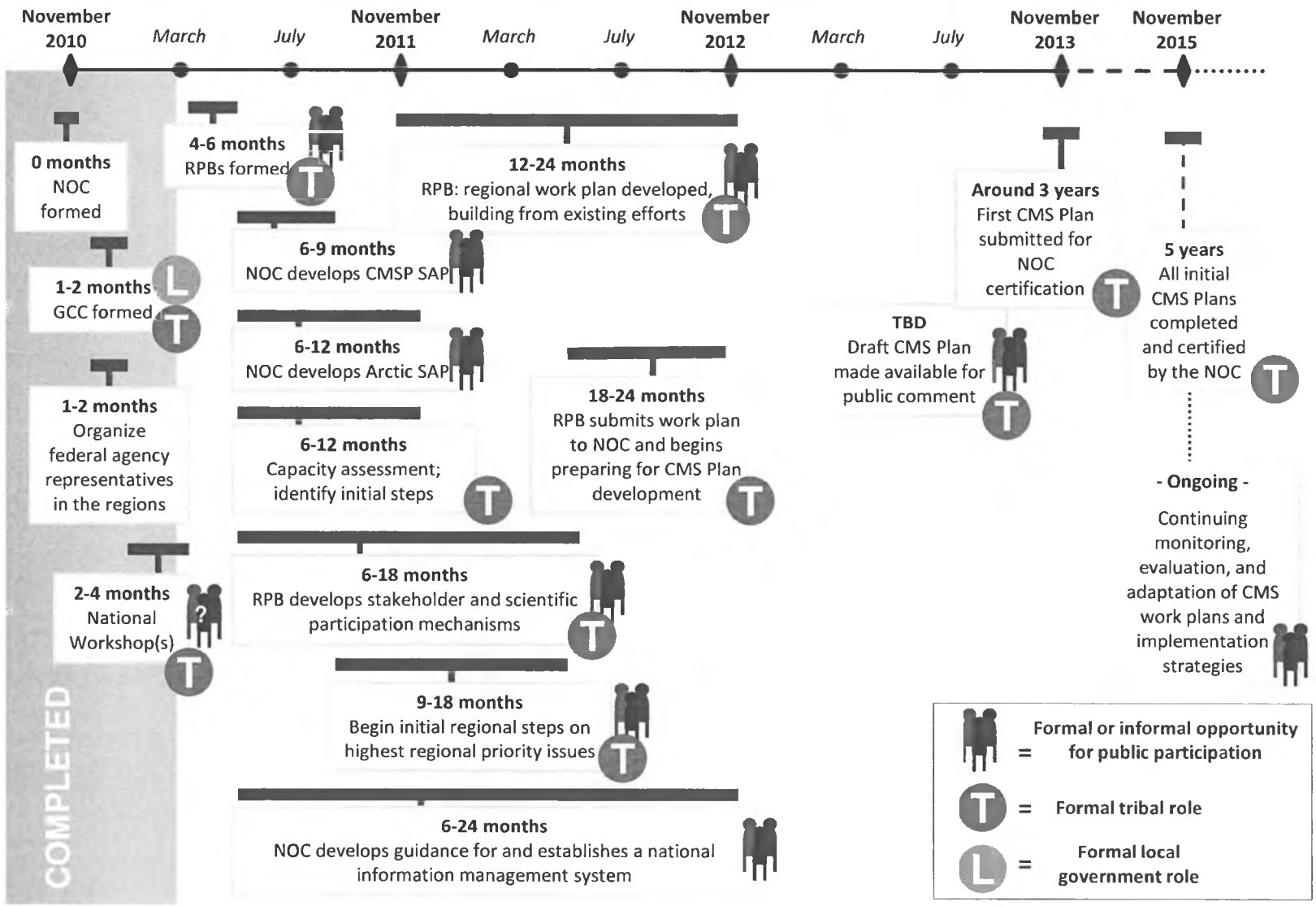

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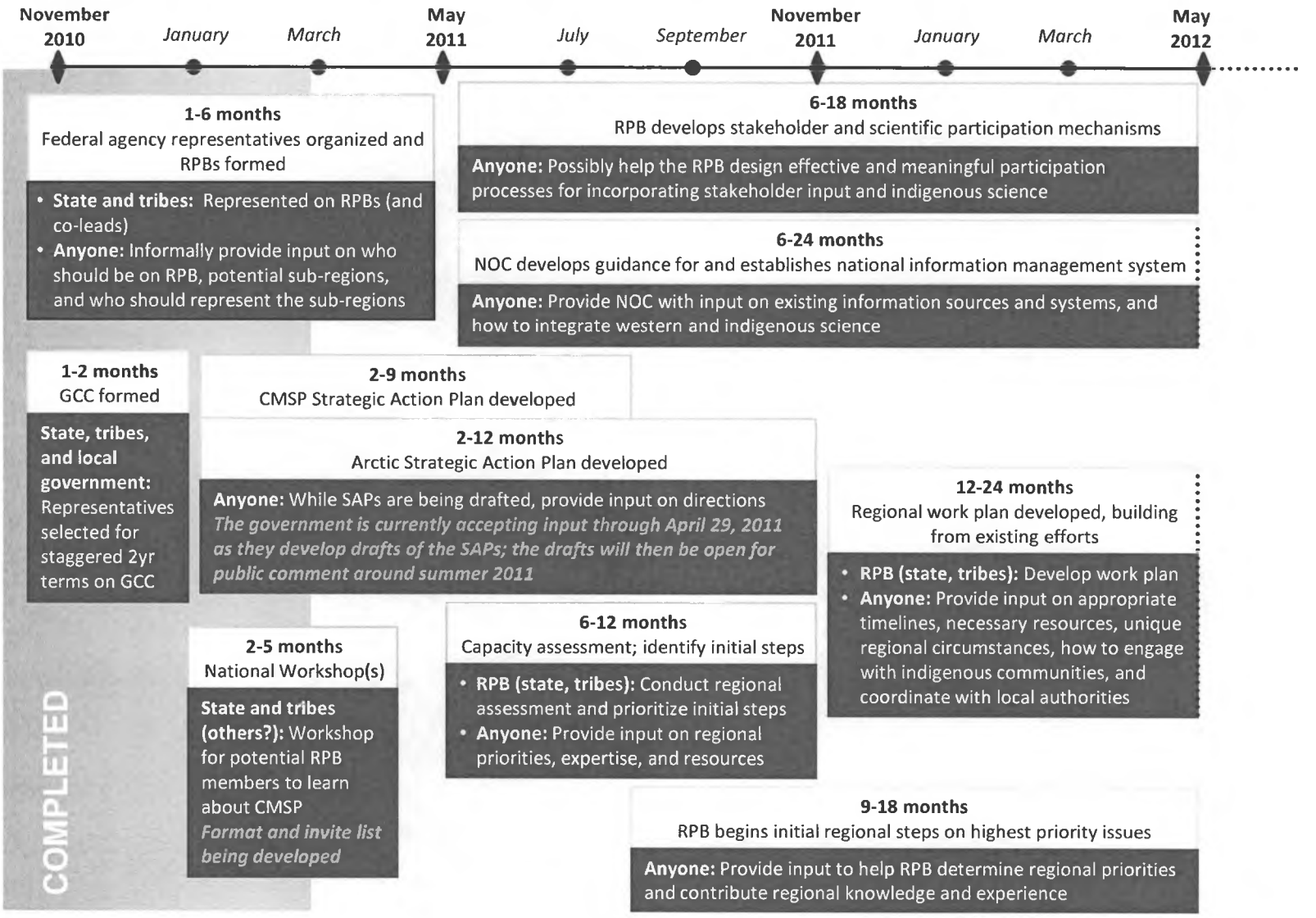

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E.

The Shared Future: A Report of the Aspen Institute Commission on Arctic Climate Change

The Shared Future:
A Report of the Aspen Institute
Commission On Arctic Climate Change

THE ASPEN INSTITUTE

Energy and Environment Program

THE ASPEN INSTITUTE

2011

THE SHARED FUTURE:
A REPORT OF THE ASPEN INSTITUTE COMMISSION ON ARCTIC CLIMATE CHANGE

THE ASPEN INSTITUTE

This report, while taking a hard and new look at climate change in the Arctic, does not exhaust the dialogue needed to address many of the important issues raised. Undoubtedly, more discussion beyond this report is warranted. Participants in the Aspen Dialogue and Commission on Arctic Climate Change participated as experts in their field and not in their professional capacity or organizational affiliation. As with all policy dialogues in the Aspen Institute's Energy and Environment program, the format followed the Institute's time-honored approach to intentional, values-based dialogue, and adhered to a strict not-for-attribution rule throughout the duration of the dialogue. The names and affiliations of participants are listed for identification purposes only and do not indicate individual or organizational responsibility for this report or recommendations. This report is issued under the auspices of the Aspen Institute and the members of the Aspen Institute Commission on Arctic Climate Change, with generous support from the Prince Albert II of Monaco Foundation and the Shell Oil Company.

The Prince Albert II of Monaco Foundation strives to act as an accelerator of projects and solutions for the environment. It promotes sustainable and equitable management of natural resources and places the individual at the centre of its projects. It encourages the implementation of innovative and ethical solutions in three main areas: climate change, biodiversity and water.

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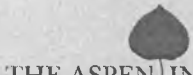

The Aspen Institute Energy and Environment Program provides nonpartisan leadership and a neutral forum for constructive dialogue on complex policy issues in the areas of energy and environmental policy.

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For all inquiries, please contact:

The Aspen Institute
Suite 700
One Dupont Circle, NW
Washington, DC 20036
Phone: (202) 736-5800
Fax: (202) 467-0790

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Preface

People the world over think of the vast ice-covered polar Arctic as a symbol of our shared natural heritage. The Arctic is a constant reminder of nature's wild beauty – the world is amazed that people live there and call it home. Our vision of the Arctic, though, is changing.

As reported by the National Snow and Ice Data Center on January 5, 2011, "Arctic sea ice extent for December 2010 was the lowest in the satellite record for that month." The rate of global warming in the Arctic, which is twice as fast as the global mean average, raises new challenges for governing and managing its many human uses in balance with protecting this unusual natural environment. While the loss of sea ice and thawing permafrost over time will likely create new access to natural resources and to shipping routes, further retreat of the ice extent will lead to new challenges (and opportunities) for the coordination and management of the Arctic marine environment by its regional governments.

Climate change raises important new questions about ecosystem resilience, adaptation readiness, sustainable development and social change in the Arctic. Just as the Arctic marine environment is not one ecosystem, neither is it one society or one people governed by a single political system. Although climate change and the impacts it will have on the Arctic are a shared global responsibility, much of the Arctic marine environment is governed by sovereign states (and international law), each with its own national priorities, regulatory and management systems, and needs. It is the sovereignty of Arctic governments, nonetheless, that affords the strongest foundation and greatest opportunity for international cooperation and shared responsibility for sustainably protecting the Arctic marine environment.

In recognition of the scientific forecast of significant changes in the Arctic caused by global climate change, the Aspen Institute convened a civil society Dialogue and Commission on Arctic Climate Change. The Commission began its deliberations by identifying a set of dialogue principles as the foundation by which governance and sustainable management should proceed in the Arctic marine environment. The Aspen Principles of Arctic Governance (see page 3) set the backdrop for the Commission's dialogue and the formulation of its recommendations.

Due to its composition, the intensity and longevity of its deliberations, and the scope of concerns it addressed, this Aspen effort is distinct. Whereas other Arctic governance projects may have focused on specific questions such as how to improve regulation of certain sectors or activities, or how to strengthen Indigenous peoples' participation in the Arctic Council, the Aspen process has been focused on the climate adaptation challenges facing the Arctic marine environment and its human communities, as well as the regional and global governance implications of these issues. As these challenges were identified and discussed, the Commission's working group strived in a dialogue process to develop a shared understanding of the potential consequences of climate change in the Arctic marine environment, and the intensifying pressure of global economic forces anticipated for the region in the future. The working group and invited experts sought to identify strategies and approaches to help conserve the critical biological resources of the Arctic Ocean and to assure sustainable livelihoods of the communities that depend on these resources for their survival. (A full description of Commission-related meetings can be found in Appendix 2).

This report presents the Commission's recommendations, foremost of which is that governance in the Arctic marine environment, which is determined by domestic and international laws and agreements, including the Law of the Sea, should be sustained and strengthen by a new conservation and sustainable development plan using an ecosystem-based management approach. The

Commission believes marine spatial planning provides a workable method or approach to begin implementation of ecosystem-based management. According to the Commission, Arctic governance can and should be strengthened through an inclusive and cooperative international approach that allows greater participation in information gathering and sharing, and decision-making, leading to better informed policy choices and outcomes.

The Commission recommends that Arctic governments, in partnership with universities and other civil society and scientific entities, develop an open-source network (or series of networks) focused on supporting a plan for conservation and sustainable development in the Arctic marine environment. These networks should be developed and used as a means to connect communities and civil society sectors with each other as well as with governments. Such networks should be created and implemented to identify, record and track existing and newly emerging transnational ecological priorities in the Arctic marine environment.

The Commission recognizes that this Aspen Dialogue has been a preliminary step toward a fuller discussion on the future of the Arctic marine environment. Its major discovery is that a more modern, holistic and integrating international plan is needed to sustainably steward and govern the Arctic marine environment. The Commission has made significant progress in understanding the needs and requirements for action to sustain the Arctic and realizes that in order to implement its recommendations the entire Arctic community must be engaged.

The dedicated participation by Members of the Commission, their working group delegates, and the invited experts, some who agreed to have their name listed in this report, was essential to defining the scope of the dialogue, guiding the direction of the project, and creating a final report. Charles N. Ehler is the principal author of the marine spatial planning section in Part Two. We thank him for applying his extensive experience and expertise in marine spatial planning to the Arctic.

The Aspen Institute would also like to thank Brooks Yeager for his prolific role as Special Advisor to the Commission. This report and its recommendations owe much to his considerable experience and his thoughtful contributions to the dialogue. Francesca Cava and Regan Nelson both served as Project Managers for this dialogue, skillfully extracting the important themes and illustrative points from a wealth of excellent presentations and complicated discussions. Timothy Olson admirably coordinated the administrative preparations and extensive dialogue support, and Ray Bolger added his invaluable drafting and editing skills, synthesizing the major themes of this report.

We are profoundly grateful to H.S.H. The Prince of Monaco and The Prince Albert II of Monaco Foundation, our partner in creating and generously supporting this timely dialogue.

David Monsma
EXECUTIVE DIRECTOR
ENERGY AND ENVIRONMENT PROGRAM
THE ASPEN INSTITUTE

Foreword

In July 2008, my wife Rosalynn and I joined over one hundred distinguished scholars, political and religious leaders, journalists, and business executives for a weeklong tour of the high Norwegian Arctic aboard the *National Geographic Endeavor*, a vessel operated by Lindblad Explorations. Of all the places in the world I have visited as a naval officer or during and after my time as president of the United States, this voyage to the Arctic stands out in memory as one of the most enlightening journeys I have taken.

One afternoon that I will never forget, Rosalynn and I ventured out from the ship on a small boat with Larry and Lucy Page, Tom Daschle, and the undersea specialist David Cothran to launch a remotely operated vehicle in about 240 feet of remarkably clear water. We photographed many animals that day (many looked like plants) growing on the sea bottom and feeding in the current.

If you have never paddled a kayak up close to a bearded seal resting on a glacier, we can attest that it is an unforgettable, wonderful experience. We stepped ashore for a walk along a fjord near the southern tip of Spitsbergen, beneath a very high cliff that was almost completely blanketed with nesting birds. As avid birdwatchers, we enjoyed the many birds we saw each day of our voyage, including rare Ivory Gulls.

The next morning, back on board the *Endeavor*, we got up early to view two large polar bears feeding on a ringed seal, while a smaller one swam around them, then climbed out on a nearby floe. The largest bear then swam over to a nearby sheet of ice and bathed and dried itself while its mate slept nearby. Although we got very close, they never seemed disturbed.

The Arctic is a world of inherent silence and stark beauty, populated by majestic animals above and below the sea, and in the air. It is a place of great natural mystery, where so much about its ecology remains unknown.

At that point in the voyage we were close to Edgeoya Island, where we went ashore on the west coast for a long hike, with reindeer roaming all around. Later that night, we steamed through the Freemanssundet Strait, moving northwest toward Nordaustlandet Island, whose ice cap is the third largest in the world, after the Antarctic and Greenland.

The Arctic is a world of inherent silence and stark beauty, populated by majestic animals above and below the sea, and in the air. It is a place of great natural mystery, where so much about its ecology remains unknown.

Yet, despite its remoteness, the Arctic is an integral part of the entire global climate system, functioning as a natural source of cooling for the planet. Alarmingly, its ability to regulate Earth's climate is being diminished as the ice and snow cover, which reflect solar heat back into the atmosphere, retreat dramatically amid rising temperatures. Global temperatures are expected to increase, and the sea level, as a result of warming oceans and melting glaciers, is expected to rise 20 inches in the next century. Already, storms in low-lying regions of the world such as Burma and Bangladesh are far more devastating than before, while coastal villagers in Alaska are being forced to move their homes en masse as the sea level increases and protective ice disappears.

Meanwhile, the greatest international interests in the Arctic appear to be fixated not on how to minimize the pervasive damage there, but how to define territory and exercise national dominion over the rich natural resources in terms of oil and gas, fishing, and minerals. The United States has yet to ratify the Law of the Sea Treaty, while Russia and other Arctic nations are making territorial claims.

Given the prevailing circumstances, many of us on board the *Endeavor* understandably began the trip in a pessimistic mood—bemoaning climate change and blaming the state of affairs on the oil producing nations, our own governments, and competition from India, China, and others for scarce energy supplies.

…profound change is in store for the region's inhabitants, including its proud Indigenous Peoples, who have existed for several thousand years in harmony with their environment.

Over the course of the journey, though, a surprising thing happened: The general mood among the ship's passengers seemed to turn more positive as we focused on the possibility of courageous leaders tapping mankind's great potential for science, innovation, efficiency, and strength when united by a challenging goal. In striving to mitigate impacts on the Arctic from climate change, we can create millions of new jobs, working harmoniously with other nations and giving special care to the poor who have least caused global warming, but who will suffer most from it.

After our enlightening journey aboard the *Endeavor* the Aspen Dialogue and Commission on Arctic Climate Change inquired into the economic and political forces affecting the region and the limited scope of scientific knowledge about its ecosystems. Their findings lead to the conclusion that profound change is in store for the region's inhabitants, including its proud Indigenous Peoples, who have existed for several thousand years in harmony with their environment.

It is our duty to help them in whatever ways possible to adapt to the changing future as we strive to minimize the scale and rate of that change. Ultimately, their interests and those of the rest of us are aligned, for we share one planet with a contiguous climate. That unavoidable reality underpins the observations and recommendations contained in this report, which are the result of the Commission's efforts to understand what is happening in the Arctic and to determine how we can best respond as an international community.

President Jimmy Carter

The Members of the Aspen Institute Commission On Arctic Climate Change

H.S.H. Prince Albert II of Monaco, PRESIDENT, **PRINCE ALBERT II OF MONACO FOUNDATION**
Lloyd Axworthy, PRESIDENT AND VICE CHANCELLOR, **UNIVERSITY OF WINNIPEG**
Frances Beinecke, PRESIDENT, **NATURAL RESOURCES DEFENSE COUNCIL**
Patricia Cochran, EXECUTIVE DIRECTOR, **ALASKA NATIVE SCIENCE COMMISSION**
Sylvia Earle, EXPLORER-IN-RESIDENCE, **NATIONAL GEOGRAPHIC**
David Lawrence, EXECUTIVE VICE-PRESIDENT, **EXPLORATION AND COMMERCIAL UPSTREAM AMERICAS, SHELL**
James Leape, DIRECTOR GENERAL, **WWF - INTERNATIONAL**
Sven-Olof Lindblad, PRESIDENT AND FOUNDER, **LINDBLAD EXPEDITIONS**
Thomas E. Lovejoy, BIODIVERSITY CHAIR, **THE HEINZ CENTER**
Lee McIntire, CHAIRMAN AND CHIEF EXECUTIVE OFFICER, **CH2M HILL**
Sheila Watt-Cloutier, HUMAN RIGHTS AND ENVIRONMENTAL ADVOCATE

THE MEMBERS OF THE ASPEN INSTITUTE COMMISSION ON ARCTIC CLIMATE CHANGE WORKING GROUP

Robert Blaauw, SENIOR ADVISOR GLOBAL ARCTIC THEME, **SHELL INTERNATIONAL EXPLORATION AND PRODUCTION B.V.**
Steve Colt, ASSOCIATE PROFESSOR OF ECONOMICS, **INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH, UNIVERSITY OF ALASKA, ANCHORAGE**
Paul Crowley, ADVISOR TO SHEILA WATT-CLOUTIER
Bill Eichbaum, VICE PRESIDENT FOR MARINE AND ARCTIC POLICY, **WWF**
Alf Håkon Hoel, ASSOCIATE PROFESSOR, **NORWEGIAN POLAR INSTITUTE, UNIVERSITY OF TROMSO**
Dan Hurley, SENIOR EXECUTIVE OFFICER, **UNIVERSITY OF WINNIPEG**
Jean Jaubert, MEMBER OF THE SCIENTIFIC AND TECHNICAL COMMITTEE, **PRINCE ALBERT II OF MONACO**
John Kelly, III, PRESIDENT AND CHAIRMAN, **PRINCE ALBERT II OF MONACO FOUNDATION USA**
Bud Lehnhausen, EXPEDITION LEADER, **LINDBLAD EXPEDITIONS**
Theresa Loar, VICE PRESIDENT INTERNATIONAL GOVERNMENT AFFAIRS, **CH2M HILL**
Rich Powell, ADVISOR TO SHEILA WATT-CLOUTIER
Tatiana Saksina, ARCTIC GOVERNANCE OFFICER, **WWF INTERNATIONAL ARCTIC PROGRAM**
Lisa Speer, DIRECTOR, INTERNATIONAL OCEANS PROGRAM, **NATURAL RESOURCES DEFENSE COUNCIL**
Brooks Yeager, EXECUTIVE VICE PRESIDENT, **CLEAN AIR- COOL PLANET, CLIMATE POLICY CENTER**

PAST AND CONTRIBUTING COMMISSIONERS

Jane Lubchenco, UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE, **NOAA ADMINISTRATOR**
Fran Ulmer, CHANCELLOR, **UNIVERSITY OF ALASKA, ANCHORAGE**
Vladimir Golitsyn, JUDGE, **INTERNATIONAL TRIBUNAL FOR THE LAW OF THE SEA**

STAFF

David Monsma, EXECUTIVE DIRECTOR, ENERGY AND ENVIRONMENT PROGRAM, **THE ASPEN INSTITUTE**
Francesca Cava, ARCTIC PROJECT MANAGER, ENERGY AND ENVIRONMENT PROGRAM, **THE ASPEN INSTITUTE**
Timothy Olson, PROJECT MANAGER, ENERGY AND ENVIRONMENT PROGRAM, **THE ASPEN INSTITUTE**

Commission Vision Statement

The Commission envisions a future Arctic as a healthy ecosystem with management and governance that is responsive to the needs of its residents, that supports conservation of its sensitive habitats, and that ensures sustainable development of its resources. To optimize economic fairness and environmental sustainability in the Arctic marine environment, the Commission envisions a regional conservation and sustainable development planning process utilizing an ecosystem-based management approach and an Arctic marine network linking all interested and affected constituencies, including Indigenous Peoples, Arctic communities, governments and the business sector. Anticipating continued, dramatic impacts in the Arctic marine environment due to climate change, the Commission envisions the development of a highly adaptive management approach to its ecosystems, based on close and consistent monitoring of environmental conditions and a constantly evolving plan that seeks to maximize the resilience of ecological and human systems in the region. To that end, the Commission envisions a far-reaching commitment by Arctic governments to cooperate more fully and broadly among themselves and with the broader international community in an effort to mitigate the damaging effects of climate change in the Arctic and to support optimal adaptation of its inhabitants.

The Commission envisions a future Arctic as a healthy ecosystem with management and governance that is responsive to the needs of its residents, that supports conservation of its sensitive habitats, and that ensures sustainable development of its resources.

Building on this vision, the Commission proposes active engagement of civil society by governments to support the rapid synthesis of scientific knowledge and effective policy making. Such governmental and non-governmental networks can help identify policy gaps and develop innovative solutions to the complex challenges facing the Arctic marine environment. These partnerships among all levels of civil society, governments and commercial institutions, when connected in an open-source network of information sharing, activity reporting, and decision making, will work together toward enhancing the capacity of Arctic governments to sustainably preserve what is unique and valuable in the Arctic marine environment—promoting adaptation to the inevitable environmental changes to come.

The Aspen Commission on Arctic Climate Change has identified the following initial Principles of Arctic Governance as forming the guiding foundation of its recommendations and the standards by which future governance and sustainable management of human activities in the Arctic marine environment should be measured. Specifically, governance and sustainable management of human activities in the Arctic marine environment should seek to:

Aspen Principles of Arctic Governance

1. Optimize ecosystem resilience, integrity and productivity by maintaining food-web (trophic) structure and protecting and restoring biodiversity and available habitat.
2. Maintain the full suite of Arctic ecosystem services to support human well-being on a continuing basis.
3. Promote investment in scientific research and related infrastructure necessary to ensure sustainable development and environmental protection.
4. Avoid exacerbating changes that may be difficult or impossible to reverse in temperature, sea-ice extent, pH, and other key physical, chemical and biological ecosystem parameters.
5. Assess, monitor and manage multiple human activities using an integrated, adaptive, ecosystem-based management system that takes into account risks and cumulative and interacting effects.
6. Apply ecosystem-based management processes based on science and traditional knowledge, particularly to new and expanded human activities which are subject to prior evaluation and analysis. Prudent measures to reduce or eliminate impacts are to be taken when there are reasonable grounds for concern that such activities, directly or indirectly, will bring about hazards to human health, harm living resources and ecosystems, damage amenities or interfere with other legitimate uses.
7. Fully respect the rights, including human rights, of Arctic residents and Arctic indigenous peoples, and maximize participation in and transparency of decision-making for all interested stakeholders.
8. Link global policy discussions to the need to conserve and manage Arctic ecosystems and dependent communities.
9. Promote cooperation among Arctic states to arrive at appropriate standards for managing activities in the Arctic to meet the special conditions of the Arctic region, while promoting sustainable development.
10. Inform, in a timely manner, national and international decision-makers as well as the public of the consequences of climate change impacts in the Arctic, and needed actions required to meet the above noted principles.

The Aspen Institute Commission on Arctic Climate Change believes that existing frameworks can be enhanced and new frameworks can be established to improve governance and strengthen resilience in the Arctic marine environment in response to climate change impacts and the need for adaptation readiness. The Commission developed its recommendations against the backdrop of at least three observable strategies currently discussed internationally: strengthen the Arctic Council; expand and strengthen the existing system of bilateral and multilateral agreements; and/or establish a new Framework Convention for Arctic governance.

Aspen Commission Recommendations

This report focuses on several major Commission recommendations as follows:

1. Arctic governments should take immediate steps to begin developing an Arctic Marine Conservation and Sustainable Development Plan by 2012, in collaboration with civil society and other interested parties.

An Arctic Marine Conservation and Sustainable Development Plan should integrate ecosystem-based management to preserve ecosystem resilience and support sustainable development in the Arctic. The key features of this approach should include a consideration of multiple scales (e.g., temporal and spatial, sectors and activities, etc.), a long-term perspective, the recognition that humans are an integral part of ecosystems, an adaptive management perspective, and a concern for sustaining natural goods and services. The Plan should articulate shared objectives within and across multiple sovereign territories and national boundaries, and be implemented by a combination of civil society actors, the private sector, and governments. This Plan should provide the umbrella that coordinates national and international planning and stewardship to balance competing economic interests, while maximizing the resilience of natural ecosystems in the region. Once the plan is initiated, it should be reviewed at sufficiently regular intervals by the Arctic Council, civil society entities, affected constituencies, government agencies, and/or other international bodies.

An Arctic Marine Conservation and Sustainable Development plan should:

- **a.** Develop a coordinated approach that emphasizes science-based management; integrated marine spatial planning covering all relevant sectors of activity; participation of and benefits to Indigenous Peoples, local communities and civil society; and application of the precautionary[1] and ecosystem-based approaches;
- **b.** Identify, within each nation's jurisdiction, sensitive marine areas (including areas of high productivity and fragile or vulnerable areas, etc.), protect such areas through appropriate national means, and share information regarding these areas to enable coordinated networks of inter-territorial marine protection; and,
- **c.** Designate the high seas of the Central Arctic Ocean as a zone of international scientific cooperation. The lack of basic scientific information regarding the ecological characteristics of the high Arctic Ocean means that informed, science based decisions on whether and where extractive and polluting activities can take place is virtually impossible. The Aspen Commission recommendations therefore call for an agreement to protect the waters of the High Arctic, beyond the Arctic coastal nations' respective exclusive economic zones, as a zone of international scientific cooperation.

[1] As per the *Final Report of the US Commission on Ocean Policy*, a balanced precautionary approach applies "judicious and responsible" management practices, based on the best available science and on "proactive, rather than reactive, policies." *See* ENDNOTE 19

2. Arctic governments, independently and collectively, should implement an integrated ecosystem-based management approach in the Arctic marine environment utilizing appropriate marine spatial planning, as well as regulatory rules and standards, that address the special conditions of the Arctic region.

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem. The approach differs from current management procedures that usually focus on a single sector, activity or concern. Rather, it considers the cumulative impacts of different sectors. Marine spatial planning is an innovative tool to implement and measure the success of ecosystem-based management across sectors. It is a public process that collects, analyzes, and identifies where human activities occur in time and space to achieve agreed upon ecological, economic and social goals.

Although several marine spatial planning efforts are underway in the Arctic, there are areas where marine spatial planning has not begun. Both marine spatial planning and regulatory standards should be used to achieve sustainable economic development, along with environmental conservation and marine area protection. Part II of this report introduces many of the preliminary steps and activities that should be considered as part of a cooperative regional initiative to develop a conservation and sustainable development plan for the Arctic marine environment.

3. In addition to an Arctic marine conservation and sustainable development plan, a number of specific actions should be initiated through the development of agreements or standards that foster consistent implementation among and across Arctic governments.

- **Fisheries:** In accordance with a precautionary approach to new or expanded commercial fishing in the Arctic, the Commission calls on all countries to refrain from authorizing their vessels to take fish in the high seas of the central Arctic Ocean where no cross-border regional fishing management organization or agreements exist, until sufficient scientific information is available on the impacts of potential new fisheries on target and non-target species, habitats, ecological relationships, and human communities. Regional Fishing Management Organization agreements should be developed for those areas of the Arctic where none currently exist.
- **Uniform Offshore Oil and Gas Standards and Spill Response:** The Commission calls for the development of a framework for the staged implementation of performance-based standards governing Arctic offshore oil and gas exploration, development, production, and transportation (including oil spill response), which take into consideration the special nature and challenges of the Arctic environment, and enable compliance integrated with regulatory arrangements.
- **Environmental Impact Assessments:** Pursuant to Article 206 of the Law of the Sea Convention, the Commission recommends conducting environmental impact assessments of individual and cumulative environmental impacts of human activities in the Arctic marine environment, including those that may have trans-boundary effects.[2] The Arctic Council should be encouraged to review the assessments and make recommendations.
- **Marine Shipping:** The Commission supports the development of a mandatory polar shipping code and recommends its swift adoption and implementation.
- **Marine Tourism:** As tourism is likely to grow with new waters opening up as ice cover diminishes, there is a clear need

[2]UNCLOS Article 206: Assessment of potential effects of activities: "When States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments in the manner provided in article 205."

to establish protocols that take safety, environmental protection and quality of experience issues into consideration. Participatory discussions that include international regulatory bodies and industry need to begin as soon as possible in order to limit accidents going forward.

4. An open-source Arctic network, focused on ecosystem-based management, should be developed through the Arctic Council and used to complement the existing system of national and international governance mechanisms in the Arctic.

Any new governance strategy and plan for Arctic marine conservation and sustainable development should recognize the region's challenges are not limited to national concerns. Given the complex economic and ecological forces affecting the Arctic marine environment, and the interwoven fabric of communities and public and private interests at stake, international cooperation, innovative ideas, and greater inclusion of interested stakeholders should be mobilized to supplement national governmental action.

As noted above, the Commission advocates development of a Conservation and Sustainable Development Plan for the Arctic marine environment. This plan would optimize the use of linked policy and community networks and the development of an open, electronic information environment through which stakeholders and institutions can exchange information needed for Arctic management and effective long-term governance. Well-structured and dynamic reporting and information-sharing networks involving public and private institutions and stakeholder groups, can be a critical element of strengthening management in the Arctic, provided that it is guided by a defined set of economic, ecological and scientific and cultural objectives, with a recognized monitoring, evaluation and reporting process to monitor ecosystem resilience, climate-induced ecological changes, and human activity as well as planning goals and conservation objectives.

A prototypical model of an open-source Arctic network should be created and implemented to identify, record, and track existing and newly emerging transnational ecological priorities in the Arctic marine environment. An Arctic marine network (or system of networks) should be based on existing structures (such as the University of the Arctic), provide opportunities for involvement by all parties who have an interest in governance and management in the Arctic, and should be designed to provide appropriate civil society access to influence governmental decisions.

The development of an open-source network should be led by the Arctic Council and Arctic governments in partnership with industry, universities and other civil society and scientific entities (as well other international bodies such as the IMO and the UNEP). It should be developed as an inclusive and cooperative international undertaking to allow open participation in information gathering and sharing, leading to better governance choices and management decisions in the Arctic. Participation in Arctic networks should be structured in a way that maximizes the use of information technologies for collection and distribution of information and data analysis, as well as embody a communication strategy that includes the implications for public policy decisions.

5. Arctic governments should call for a special diplomatic conference in 2012, which includes participation by Indigenous Peoples and the eight Arctic nations, to establish a timetable for designing and implementing the preceding recommendations.

Diplomatic conferences have historically played a key role in Arctic governance. In 1996, for example, the Ottawa Declaration established the Arctic Council as a high intergovernmental level forum focused on environmental protection of the Arctic. Since 1996, climate change and world economic forces have presented new challenges in the Arctic and led many Arctic policy-makers to begin rethinking the direction of governance in the region. The Commission envisions that a new diplomatic conference can both promote the importance of the Arctic and seek ways to strengthen the safeguards needed to protect sensitive ecosystems and highly productive marine habitats.

6. All Arctic residents, including Indigenous Peoples, should play a pivotal role in planning the future of the Arctic and should share in the benefits of its resources as well as responsibility for its sustainable future.

Arctic governance decision-making should build upon the Permanent Participants' strong engagement in the Arctic Council through a networked structure that: 1) recognizes the existing complex institutional arrangements at local, national and international levels; 2) brings the diverse and traditional knowledge and expertise of Arctic residents, including indigenous peoples, to the forefront where their perspectives can inform and advise Arctic-wide ecosystems-based management; and 3) works to alleviate the procedural and resource constraints that limit indigenous organizations' full and effective participation.

All states should therefore recognize the unique rights of Indigenous Peoples over development of their traditional lands and waters, and provide them with the necessary technical and financial support they need to participate in key policy venues affecting their futures, as avowed in the United Nations Declaration on the Rights of Indigenous Peoples, adopted by General Assembly Resolution 61/295 on 13 September 2007, Article 32, 2 says the following:

> *"States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources."*[3]

In building the capacity for Arctic residents to participate in Arctic governance, communication protocols and technological infrastructure must be expanded and improved to effectively share information to and from Arctic communities. The benefits of economic development in Arctic marine environment should also be invested in organizations and communities to sustainably support the engagement of Arctic communities and develop leadership among their youth.

7. An Arctic science program should be implemented and integrated as part of the Arctic Marine Conservation and Sustainable Development Plan using an open-source information network.

The program should contain the following minimum areas of focus:

- Designating the high seas of the Central Arctic Ocean as a zone of international scientific cooperation.
- The Sustaining Arctic Observation Networks (SAON) should be expanded to maintain observing systems in the Arctic, improve coordination between multidisciplinary networks, and facilitate data acquisition, access and dissemination.
- The effects of climate change on the Arctic marine and terrestrial environments, including the potential release of

[3]United Nations Declaration on the Rights of Indigenous Peoples Adopted by General Assembly Resolution 61/295 on 13 September 2007, Article 32. UNDRIP is a Declaration adopted by the General Assembly of the United Nations; a Declaration adopted by the General Assembly reflects the collective views of the United Nations but is not subject to ratification and does not have legally binding status.

methane and other greenhouse gases due to melting permafrost.

- Access to research data and data sharing should be improved, and issuance of research permits should be expanded in Arctic countries.
- Environmental and development challenges facing the Arctic should drive the development of scientific questions and the collection of scientific data that inform the decisions of policy makers.
- Education, recruitment and retention of key personnel at educational facilities, such as the University of the Arctic and others, should be supported in order to encourage a culture of understanding across boundaries and disciplines.
- The International Polar Year's scientific data and information should contribute to future assessments by the Intergovernmental Panel on Climate Change, as well as other efforts to address climate change. In particular, there is a need to utilize local and traditional knowledge and observation as part of the scientific process. Arctic residents should also be kept abreast of the results of Arctic scientific findings and conclusions.
- Encourage a series of bilateral memoranda of understanding (MOUs) among Arctic nations to support common scientific research. These MOUs would provide a predetermined means of transferring or sharing resources such as scientific instruments, personnel and data, and would perform services like contracting mechanisms to facilitate execution of scientific support activities. Scientific MOUs would likely be between corresponding agencies of each country (i.e., NOAA-to-NOAA counterparts).

8. The Commission urges that the Arctic Council be reinforced as an effective, multilateral organization for the region and that it be given the resources and a revised architecture to ensure that the planning, participation, management and accountability recommendations put forward in this report are implemented.

The short-term and practical way to successfully implement the Commission's proposed recommendations is to build on the existing framework and activities of the Arctic Council, which provides a forum for effective, cooperative management of the circumpolar region with due recognition of the rights of its people. In the interest of good stewardship in the Arctic the Commission recommends:

- Member states should commit to full cooperation in the development of a new conservation and sustainable development plan, similar in purpose to the level of coordination around search and rescue.
- The Arctic Council should be given a full-time secretariat and sufficient funds to produce strong results from its working groups. A sustainable source of funding is provided for the participation of Indigenous Peoples' Organizations.
- Governments should recommit to the spirit of the Arctic Council as a true partnership between Arctic states and Indigenous Peoples. Six Indigenous Peoples[4] are considered "permanent participants" at the Council. Their active inclusion in all future deliberations on Arctic governance is paramount.
- Arctic nations should participate in the Arctic Council through senior or ministerial-level officials who are empowered to make significant commitments and decisions for their governments.

[4]The six permanent participants of the Arctic Council are: the Aleut International Association, Arctic Athabascan Council, Gwich'in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North (RAIPON), and the Sami Council.

Introduction

In the fall of 2007, the drastic melting of Arctic sea ice as viewed from space satellites offered the most dramatic evidence to date of global climate change and provided a sharp image that was easily understood by observers around the world. Meanwhile, at ground level across Arctic Canada, Inuit hunters reported that their traditional means of weather monitoring were no longer accurately predicting dangerous weather, often exposing hunters to treacherous travel conditions at times they would otherwise have thought safe. [1]

Glaciers are melting, sea level is rising and Indigenous coastal villages are becoming increasingly vulnerable to erosion and storms that were previously buffered by shorefast ice. Meanwhile, the seas of the Arctic continue to warm, mainly as a result of wide-scale ice melt, which allows more solar energy to be absorbed by the darker ocean. On land, trees and shrubs are advancing further into the tundra and foreign species of insects are being observed in the region.

The Arctic is the first region in which human-induced climate change impacts are being seen and it will—in all probability—be the first region where climate change will lead to transformative ecological, economic, and social change.

The Arctic is among the first regions in which human-induced climate change impacts are being seen and it will—in all probability—be the first region where climate change will lead to transformative ecological, economic, and social change. The rapid and profound transformation underway in the Arctic as a result of climate change may well trigger other global changes and climate shifts: The Arctic's ability to contribute to the cooling function of the planet could be altered; Arctic atmospheric warming and the potential release of greenhouse gases from land and the seabed could impede global efforts to mitigate greenhouse gas emissions; The stability of ocean circulation systems and biological productivity in the region and globally could change inexorably. These changes will almost certainly manifest themselves in terms of rising sea levels, increased contribution to global climate change, and increased demand for exploitation of new energy and food sources from the Arctic Ocean.

"The Arctic's warmer temperatures and decreases in permafrost, snow cover, glaciers and sea ice also have wide-ranging consequences for the physical and biological systems in other parts of the world."

Jane Lubchenco, PhD
Under Secretary of Commerce
for Oceans and Atmosphere
and NOAA Administrator

Further complicating the situation, although the Arctic is a definable marine environment it is not a single ecological or political system. It is governed by several sovereign states, each with its own priorities and regulatory and management systems. National efforts by Arctic governments, as well as the international agreements, laws and institutional arrangements that presently guide the management of the Arctic marine environment, may or may not contend well with new levels or new forms of economic activity, unparalleled changes in the function of natural ecosystem services, or further negative impacts to human and natural habitats, if the Arctic continues to warm at an unprecedented rate.[2] The anticipated further recession of the Arctic ice pack will, over time, impel new levels of economic activity, including expanded oil and gas development, new commercial-scale fisheries, and increased bulk and trans-

continental shipping. These activities are reasonably expected to have impacts on the region's ecology and economy and will pose serious management challenges to the Arctic nations.

The deep basin of the Arctic Ocean is surrounded by the continental shelves of Eurasia and North America. In the modern era, the legal and regulatory framework for managing resources in the Arctic has largely been defined by international law and the United Nations Convention on the Law of the Sea, as well as the laws of individual Arctic nations within their territorial waters and exclusive economic zones.[3] The Arctic Council, formed in 1997, is constituted as an international forum for the discussion of environmental and development issues in the region—not as a regulatory body—and has strict constraints on its ability to address the scale of emerging challenges.[4]

It is the sovereignty of Arctic governments... that affords the strongest foundation and greatest opportunity for international cooperation and shared responsibility for sustainably protecting the Arctic marine environment.

The eight Arctic nations have addressed challenges in the region with a substantial number of multilateral agreements. However, these agreements have not been uniformly adopted and the stronghold of beliefs in national sovereignty has caused some governments to overlook the benefits and necessity of greater multilateral cooperation – particularly in view of climate change. In addition to national management efforts within territorial waters, and international agreements such as the Law of the Sea, Arctic governments need to respond to the call for enhanced regional cooperation and innovative transnational stewardship approaches with greater involvement of new and existing actors. There is an obvious need for greater international cooperation and collaboration between states, which includes participation from all levels of civil society and interested stakeholders, to support effective management of the Arctic ecosystem as it undergoes dramatic change and economic activity there expands.

First, all options must be consistent with the fundamental framework for governance of the Arctic marine environment, the UN Convention on the Law of the Sea (UNCLOS).

Early on, the Aspen Arctic Commission recognized that Arctic residents are already beginning to adapt to significant physical and ecological shifts as a result of climate change. Because several nations have contiguous territories bordering on the Arctic Ocean and share the ocean's living resources, adaptation to an environment significantly altered by climate change will require both clear national policies, multinational cooperation and local implementation. Although changes will result in the Arctic, they will have significant implications for the global community as well, and the challenges of adaptation to climate change for communities and living resources in this remote region may provide important lessons for the future of other regions.

Thus, regulation, management, and governance in the Arctic must respond to the transformation already taking place in the region. This led the Commission to discussions leading to the *Principles of Arctic Governance* (see page 3), which became the first public product of its thinking. The principles are specific to the unique conditions of the Arctic. However, in considering institutional and governance developments that respond to climate change in the Arctic, some universal considerations also

were taken into account: First, all options must be consistent with the fundamental framework for governance of the Arctic marine environment, the UN Convention on the Law of the Sea (UNCLOS). Second, governance reform proposals need to be responsive to the rate of change occurring in the Arctic and should be appropriately matched to the scale of the issue. Third, governance options should seek to build on the strengths of existing institutions. Finally, they must seek every means to address issues cooperatively and diplomatically, and without destabilizing peace, security, and stability in the region.

In reviewing various approaches to the management of marine systems over the past half century, the Commission became convinced that industry sector-based regulation as traditionally practiced has not been successful in protecting the integrity of marine ecosystems, and will likely not prevent the degradation of the Arctic. The Commission recognized that most of the new economic activity projected in the Arctic marine environment will take place in the coastal zones surrounding the high Arctic, and that the resources of these coastal areas are increasingly fragile and stressed by the direct impacts of climate change. Thus, they focused on the potential for ecosystem-based management and integrated marine spatial planning as strategies for ensuring the rational and sustainable use of this fragile resource base.

Second, governance reform proposals need to be responsive to the rate of change occurring in the Arctic and should be appropriately matched to the scale of the issue.

One particular feature of the ecosystem-based management and integrated marine spatial planning approaches heightened their attractiveness for the Commission, namely their accessibility to and reliance on the contribution of local communities and stakeholders. The Commission believes strongly that the conservation and sustainable use of the resources of the Arctic marine environment should be conducted in a manner that benefits the local communities of the Arctic, and most particularly the traditional communities that have co-existed in the region's environment for thousands of years. There is a clear need for traditional and indigenous communities to have a role in decisions affecting their future, and it is hoped that an integrated planning approach such as the one outlined in this paper will contribute a useful framework for their increased participation in the future.

Third, governance options should seek to build on the strengths of existing institutions.

Ultimately, it is clear to all on the Commission that global climate change, if not effectively addressed by the international community, could result in serious degradation of the Arctic's ecosystems and massively transform the region, making incremental efforts at adaptation futile. The reality of this threat resulted in the Commission Statement on Arctic Climate Change, which many commissioners endorsed.

Definitions Of The Arctic

Offshore Oil and Gas Guidelines (2009 version; ANNEX A - Definition of the Arctic)

Canada:
Canada has defined its Arctic area to include the drainage area of the Yukon Territory, all lands north of 60 degrees North latitude and the coastal zone area of Hudson Bay and James Bay.

Kingdom of Denmark
The Arctic area within the Kingdom of Denmark is the Faroe Islands and Greenland, which is the world's largest island on which stands 9% of the World's ice cap.

Finland:
In Finland the Arctic Area is defined as the territory north from the Polar Circle.

Iceland:
Iceland has defined the whole of Iceland to be within the Arctic area.

Norway:
Norway does not have any formal definition of the Arctic. For the purposes of the Arctic Oil and Gas Guidelines, 62 degrees North in the Norwegian Sea areas north shall be used as the southern delimitation of 62 degrees North form the Arcticthe Arctic area. This is in line with the AMAP Assessment delimitation.

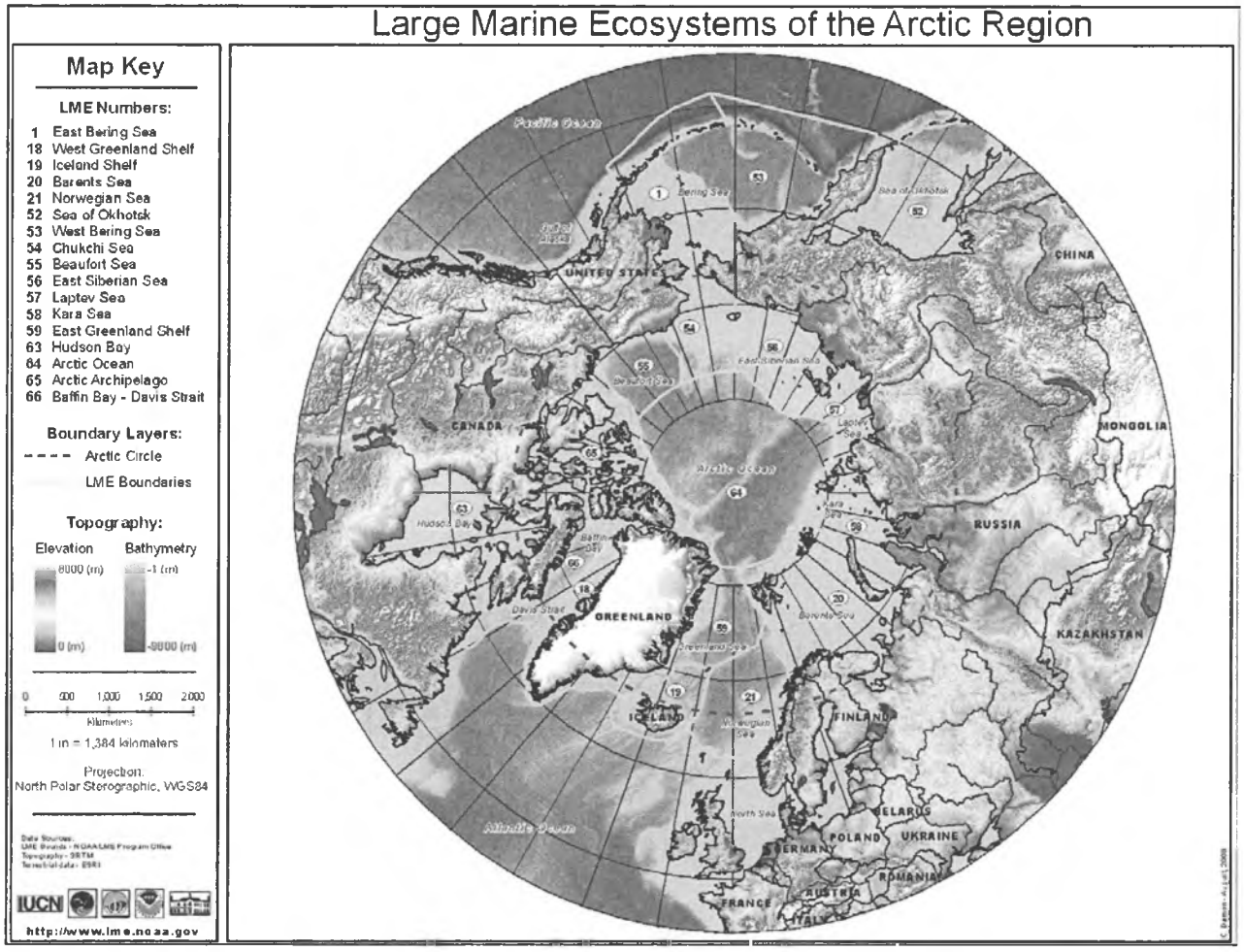
Sweden:
Sweden does not have any formal delimitation of the Arctic but has, for the purpose of the Arctic Council, accepted the Arctic Circle as the southern delimitation of the Arctic area.

Russian Federation:
In accordance with the draft Law of the Russian Federation "On Zoning of North Russia", the Arctic areas of North Russia include:

- All lands and islands of the Arctic Ocean and its seas;
- Within the Murmansk region: Pechenga district (coastal areas of the Barents Sea including populated centers located on Sredniy and Rybachiy Peninsulas, as well as Liynakhamareye populated center, and the town-type settlement of Pechenga) Kolsk district (territories administered by the Tyuman and Ura-Guba rural government bodies), Lovozersk district (territory under the Sosnovsk rural government body), territory administered by the Severomorsk municipal government, and closed administrative-territorial entities of Zaozersk, Skalistiy, Snezhnogorsk, Ostrovnoy, and the city of Polyarniy with populated centers administratively Attached to it;
- Nenets autonomous national area – all territory;
- Within the Komi Republic – city of Vorkuta, within areas managed by it;
- Within the Yamal-Nenets autonomous national area; Priural, Tazov, and Yamal District, and territories and administered by the Salekhard and Labytnang Municipal governments;
- Taimyr (Dolgan-Nenets autonomous area) – all territory;
- Within the Krasnoyarsk territory – areas administered by the Norilsk municipal government;
- Within Sakha Republic (former Yakutia): Allaikhov, Anabar, Bulun, Nizhnekolym, Olenek and Ust-Yan district;
- Chuckchi autonomous national area – all territory;
- Within the Koryak autonomous area – Olutor district.

United States of America:
All United States territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain.

Figure 1. Commonly Used Reference Map of the Arctic



The eight Arctic nations have addressed challenges in the region with a substantial number of multilateral agreements. However, these agreements have not been uniformly adopted and the stronghold of beliefs in national sovereignty has caused some governments to overlook the benefits and necessity of greater multilateral cooperation – particularly in view of climate change. Thus, there is an obvious need for greater international cooperation and collaboration between states, which includes participation from all levels of civil society and interested stakeholders, to support effective management of the Arctic ecosystem as it undergoes dramatic change and economic activity there expands.

I. A CONSERVATION AND SUSTAINABLE DEVELOPMENT PLAN FOR THE ARCTIC

Considering the scale and complexity of ecological and social impacts that are occurring in the Arctic due to climate change, some of which are beyond the capacity of governments acting alone to address, the Commission urges that a comprehensive Arctic Marine Conservation and Sustainable Development Plan be developed as rapidly as possible. Given the many layers of public and private interests at stake, as well as the dynamic economic and ecological forces at work in the region, the plan should encourage international cooperation, innovative ideas, and greater inclusion of all interested stakeholders, so as to complement official governmental policies and actions.

The Arctic Marine Conservation and Sustainable Development Plan should provide an umbrella that coordinates national and international planning to balance competing economic interests, while maximizing the resilience of natural ecosystems in the region. It should also open the door to a new model of natural resource governance in the Arctic that promotes an ethic of stewardship and multinational use of best management practices. Successful governance in the region will require a capacity to deal with human and natural systems that are complex, heterogeneous, dynamic, and prone to nonlinear and sometimes abrupt changes.

The Arctic Marine Conservation and Sustainable Development Plan. . . should also open the door to a new model of natural resource governance in the Arctic that promotes an ethic of stewardship and multinational use of best management practices.

This is not simply a matter of improving the management of fisheries, paying more attention to the effects of vessel routing, or managing the effects of increased tourism. What is needed is a more holistic and integrated "systems approach" to planning that facilitates analysis of the interactions between multiple natural and human drivers, and directs attention to emergent and cumulative impacts. To be successful under these conditions, management systems must be able to monitor various types of change closely, adjust strategies to changing circumstances, and cope with a relatively high degree of uncertainty (i.e., engage in adaptive management).[5]

High Seas of the Central Arctic Ocean as a Zone of International Scientific Cooperation

Substantial onshore areas of the Arctic enjoy some kind of protected status. Unfortunately this is not the case with the Arctic marine environment, where only a tiny fraction of the ocean is off limits to industrial development. In addition, the Arctic marine environment remains one of the least understood regions of the planet.

The lack of basic scientific information regarding the ecological characteristics of the high seas of the central Arctic Ocean means that informed, science based decisions on whether and where extractive and polluting activities can take place is virtually impossible. The Aspen Commission recommendations therefore call for an agreement to protect the waters of the High Arctic, beyond the Arctic coastal nations' respective exclusive economic zones, as a zone of international scientific cooperation. Such protection could be achieved through establishment of a zone of international scientific cooperation in international waters of the Arctic high seas. For example, in the waters of an Arctic science reserve, new economic activities could be temporarily suspended

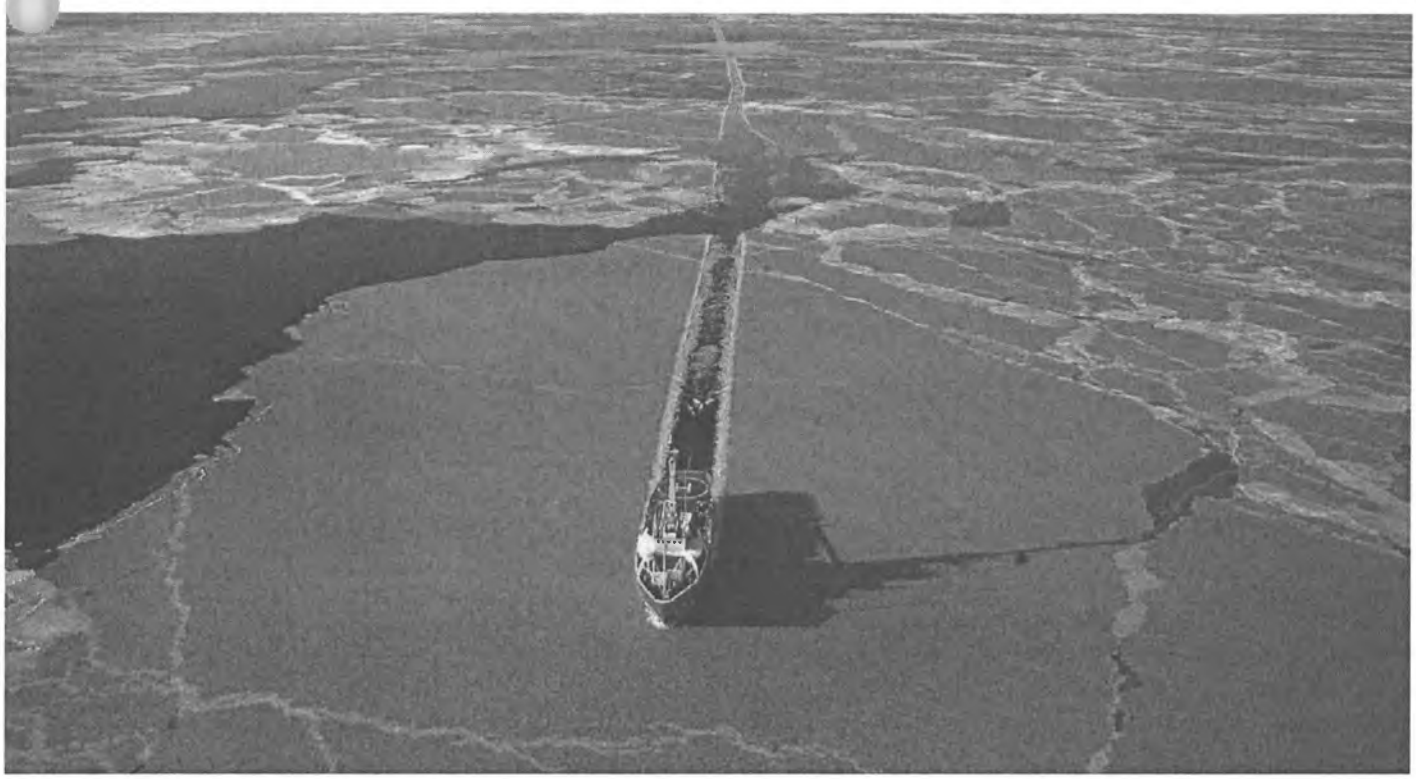
in order to allow scientific understanding of the ecology of the high Arctic and the changes it is undergoing to "catch up" with the pace of warming temperatures, melting summer sea ice and the extraordinary ecological changes underway as a result.

Establishment of an Arctic marine science reserve would encourage necessary international cooperation and development of a science plan to provide both protection and future sustainable use of this area.

Establishment of a zone of international scientific cooperation (i.e., Arctic marine science reserve) would encourage necessary international cooperation and development of a science plan to provide both protection and future sustainable use of this area. This reserve should encompass the water column beyond the jurisdiction of individual nations. It would not cover the seabed, which is subject to a variety of claims by neighboring coastal States that are currently being resolved.

II. ECOSYSTEM-BASED MANAGEMENT AND MARINE SPATIAL PLANNING

The ecosystem-based management (EBM) strategy is an integrated approach, with a goal of maintaining an ecosystem in a healthy, productive and resilient condition. As such, it differs from prevalent, place-based natural resource management strategies that focus on a single species, economic sector, activity or concern.



In fact, many recommendations for such an ecosystem-based approach to marine management in the Arctic already exist and most of the Arctic countries are working to one degree or another to implement EBM within their own marine areas. Norway, Canada and the United States have already embraced an ecosystem-based approach in the Arctic, as has the European Commission. The multilateral Arctic Council has repeatedly called for an ecosystem-based approach to marine management in the region, but as yet there is no truly integrated plan, and no plan yet conceived that speaks to the spatial and temporal scale necessary to understand and cooperatively manage large marine ecosystems and changing climate factors.

In order to overcome this as yet still fragmented management coordination, and to build on nascent attempts at EBM, the Commission calls for the development of a holistic plan that builds on efforts such as The Best Practices in Ecosystem-based Oceans Management in the Arctic[6] (BePOMAr) project of the Arctic Council, which has summarized the practices that Arctic countries have used to apply ecosystems-based management in marine environments, including:[7]

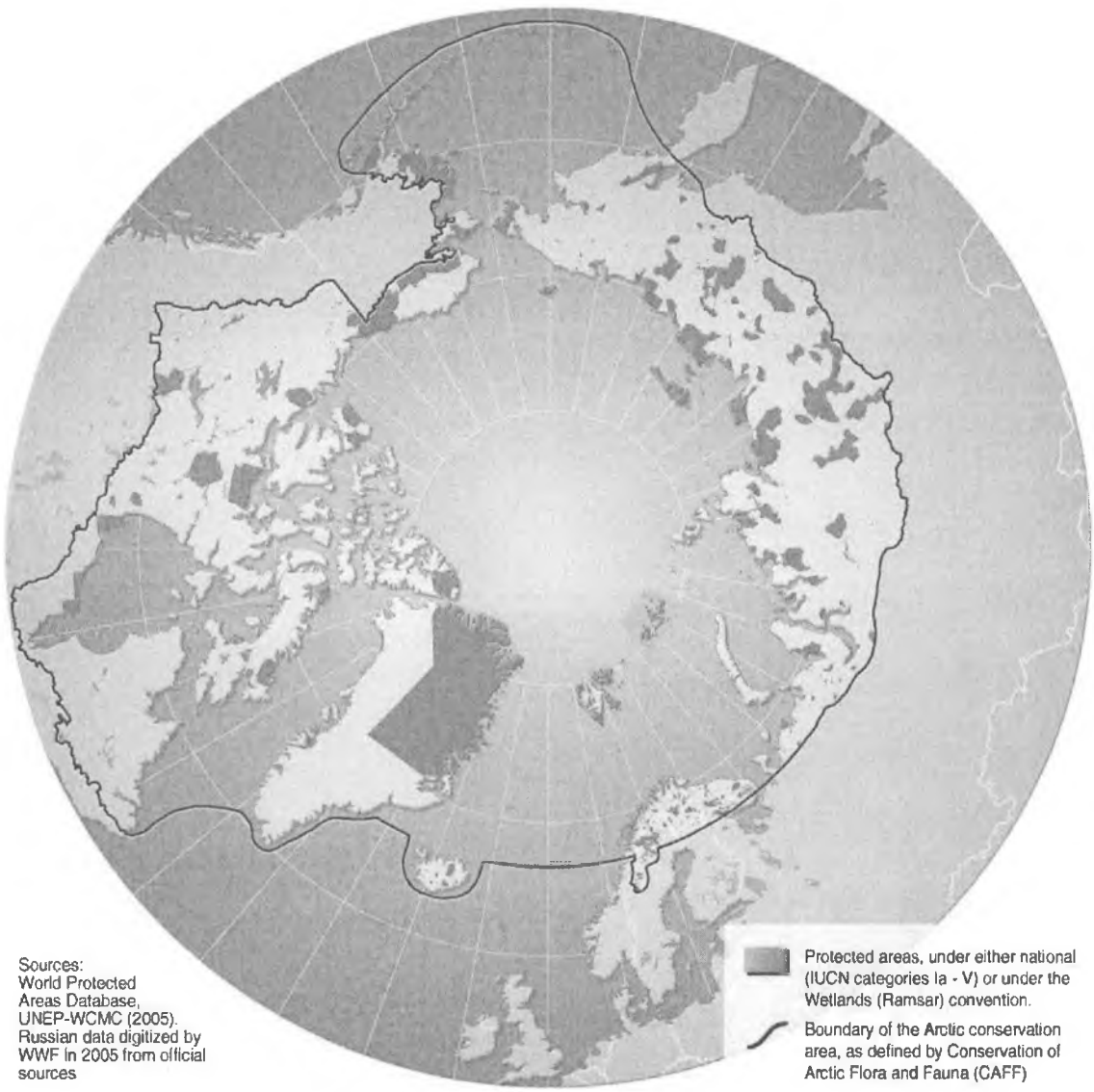
The plan envisioned by the Commission for the Arctic would set forth common objectives across multiple sovereign territories and national boundaries and be implemented by a combination of civil society actors, the private sector, Indigenous Peoples, and governments.

- Integrated and science-based decision-making;
- Flexible application of ecosystem-based oceans management;
- National commitment to effective management;
- Area-based approaches and trans-boundary perspectives;
- Stakeholder and Arctic resident participation;
- An adaptive management approach.

The plan envisioned by the Commission for the Arctic would set forth common objectives across multiple sovereign territories and national boundaries and be implemented by a combination of civil society actors, the private sector, Indigenous Peoples, and governments. It should consider the specific challenges presented by new and expanding economic development of the Arctic in the areas of fisheries; oil, gas and minerals extraction; shipping and tourism; and bio-prospecting. It should lay the groundwork for agreements and standards that foster uniform, international cooperation in regulating these expanding economic activities in a sustainable manner.

Once the Arctic Marine Conservation and Sustainable Development Plan is developed and implemented, its outcomes should be constantly evaluated, based on the identification and monitoring of key biophysical, social, economic and governance indicators. Outcomes of the plan should undergo constant review by all relevant stakeholders and the plan should be adjusted as necessary based on continual monitoring and analysis of changing ecosystem conditions.

Figure 3. *Protected Areas in the Arctic*



The Arctic is a unique region in the world, with very little human activity and vast expanses of tundra and taiga that presents ecological values. This graphic presents the areas that currently are protected for conservation, as recognized by the IUCN in the World Protected Areas Database at UNEP-WCMC, 2005. Some areas, like the Dehcho territory in Canada, have been placed under interim protection. The data for Russia has been updated from national sources, with the assistance of WWF Russia. Note the dearth of marine protected areas, despite their ecological significance and importance to indigenous peoples.[8]

Marine Spatial Planning in the Arctic

As sea ice coverage in the Arctic diminishes over time, the opportunity for various economic activities in the marine environment expands accordingly, most notably in fisheries, oil and gas extraction, shipping, and marine tourism. Failure to plan for holistic, ecosystems-based management of all the various expanding economic activities in the Arctic will almost assuredly lead to regrettable environmental impacts, as well as otherwise preventable disputes or conflicts in proposed uses.

The Arctic marine environment supports unique species and habitats found nowhere else on the planet and may be the basis of future commercialized pharmaceutical, agricultural, industrial or chemical products. An effective Arctic Marine Conservation and Sustainable Development Plan will integrate scientific information and ecosystem-based management principles, as well as identifying and protecting critically sensitive marine areas within all jurisdictions, including areas of high biological productivity and fragile or vulnerable ecosystems, while allocating space to permit sustainable economic development.

Failure to plan for holistic, ecosystems-based management of all the various expanding economic activities in the Arctic will almost assuredly lead to regrettable environmental impacts, as well as otherwise preventable disputes or conflicts in proposed uses.

The past failures of sector-by-sector management in marine areas around the world are well known and documented. Typically, fisheries have been managed separately from oil and gas development, which in turn has been managed separately from marine navigation, etc., despite real and potential conflicts among various uses. Single-sector management has generally failed to resolve incongruent policy goals, rarely dealing explicitly with the inherent trade-offs between various uses—and even more rarely dealing with the compound and cumulative effects of multiple uses on marine environments.

In response, the Arctic Council has repeatedly called for an ecosystem-based approach to marine management, but cooperative action so far has been limited. Most of the Arctic nations are working unilaterally to implement ecosystem-based management of their own marine areas to some degree,[9] but these are essentially disconnected efforts, whereas the Arctic's ecosystem spans across national boundaries (fish, whales and polar bears, for example, migrate without concern for territorial boundaries).

Marine Spatial Planning or "MSP" (more fully developed and applied in Part Two of this report) is an alternative, public process that collects, analyzes, and identifies where human activities occur, in order to achieve agreed upon ecological, economic and social goals. Key features of successful MSP programs include consideration of multiple scales; a long-term perspective; recognition that humans are an integral part of ecosystems; an adaptive management perspective; and concern for sustaining ecosystem goods and services.[10] Some of the potential conflicts that arise from competing uses can be (and have been) avoided or reduced in various ocean environments through MSP, which manages multiple human activities in space and time. [11]

Recently, MSP initiatives have been undertaken in highly used marine areas such as the North Sea, the Baltic Sea, the coastal seas of China, and in large ocean areas such as the exclusive economic zones of Canada, Australia and New Zealand. The new U.S. National Ocean Policy calls for the systematic development of marine spatial plans throughout its entire marine and Great Lakes regions. In the Arctic, Norway has served as an early leader in adopting MSP within its own territory, through its efforts to address environmental conservation and potentially conflicting uses in the Barents Sea. Some grassroots MSP efforts among indigenous communities in Canada also provide examples of a more holistic approach to ecosystems management.

What is needed to promote natural resilience and support sustainable development in the Arctic marine environment is a more coordinated, scientific system that reflects the actual temporal and spatial scales of the Arctic ecosystem and integrates MSP programs internationally, across the region.

What is needed to promote natural resilience and support sustainable development in the Arctic marine environment is a more coordinated, scientific system that reflects the actual temporal and spatial scales of the Arctic ecosystem and integrates MSP programs internationally, across the region. A detailed analysis of just how such a plan might be developed specifically for the Arctic, based on the current state of various ecosystem management programs in the region, is provided in Part II of this report, "Marine Spatial Planning in the Arctic," which was produced at the direction of the Commission. By its nature, the MSP process engenders interaction and cooperation between various economic sectors and the governing bodies that oversee and regulate them. Indeed, in order to be effective, the specific goals and objectives that arise from a cooperative MSP process must have sufficient governing authority backing them up—one of the key attributes of MSP programs that have proved successful thus far in various parts of the world.

Marine Spatial Planning can also be used to consider what appropriate protective measures should be in place. In the Arctic, less than 1% of large marine ecosystems[12] are currently protected, leaving vulnerable areas open to harmful impacts before their potential value is understood. Moreover, there is presently no international mechanism to establish a transboundary network of marine protected areas in the Arctic. While there have been efforts to identify and map ecologically significant marine sites and some important areas have been protected from certain activities[13], designation of protected areas in the ocean generally lags far behind the terrestrial areas of the Arctic, where substantial portions enjoy some type of protected status.[14]

By its nature, the MSP process engenders interaction and cooperation between various economic sectors and the governing bodies that oversee and regulate them.

The need to identify and protect critical Arctic marine habitats is urgent. Establishment of a network of marine protected areas can provide a tangible mechanism to implement the UN Convention of Biological Diversity. Marine protected areas can also provide a barometer for better understanding the impacts of increased human activities in the Arctic marine environment made possible by the accelerating retreat of sea ice. Once economic interests become entrenched, it will be very difficult to protect areas that are subsequently identified as biologically significant.

III. THE NEED FOR AGREEMENT ON COMMON STANDARDS

Although the Arctic is a definable marine environment, it is not a single ecological or political system. It is governed by several sovereign states, each with its own priorities and management systems. Further complicating the situation, the existing fabric of international hard and soft law governing the Arctic developed when ice and extreme cold severely constrained what economic activities people could feasibly pursue. Now, as fishing, shipping, and offshore oil and gas activity is expected to expand, along with advances in technology and diminishing sea ice, important regulatory gaps have been exposed.

In addition to an Arctic marine conservation and sustainable development plan, a number of specific actions should be initiated through the development of agreements or standards that foster consistent implementation among and across Arctic governments.

Most of the new economic activity projected in the Arctic will take place in the coastal zones surrounding the high Arctic, while the resources of these coastal areas are increasingly fragile and stressed by the direct impacts of climate change. The Commission has surveyed the main areas of economic activity occurring in the Arctic, which are likely to continue expanding as sea ice diminishes and new technologies are developed, and has arrived at the following, broadly considered observations and recommendations for each sector:

. . . there should be implementation of international standards governing all phases of new resource development such as offshore oil and gas exploration, development and production, with improved oil-spill prevention and response capabilities assuming first priority.

Oil and Gas

A report issued by the US Geological Survey in 2008 estimated that the Arctic contains as much as 13% of the world's remaining undiscovered oil and 30% of its undiscovered gas. Of these resources, most of the oil is expected to occur offshore.[15] Exploration and development of these resources will involve seismic surveys, drilling, platform construction, pipe laying and the building of processing facilities onshore, in addition to marine and air support, and tanker operations. The key sustainable development issues for the oil and gas industry in the Arctic are potential spills, impacts on biodiversity, and influences on Indigenous Peoples and traditional ways of life.

In order to adequately manage and govern oil and gas development together with other economic activities in the Arctic, the Commission proposes applying best-in-class practices for environmental impact assessment and associated science; comprehensive and inclusive stakeholder engagement; ecosystem-based management; the use of marine spatial planning; and a framework for harmonized offshore operating standards subject to compliance assessment. To that end, there should be implementation of international standards governing all phases of new resource development such as offshore oil and gas exploration, development and production, with improved oil-spill prevention and response capabilities assuming first priority.[16]

Fisheries

Some of the world's largest and most valuable fisheries such as cod, herring and pollock occur in the sub-Arctic and many experts predict these fisheries are likely to move north as the ocean warms and sea ice melts.[17] However, for areas north of the Bering Strait and Svalbard/East Greenland shelf no significant commercial fisheries have yet been established, and no international regimes exist to manage fishing other than in the small portion of the Central Arctic Ocean that lies within the North East Atlantic Fisheries Convention area.[18]

Marine species in the Arctic are also likely to be affected by CO2-related changes that include warming water temperatures, loss of sea ice, changes in salinity due to melting glaciers, and ocean acidification. Fish populations are likely to be affected by expanded economic activities, particularly by fish harvesting and to a lesser extent by offshore oil and gas development, shipping, and tourism—all made possible by receding sea ice. The ecological implications of climate-related impacts on marine species are difficult to assess, but are likely to reverberate in unpredictable ways throughout Arctic marine food webs.

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In accordance with a precautionary approach to new or expanded commercial fishing in the Arctic,[19] the Commission calls on all countries to refrain from authorizing their vessels to take fish where no international regional fishing management organizations exist, until sufficient scientific information is available about the impacts of potential new fisheries on target and non-target species, habitats, ecological relationships and human communities. The Commission also urges that the high Arctic, an area of great scientific uncertainty, be protected as a zone of international cooperative research until better understanding of its geophysical and biological systems can be attained.

Marine Shipping and Tourism

Diminishing sea ice cover is opening the Arctic to expanded intra- and trans-Arctic shipping of all kinds. According to the 2009 Arctic Marine Shipping Assessment, there are roughly 6,000 individual vessels that operate in the Arctic, many making multiple trips, of which a substantial number are fishing vessels. Marine-based tourism is expanding especially rapidly in the Arctic, from 1.2 million cruise ship passengers traveling to Arctic destinations in 2004 to more than double that number in 2007. In Greenland, the number of passengers calling at its ports (22,051) represented almost half the number of Greenland's total population in 2006.[20]

Figure 4. *Vulnerable Areas*

Alarmingly, most of these vessels are not designed to operate in the Arctic and are not ice-strengthened. Retreating summer sea ice is likely to result in increased trans-Arctic and intra-Arctic shipping traffic, bringing with it the risk of groundings, collisions, spills, invasive species, pollutant discharges and underwater noise. Like other types of shipping, marine vessel tourism can significantly affect the environment, but it is not currently subject to uniform, mandatory international environmental standards specific to the Arctic.

Environmental Impact Assessments

Environmental impact assessment of proposed economic activities *prior* to their approval is fundamental to preventing potentially harmful results, but there is currently no international mechanism to assess and mitigate the individual or cumulative effects of human activities affecting transboundary ecosystems or species in the Arctic. In addition, there is no Arctic-wide mechanism to assess activities within the zone of one country that can easily affect transboundary species or ecosystems that are important to others.

Article 206 of the United Nations Convention on the Law of the Sea (UNCLOS) requires, when there are reasonable grounds for believing that planned activities within the jurisdiction or control of a state may cause substantial pollution or significant harmful changes to the marine environment, that state must assess the potential effects of such activities. Thus, Arctic states should implement Article 206, elaborating requirements to conduct environmental impact assessments of individual and cumulative impacts, including those that may have transboundary effects. Such a framework could also incorporate guidance on marine environmental impact assessments beyond national jurisdiction under the auspices of the Convention on Biological Diversity.[21] Further, because impact assessments can vary considerably in their quality and level of detail, a uniform set of standards for conducting environmental impact assessments of activities throughout the Arctic should be adopted.

IV. ARCTIC NETWORKS

There is an obvious demand for more effective means of international teamwork and goal-setting to meet the challenges of Arctic governance brought about by global climate change. In recent years, information, community and "policy networks" have emerged as a means to address governance issues globally. These networks have been possible because of advances in communication information technology—in particular the Internet, "cloud" computing,[22] and social networking applications—and the recognized need and benefits of collaboration across sectors and borders.[23] They have demonstrated promise in addressing some of the world's most complex, intractable political and ecological challenges by promoting use of best management practices and adoption of successful protocols developed by the world's best experts.

The creation of the Landmines Treaty[24] in 1997 and the International Criminal Court (ICC) in 2002 via the Rome Statute were early expressions of this line of thinking. Coalitions of like-minded states combined with NGOs and international organizations such as the Red Cross to overcome the resistance of unresponsive powers in order to create both new norms and new institutions to advance human security objectives. These groups have displayed an impressive ability to mobilize public opinion and put sustained pressure on relevant institutions.

Global environmental governance questions are not limited to the Arctic marine environment or "who" governs according to which national policies, or international laws, but how "governance" is changing and evolves.[25] For example, "Netpolitik"[26]—a nascent reference akin to the concept of "networked governance"—is emerging around the world, wherein diplomacy and international politics are being altered by the power of new actors working together to share ideas and resources in innovative ways.[27] Change on a variety of shared global problems can be mobilized more efficiently as governments and government agencies, civil society groups, international bodies, and groups of individuals work together to effect change. By their nature, this collaborative approach can help narrow down complex issues and present new solutions that spring from fresh and unconventional views on otherwise deadlocked political positions.[28] As opposed to traditional "top-down," command-and-control systems, these new networks involve input from stakeholders at all levels through less formal channels.[29]

> ***"The management of the global issues in an era of growing interdependence, demands innovative governance on our part as the rapid pace of the change in the information flow alters the concept of what we consider information."***
>
> David Bollier
> The Rise of Netpolitik

In the Arctic, networks can be used to build consensus and long-term capacity by directly addressing the newly emerging priorities in the Arctic and seeking to reduce conflict among participants. Such a process should be encouraged through the Arctic Council which is already a model for collaboration. Use of networks would allow for the integration of various levels of government, NGOs, private sector, industry, and Indigenous peoples, and enable different groups to provide their input and

have a role in implementing management goals. Scientists and environmental NGOs, human rights organizations, academic and other relevant institutions can all play a vital role in a policy making for the Arctic. Not only are their areas of expertise key to developing effective policy solutions, they have been on the front lines of the creation of global issues based networks and using the Internet to mobilize change and monitor activities of the private sector and governments. For example, this is a fundamental tenant in applying Marine Spatial Planning throughout the region.

In the Arctic, networks can be used to build consensus and long-term capacity by directly addressing the newly emerging priorities in the Arctic and seeking to reduce conflict among participants. Such a process should be encouraged through the Arctic Council which is already a model for collaboration.

In addition to the use of networks of the world's experts to support cooperative, ecosystem-based management in the Arctic, the Commission urges the development of a dedicated prototypical "Arctic Conservation and Sustainable Development Network" designed around the principles of marine spatial planning, which will map and monitor the ecology and ongoing human activity in the region. The proposed Arctic Network should be organized as an inclusive and cooperative international undertaking so that participation in it—as well as access to its data and analysis—is maximized through an "open source" approach. Through the collection, tracking, linking and dissemination of information and analysis about environmental change and human activity in the Arctic, the long-term goal of the network will be to inhibit unplanned exploitation of natural resources and to identify opportunities for conservation and sustainable economic development in the region.

The prototype of an open-source Arctic observation and information-sharing network should be created and implemented to identify, record and track existing and newly emerging transnational ecological priorities in the Arctic marine environment.

The prototype of an open-source Arctic observation and information-sharing network should be created and implemented to identify, record and track existing and newly emerging transnational ecological priorities in the Arctic marine environment. This network (or networks) should be designed to stimulate policy discussions and help preempt potential use conflicts. The development of an Arctic-wide system of participatory networks should be led by Arctic governments in partnership with universities (i.e., the University of the Arctic) and other civil society and scientific entities. It should encourage equitable participation and employ a communications

strategy that makes clear the implications of its scientific data analysis for public policy decisions.

Scientists and environmental NGOs, academic and other relevant institutions, and human rights organizations will all have important roles to play in an Arctic network as it is envisioned by the Commission. Many of these sectors have already been employing global issues-based social networks to support their missions, using the Internet to mobilize change (e.g., Google Earth), as well as monitoring activities of the private sector and governments. This practical experience will be particularly useful in developing an information network that supports a marine spatial planning process throughout the Arctic.

When effectively instituted with cooperation between the states involved in the framework of the Arctic Council and other civil society entities, a dedicated communications and information regime will make the present governance system all the more holistic, integrated and effective across borders, sectors, and time.

In addition to modern scientific information, information and policy networks should also incorporate input from local communities, as well as the traditional knowledge of Indigenous Peoples, who are keenly aware of their natural environment and often best situated to detect changes in it. In order to fully access and contribute to the network, Indigenous communities should receive the necessary financial and technical support. Indeed, there is an opportunity here for governments and the private sector to support an information technology infrastructure that will allow all stakeholders to fully engage in Arctic governance.

Governments, the private sector and foundations should all commit to investing in an information-sharing network that ensures all stakeholders can effectively participate in the governance process. Support should include training in the use of hardware and software resources; providing equal access to all relevant data and analysis; and creating specific web-based communication and decision-making portals for carrying forward the policy setting, implementation, and course-correction actions called for in the Arctic, as determined by all the interested rights holders and stakeholders, together with government.

While ultimate responsibility for political decisions continues to lie with the executive authority (usually the government), it is also possible to construct incentives for ensuring compliance with a plan through heightened standards of accountability. Through stakeholder involvement increases each stakeholder group's responsibility for their own contributions and makes each one more likely to hold government and other stakeholders accountable for their respective commitments.

When effectively instituted with cooperation between the states involved in the framework of the Arctic Council and other civil society entities, a dedicated communications and information regime will make the present governance system all the more holistic, integrated and effective across borders, sectors, and time. Given the spatial expanse, multiple sovereign territories, and the dimensions of human activity in the Arctic now and in the future, an information-network-driven form of accountability for governance in the region is precisely what is needed to enhance the stewardship of newly emerging adaptation priorities in the Arctic due to climate change.

V. CALL FOR A SPECIAL DIPLOMATIC CONFERENCE ON THE ARCTIC

Achieving integrated, cross-sector ecosystem-based management on an international scale will require a political commitment at the highest levels. The Commission therefore recommends that, no later than 2012, heads of governments of the eight Arctic states convene an international diplomatic conference expressing clear agreement on a commitment to set in motion a ministerial level of action to develop an Arctic Marine Conservation and Sustainable Development Plan.

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Recognizing the rapid and unpredictable changes that are occurring in the Arctic due to climate change and the fact that no adequate governance structure currently exists to address this change, the Commission proposes that the Arctic Governments authorize or otherwise engage the Arctic Council, with dedicated ministerial level and multi-stakeholder involvement, to initiate a five year planning process to develop an Arctic-wide Marine Conservation and Sustainable Development Plan based on integrated ecosystem-based management and a marine spatial planning process. This planning process should be used to define a set of common rules and standards for the Arctic marine environment based on ecosystem sciences, international law and the Law of the Sea, to effectively and sustainably manage human activities and natural resources across territorial boundaries and on the High Seas of the Arctic Ocean. The Commission believes a special diplomatic conference would both promote international cooperation and the importance of the Arctic, as well as seek ways to strengthen the safeguards needed to protect sensitive ecosystems and highly productive marine habitats.

Diplomatic conferences have historically played a key role in Arctic governance. The Ottawa Declaration in 1996, for example, established the Arctic Council as a high-level, intergovernmental forum focused on environmental protection in the region.[30] However, climate change impacts since the Council's founding have forced the need to rethink the direction of governance in the region. The Commission anticipates that a new diplomatic conference can promote the importance of the Arctic as a highly unique ecosystem, as a primary feature of global climate regulation, and as a focus of potentially competing international economic interests.

This high-level diplomatic conference proposed by the Commission will set in motion a more intentional form of multilateral cooperation between governments and civil society aimed at advancing an integrated plan, as well as information networks for conservation and sustainable development in the Arctic. The conference will also act as an international venue to raise global awareness of the importance of the Arctic and the ecological and social disruptions occurring there due to climate change.

VI. THE CRITICAL ROLE AND RIGHTS OF ARCTIC INDIGENOUS PEOPLES

Arctic Indigenous Peoples are not merely another group of stakeholders with an interest in the region; they are *rights-holders* under a number of formal international and domestic mechanisms.[31] Nevertheless, currently their interests are not fully represented in all the relevant governing bodies.

All states should therefore recognize the unique rights of Indigenous Peoples over development of their traditional lands and waters, and provide them with the necessary technical and financial support they need to participate in key policy venues affecting their futures, as avowed in the United Nations Declaration on the Rights of Indigenous Peoples, adopted by General Assembly Resolution 61/295 on 13 September 2007, Article 32, 2 says:

> *"States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources."*[32]

New scientific findings should be communicated to Indigenous Peoples, as they are discovered, and economic benefits flowing from development in the Arctic should be shared equitably by the Indigenous Peoples.

All of the Permanent Participants (PPs) of the Arctic Council presently face thin staffing and a lack of scientific and technical capacity—a situation that will lead to growing difficulties as they participate in ever more demanding Arctic management processes, such as marine spatial planning or Arctic Ocean-wide fisheries management. To effectively engage in the processes affecting their future, these communities need the capacity to preserve their cultural heritage and richness which has made them such effective stewards of Arctic lands and waters for generations.

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In order to foster fuller civic participation among Northern indigenous communities and to ensure that those with the best knowledge of Indigenous Peoples' concerns are brought into the appropriate conversations and decision-making bodies, the capacity of these organizations and communities to participate

in such structures must be increased. Additional support must take the form of increased funding from member states and other sources (perhaps from civil society) as well as increased and/or pooled technical resources.

Some structures already in place may be able to serve the purpose of increased Indigenous participation in governance bodies, but they would require additional support. Linkages with NGOs, universities and other institutions should be explored to provide technical capacity to Indigenous Peoples. Universities in the region might serve as convening bodies, pools of expertise to support monitoring and decision-making, and centers with advanced telecommunications such as videoconferencing systems.

Formal institutions alone, however, will not be enough to ensure Arctic communities can effectively participate in new networked systems. Communications between communities and organizations at all levels must be improved.

The University of the Arctic, for example, was launched in 2001 with the goal of performing a social and cultural development and outreach role in Northern communities. Since then, it has evolved into a virtual network, with less focus on direct community development and more on providing post-secondary educational courses through a network of partner institutions. The university's original charter should be re-examined with a view toward how it can better support participation by Indigenous Peoples in Arctic governance. Its structure could be adapted to provide a long-term institutional communication network, including linguistic translation for non-English speakers and developing programs focused on building the next generation of young indigenous leaders with the skills and capacity to actively engage in future policy decision-making processes.

Some structures within the University of the Arctic could be revised or improved to very directly support networked processes. In particular, its Standing Committee on Ecosystem-Based Management, with its strong membership of indigenous organizations, might be well-placed to initiate Arctic-wide ecosystem-based management planning and activities, if reinvigorated. Formal institutions alone, however, will not be enough to ensure Arctic communities can effectively participate in new networked systems. Communications between communities and organizations at all levels must be improved.

As part of the capacity-building effort for Indigenous Peoples throughout the Arctic, it will be necessary to develop and encourage multiple means of communication, in multiple languages, whether informal channels like radio and TV announcements and web outreach or more formal channels including regular meetings, dialogues and reports. These methods should all be leveraged to complete the circle of information to and from communities.

VII. COLLABORATING ON ARCTIC SCIENCE

In view of the scale of global climate change and the lack of any international agreement on mitigation of its impacts, the need to better understand adaptation with respect to the geophysical and ecological dynamics of Arctic systems has only grown more urgent. But much about the natural ecosystems of the Arctic is still unknown. At the same time, the Arctic remains a remote and expensive place to conduct scientific research, placing a premium on cooperation, coordination of monitoring

efforts, and the sharing of research platforms.

Scientific understanding of fish-population numbers, life history characteristics, spatial distribution, and predator-prey relationships over much of the Arctic is very limited, with the exception of the North East Atlantic fishery. Predicting how CO2-related changes will affect fish is even more difficult, but some experts predict that polar cod, capelin and Greenland halibut populations are likely to decline as their ranges contract, while others are likely to expand into the Arctic.

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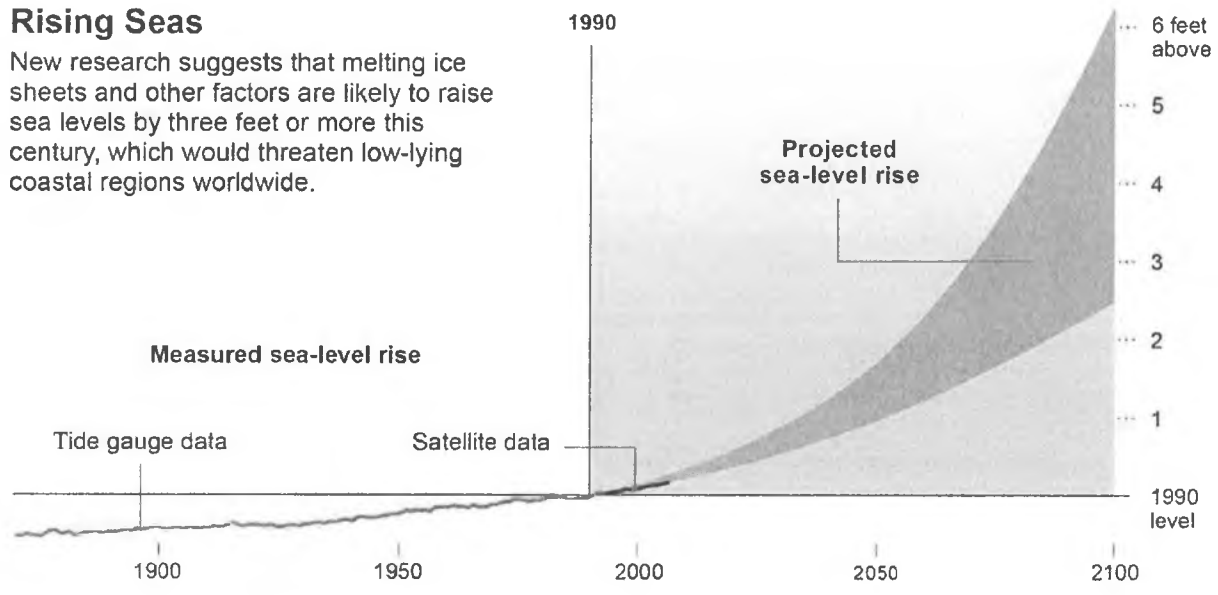
The major limitation to establishing marine protected areas in the Arctic is the relative scarcity of published scientific information on specific marine habitats in the regions that are biologically or ecologically important. In addition, there has never been a coordinated, Arctic-wide effort to tap the enormous reservoir of local knowledge about ecologically and biologically significant marine habitats. The United Nations Convention on the Law of the Sea provides a basic framework for conducting scientific research, but not for allowing access to territorial waters for that specific purpose. Several national policies support international cooperation in this area, yet no international agreement exists to respond to the effects of climate change. Meanwhile, satellites that have provided invaluable tools for scientists studying changes to Arctic glaciers are reaching the end of their useful life, leaving a real void in the ability to continue observing key geophysical phenomena in the region.

In general, funding of scientific research in the Arctic should be prioritized based on specific environmental and development challenges facing policymakers. The effects of climate change on Arctic marine and terrestrial environments should be a primary focus.

One successful model of cooperative scientific research in the region, the International Polar Year (IPY) was a particularly important effort in the development of polar science. Concluded in 2009, it represented a vast investment in science for enhanced understanding of the polar areas and their role in the global climate system in particular. However, with the conclusion of IPY, the level of effort in polar research (the larger share of which went to the Antarctic in any case) has been substantially reduced. A concerted effort is therefore required to maintain momentum in polar science and to build on the legacy of the IPY, whose Sustaining Arctic Observation Network (SAON) should be continued and developed further. Its data and analysis should also contribute to future assessments by IPCC.

Scientific education, recruitment, funding and exchanges are critical to encouraging a culture of understanding across borders and disciplines. Achieving mutual objectives for data sharing, unified monitoring, and access may be possible on the basis of existing technical working relationships, but it is also likely that some important scientific initiatives would benefit from broader, more formal agreements at the regional level.

Figure 2. Rising Seas



Sources: PNAS; Martin Vermeer, Aalto University; Stefan Rahmstorf, Potsdam Institute for Climate Impact Research; NASA; CNES; Center for Remote Sensing of Ice Sheets, University of Kansas

THE NEW YORK TIMES

The Commission therefore urges the development of a series of multilateral memoranda of understanding (MOUs) among Arctic nations to support shared research infrastructure and access to areas of scientific interest in the Arctic. Access to research data and the issuance of research permits should be expanded, as should access to resulting scientific data and analysis. These MOUs will provide a predetermined means of sharing resources such as scientific instruments, personnel, and data, and perform additional services such as contracting mechanisms to facilitate execution of scientific support activities.

Perhaps one of the most obvious strategies for implementing the Commission's proposed recommendations in this report is to reinvigorate the Council as a forum that supports effective, cooperative governance of the circumpolar region with due recognition of the rights of its people.

Traditional knowledge has been a vital component to scientific understanding of Arctic ecosystems for centuries, and Indigenous peoples have been instrumental in a number of recent Arctic Council technical initiatives, such as Arctic Climate Impact Assessment.

In addition to enhancing the University of the Arctic's existing structure, reforms might also aim to create a "bricks and mortar" higher educational system directly in Northern communities. This system could focus on training a new generation of indigenous scientists to respond to the complex challenges of resource conservation, monitoring and management, and sustainable development that lie ahead for Arctic peoples.

In general, funding of scientific research in the Arctic should be prioritized based on specific environmental and development challenges facing policymakers. The effects of climate change on Arctic marine and terrestrial environments should be a primary focus.

VIII. STRENGTHENING THE ARCTIC COUNCIL

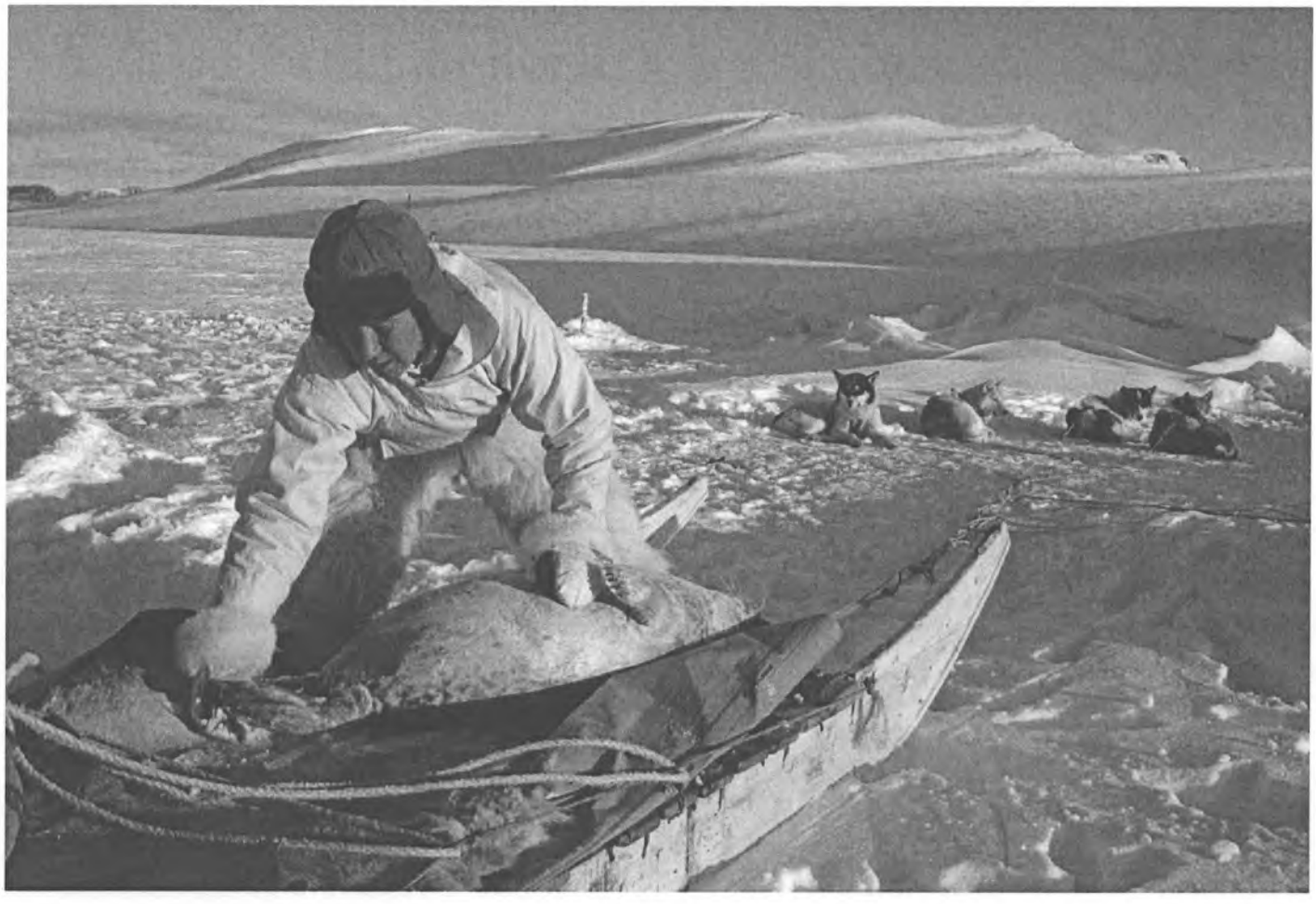
As a result of the fact that a number of Commission participants have worked extensively over the years with the Arctic Council, they were well aware that the Council, from its founding in 1996, represents an historic innovation, both in its structure and operations. The formal inclusion of the six permanent participant (PP) representatives of Indigenous Peoples in the Council, for example, remains a progressive benchmark.

The Arctic Council has embodied a commitment among the eight Arctic nations to cooperate on issues of environmental protection and sustainable development. As such, the spirit in which the Council was founded represents the type of cooperative, collegial, institutional thinking needed now to address new challenges arising from climate change in the Arctic.

The active inclusion of Permanent Participants (PPs) in all future deliberations on Artic governance is paramount, which means a sustainable source of funding must be available for the participation of Indigenous Peoples' Organizations.

Over the years, the Council has focused on critical issues such as widespread chemical contamination caused by persistent organic pollutants (POPs) in Arctic wildlife and human communities, with rigorous scientific assessments leading to recommendations for corrective action by the Arctic governments. Other priorities that have emerged from the Council's cooperative process include the remediation of abandoned hazardous and radioactive waste sites; the enhancement of habitat conservation through protected area strategies; the enhancement of capacity for emergency preparedness and response; improvement of post-secondary educational opportunity in the region; the strengthening of regulation of shipping; improvement of the consistency of regulation of offshore oil and gas activities; development of ecosystem-based management strategies for marine resources; and the improvement of understanding and response to threats related to climate change.

Moving forward, the Council will also need to reconsider how it interacts—both formally and informally—with interests beyond the eight Arctic nations.



The Council also recently conducted a thorough assessment of the impact and management of future shipping in the Arctic Ocean, and has recommended steps to address a number of regulatory gaps in this area. Its recommendations in this area will require the Arctic governments to work in concert with the recognized international shipping regulator, the International Maritime Organization (a coordination effort that inherently adds to the complexity and time needed to reform Arctic shipping regulations).

Despite its notable achievements, the Council is constituted as a forum, rather than a regulatory body in its own right, and therefore has no legal or policy-forming personality to address emerging governance challenges in the region. In recent years, the Council has faced a lack of resources and an increasing tendency among its member countries to bypass it as a forum for discussion and decision. While it remains an important body, issues of real geopolitical significance for the region are increasingly being debated among the Arctic Ocean states outside the purview of the Council. The Arctic nations now appear to be growingly concerned with mapping out their undersea shelves, planting flags at the bottom of the ocean, and arguing over the possession of tiny islands.

The Arctic Council should be reinforced as an effective, multilateral organization for the region by giving it the resources and a revised architecture to ensure that the planning, management and accountability expressed in this report's recommendations are realized. The Council should be given a full-time secretariat and sufficient funding to produce strong results from its working groups and non-Arctic states should be permitted to participate in the Council.

The Arctic Council should be reset as an effective, multilateral organization for the region and given the resources and a revised architecture to ensure that the planning, management and accountability expressed in this report's recommendations are realized. The Council's mandate should be expanded to include discussions of environmental security and it should be given a full-time secretariat and sufficient funding to produce strong results from its working groups. A permanent post of Ambassador for Circumpolar Affairs should be appointed to the Council by each member state (alternatively, Arctic nations should participate in the Arctic Council through senior ministerial-level officials who are empowered to make significant commitments and decisions for their governments) and non-Arctic states should be permitted to participate in the Council as permanent observers.

The active inclusion of Permanent Participants (PPs) in all future deliberations on Artic governance is paramount, which means a sustainable source of funding must be available for the participation of Indigenous Peoples' Organizations. Enhancing their capacity to participate in the Council's forum, by strengthening the PPs technically and financially, along with other indigenous organizations (such as the Indigenous Peoples' Secretariat) and other communities across the Arctic, may be the first, most effective step in this capacity-building process. Moving forward, the Council will also need to reconsider how it interacts—both formally and informally—with interests beyond the eight Arctic nations.

Conclusion: A Hopeful Future For The Arctic

Having extensively, although not entirely, analyzed some of the most difficult and complex challenges facing the Arctic, a unique and remote region that affects the entire globe, the Commission has formulated what it considers the most hopeful and flexible strategies for ensuring the highest degree of resilience and adaptation for the region's societies and ecosystems.

To optimize economic fairness and environmental sustainability in the Arctic, the Commission recommends an enhanced management system that includes linked information networks among all interested stakeholders. This entails a new model of ecosystems management in the Arctic, employing global and regional information networks that promote an ethic of stewardship and multinational use of best management practices, as well as adoption of successful management protocols developed by leading experts from around the world.

A model of transparent governance and open-source information sharing and decision making will complement the existing system of national and international governance mechanisms in the Arctic across traditional boundaries and sectors, enhancing ecological stewardship as new priorities emerge in the region. It will also help empower Indigenous Peoples in the Arctic to adapt socially and economically to the future impacts of climate change, with an appreciation for their ancient connection to the environment and the cultural values they derive from it.

A well-structured and dynamic network of public and private institutions and stakeholder groups will be critical to strengthening management and governance in the Arctic, guided by a defined set of economic, ecological and scientific and cultural objectives that allow for sustainable development. The proposed Arctic network will integrate monitoring, evaluation and reporting processes that consider ecosystem resilience, climate-induced ecological changes, and human activity, as well as a transparent process for establishing planning goals and setting conservation objectives.

It should be noted that stakeholders committed to an improved system of Arctic governance need not wait for governments to take the lead; like-minded groups could begin any time developing networks that strengthen and improve governance in the region. Indigenous Peoples, for example, already have the basis for a network of their own through organizations such as the Inuit Circumpolar Council (ICC) and the University of the Arctic. With sufficient resources and a clear strategy, such as a common approach for initiating large scale marine spatial planning, such existing networks could be interconnected and mobilized to begin playing an active, cooperative role in Arctic governance.

Essentially, what the Commission proposes is a civil society governance model that rapidly synthesizes scientific knowledge and supports effective political decision making through a marine spatial planning process. A network of non-governmental organizations—along with active engagement and support from governments—will help develop fresh and unconventional solutions to the complex scientific and governance challenges facing the Arctic. These creative new alliances will involve partnerships between a broad constellation of actors at all levels of civil society, governments and commercial institutions, not necessarily limited by the traditional concerns of nation states, but sharing ideas and resources in innovative ways, all directed toward preserving what is unique and valuable in the Arctic, and promoting adaptation to the inevitable environmental changes to come.

APPENDIX 1

NOTED ARCTIC EXPERTS INVITED TO SELECTED COMMISSION AND WORKING GROUP MEETINGS

Jack Belcher, PARTNER, **ENERGYNORTHAMERICA LLC**

Paul Berkman, HEAD, **ARCTIC OCEAN GEOPOLITICS PROGRAMME, SCOTT POLAR RESEARCH INSTITUTE, UNIVERSITY OF CAMBRIDGE**

Mike Boots, ASSOCIATE DIRECTOR, **LAND AND WATER ECOSYSTEMS, COUNCIL ON ENVIRONMENTAL QUALITY**

John Crump, POLAR ISSUES COORDINATOR, **UNEP/GRID-ARENDAL**

Hajo Eicken, PROFESSOR OF GEOPHYSICS, **UNIVERSITY OF ALASKA FAIRBANKS**

Chad English, DIRECTOR OF SCIENCE POLICY OUTREACH, **COMPASS**

Bernard Fautrier, VICE-PRESIDENT AND CEO, **PRINCE ALBERT II OF MONACO FOUNDATION**

Paul Gibbard, DIRECTOR, **ABORIGINAL AND CIRCUMPOLAR AFFAIRS, FOREIGN AFFAIRS AND INTERNATIONAL TRADE DEPARTMENT, CANADA**

David Gordon, EXECUTIVE DIRECTOR, **PACIFIC ENVIRONMENT**

Marika Holland, SCIENTIST, **NATIONAL CENTER FOR ATMOSPHERIC RESEARCH**

Maria Ivanova, DIRECTOR, **GLOBAL ENVIRONMENTAL GOVERNANCE PROJECT, CENTER FOR ENVIRONMENTAL LAW AND POLICY, YALE UNIVERSITY**

Brendan Kelly, RESEARCH BIOLOGIST, **NATIONAL MARINE MAMMAL LABORATORY**

Thomas Laughlin, DEPUTY HEAD OF THE GLOBAL MARINE PROGRAMME, **INTERNATIONAL UNION FOR CONSERVATION OF NATURE**

Michael Macrander, SCIENCE TEAM LEAD, ALASKA VENTURE, **SHELL EXPLORATION AND PRODUCTION COMPANY**

Dawn Martin, PRESIDENT, **SEAWEB**

Michael Mehling, PRESIDENT, **ECOLOGIC INSTITUTE**

Petter Meier, COUNSELOR FOR FISHERIES, **NORWEGIAN EMBASSY, WASHINGTON, D.C.**

Kent Satterlee, III, MANAGER REGULATORY POLICY –OFFSHORE UPSTREAM AMERICAS, **SHELL EXPLORATION & PRODUCTION COMPANY**

Rodion Sulyandziga, FIRST VICE-PRESIDENT, **RUSSIAN ASSOCIATION OF INDIGENOUS PEOPLES OF THE NORTH (RAIPON)**

Mead Treadwell, FORMER CHAIR, **U.S. ARCTIC RESEARCH COMMISSION, CURRENT LIEUTENANT GOVERNOR, ALASKA**

APPENDIX 2

COMMISSION MEETINGS AND EVENTS

The following is a list of the meetings convened by the Aspen Institute for the Commission:

- **May 4 - 7 2008:** Formal start of the Dialogue and Commission on Arctic Climate Change and Working Group Meeting - Session I, Aspen, CO
- **July 11 - 18, 2008:** Commission Expedition to the Arctic
- **August 11 – 14, 2008:** Dialogue and Commission on Arctic Climate Change Working Group Meetings with Arctic Parliamentarians; Barrow, AK, residents; and University of Alaska, Fairbanks, scientists to hear their findings and concerns firsthand
- **November 19 – 22, 2008:** Dialogue and Commission on Arctic Climate Change Working Group - Session II, Wye, MD
- **March 5 – 7, 2009:** Dialogue and Commission on Arctic Climate Change Working Group - Session III, Brussels, Belgium; the Commission also participated in the Arctic Transform Meeting entitled "Transatlantic Policy Options for the Marine Environment."
- **April 17 – 18, 2009:** Dialogue and Commission on Arctic Climate Change - Commissioner Meeting, Monaco
- **July 22 – 25, 2009:** Dialogue and Commission on Arctic Climate Change Commissioner Meeting and Working Group - Session IV, Winnipeg, Canada
- **September 22, 2009:** Commission United Nations General Assembly Press Conference featuring remarks by Prince Albert II and selected Commissioners
- **November 12 – 14, 2009:** Dialogue and Commission on Arctic Climate Change Working Group - Session V, Ft. Baker, CA
- **December 3, 2009:** Arctic Workshop, Antarctic Treaty Summit, Washington DC
- **December 11 – 15, 2009:** Informal press event with Prince Albert II and selected Commissioners, COP-15; participation in the WWF "Pole to Pole" Tent
- **February 21 – 24, 2010:** Dialogue and Commission on Arctic Climate Change Working Group - Session VI, Aspen, CO
- **May 17 – 18, 2010:** Dialogue and Commission on Arctic Climate Change Working Group - Session VII, Washington, DC
- **August 1 – 4, 2010:** Dialogue and Commission on Arctic Climate Change Working Group - Session VIII, Ft. Baker, CA
- **August 4 – 6, 2010:** Dialogue and Commission on Arctic Climate Change Working Group Meeting with Indigenous Leaders, Ft. Baker, CA
- **September 20 – 21, 2010:** Dialogue and Commission on Arctic Climate Change Meeting, New York City, NY
- **September 22 – 23, 2010:** International Forum: The Arctic: Territory of Dialogue, hosted by the Royal Geographic Society, Moscow, Russia
- **October 13 – 15, 2010:** NATO Advanced Research Workshop: Environmental Security in the Arctic Ocean, hosted by Scott Polar Research Institute, University of Cambridge
- **October 14 – 15, 2010:** Arctic Futures Symposium, Climate Change, Research and Developing Economic Opportunities, Implications for Policy in the Arctic, Brussels, Belgium

ENDNOTES

[1]The Arctic's Indigenous Peoples are already facing the need to adapt their ways of life as the summer ice pack retreats, resulting in profound implications for their economic and cultural traditions. These changes include impacts on subsistence hunts for marine mammals, with declines of ice-dependent species such as polar bear, walrus, and certain seal species.

[2]National Oceanic and Atmospheric Administration: "Arctic Report Card: Region Continues to Warm at Unprecedented Rate…Record temperatures in Greenland, thinning sea ice, record snow cover decreases and links to some Northern Hemisphere weather are among dramatic changes…" and pullout quote accompanying text: Jane Lubchenco, PhD, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, "The Arctic is an important driver of climate and weather around the world and serves as a critical feeding and breeding ground that supports globally significant populations of birds, mammals and fish." October 21, 2010.

[3]See comparative list of definitions of the Arctic and a commonly used reference map of the Arctic at pp. 12-13.

[4]As a result of the fact that a number of Aspen Commission participants have worked extensively over the years with the Arctic Council, the group was well aware that the council represented an historic innovation, both in its structure and its method of operation. In particular, the formal inclusion of the six "permanent participant" (PP) representatives of Indigenous Peoples in the Arctic region's premier intergovernmental forum remains a progressive benchmark.

[5]Young, Oran, Gail Osherenko, Julia Ekstrom, Larry B. Crowder, John Ogden, James A. Wilson, Jon C. Day, Fanny Douvere, Charles N. Ehler, Karen McLeod, and Robbin Peach. Solving the crisis in ocean governance: place-based management of ocean ecosystems. ENVIRONMENT. Vol. 49, no. 4, May. pp. 20-32 (1997).

[6]The joint SDWG/PAME Best Practices in Ecosystems Based Oceans Management project was initiated by Norway in 2006 and adopted by the Arctic Council's Senior Arctic Official meeting in April 2007, following a startup workshop in February 2007. The objective of the Bepomar project was to present the concepts and practices the Arctic countries have developed for the application of an ecosystem-based approach to oceans management.

[7]Hoel, A.F. (ed.), 2009. Best Practices in Ecosystem-based Oceans Management in the Arctic. Norwegian Polar Institute/Polar Environmental Centre: Tromso, Norway. Report Series 129. 113 p.

[8]Protected areas in the Arctic. (2007). In UNEP/GRID-Arendal Maps and Graphics Library. Retrieved 04:13, January 7, 2011 from http://maps.grida.no/go/graphic/protected-areas-in-the-arctic. p. 17

[9]Yeager, B.B., 2009. Managing towards sustainability in the Arctic: some practical considerations. Zeitschrift für ausländisches öffentliches Recht und Völkerrecht (Heidelberg Journal of International Law, Sonderabdruck aus Band 69, Nr 3. Pp. 567-578.

[10]Arctic Council, 2004. Arctic Marine Strategic Plan. PAME International Secretariat: Akureyri, Iceland. 13 p.

[11]Charles N. Ehler, "Marine Spatial Planning in the Arctic: A First Step Toward Ecosystems-based Management."

[12]NOAA defines "large marine ecosystems" as areas of the ocean characterized by distinct bathymetry, hydrology, productivity and trophic interactions. Annually, LMEs produce 95 percent of the world's fish catch, according to the agency.

[13]For example, Russia recently established a 1.5 million hectare protected area that includes marine portions in Novaya Zemlaya.

[14]http://maps.grida.no/go/graphic/protected-areas-in-the-arctic

[15]U.S. Geological Survey, 2008. Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle

[16]Other key operations subject to standards include the policy for relief wells, handling of solid and liquid discharges, marine sound emissions, air emissions and possible seasonal restrictions (e.g., with respect to marine mammal migration). There are different standards across the arctic for different jurisdictions and operating theatres and it is imperative that industry, regulators and key stakeholders share best practices based on science and prevailing local requirements

[17]On the other hand, polar cod, capelin and Greenland halibut will are likely to see their ranges contract and are expected to decline in abundance. The latter three species play an important role in Arctic ecosystems. Capelin is an important prey species for cod, seabirds and seals. Greenland halibut provides an important source of food for deep feeding marine mammals (narwhals and hooded seals), and sharks. Polar cod is considered a keystone species linking lower trophic levels to seals, whales and seabirds. The ecological implications of climate-related impacts on these species fish are difficult to assess but are likely to reverberate in unpredictable ways up the marine food chain.

[18]Fishing for species that occur solely within waters under the jurisdiction of an Arctic nation is subject to national regulation and control. Fishing for species that occur beyond the jurisdiction of one country typically requires international management. Many global soft and hard law agreements apply to fishing generally, including in the Arctic. These include the Law of the Sea, the UN Fish Stocks Agreement, and various voluntary guidelines and codes of conduct. In addition, there are a number of bilateral or regional fishery management organizations and arrangements (RFMO/As) that apply to fishing in the Arctic south of the Bering Sea and Svalbard.

[19]As per the Final Report of the US Commission on Ocean Policy, a balanced precautionary approach applies "judicious and responsible" management practices, based on the best available science and on "proactive, rather than reactive, policies." When the level of uncertainty is low and the likelihood of damage is also low, the decision to proceed with an activity is supported. At the other extreme, when the level of uncertainty is high and the potential for irreversible damage is also high, activities should not be allowed to proceed. (In actual practice, managers typically face decisions between these two extremes). After a decision to proceed with a certain activity is made, managers must continue to gather information needed to reduce uncertainty, periodically assess the situation, and modify activities as appropriate.

[20]AMSA, 2009, pp. 78, 79.

[21]See "Report of the CBD Expert Workshop on Scientific and Technical Aspects Relevant to Environmental Impact Assessment in Marine Areas Beyond National Jurisdiction." Manila, 18 - 20 November 2009 http://www.cbd.int/doc/meetings/mar/eweiama-01/official/eweiama-01-02-en.pdf

[22][24]"This "cloud" can be regarded as the computational equivalent of the network of telecommunication service providers today, which provide wired and wireless audio and digital communications services. The new cloud for computing will dramatically lower the cost of services and enable mind-numbing increases in interactive collaboration, content creation, and intelligence augmentation." David Bollier, The Rise of Collective Intelligence: Decentralized Co-Creation of Value as a New Paradigm of Commerce and Culture, A Report of the Aspen Institute Roundtable on Information Technology, 2007, p33.

[23]"The Internet has greatly lowered the costs of transmitting information, enabling people to bypass traditional intermediaries whose power revolved around the control of information: national governments, the diplomatic corps, transnational corporations, and news organizations, among others. As a result, nongovernmental organizations (NGOs), academic experts, diasporic ethnic communities, and individuals are using the Internet to create their own global platforms and political influence. As the velocity of information increases and the types of publicly available information diversify, the very architecture of international relations is changing dramatically." David Bollier, The Rise of Netpolitik: How the Internet Is Changing International Politics and Diplomacy, A Report of the Aspen Institute Roundtable on Information Technology, February 2003, p.1.

[24]Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti Personnel Mines and on Their Destruction. Ottawa 1997.

[25]Lloyd Axworthy and Dan Hurley, Networks and the Future of the Arctic. "A new strategy for Arctic governance must therefore encompass a shift in consciousness toward global networks, and recognize that the challenges of the region are not limited to national concerns – and, indeed, that these broader concerns cannot be addressed solely by the governments of nation-states. These are challenges that require broader awareness, international cooperation and innovative ideas…One idea gaining credence as an alternative to the state-centric approach is the notion of network governance."

[26]The Rise of Netpolitik, id at n23

[27]It is imperative at the onset of the consideration for how "networked governance" can be used in the context of Arctic stewardship to recognize the uncertainty and skepticism that this concept elicits. Contrary to what may be gainsaid about networked governance as a way to enhance international policy and regulatory objectives (i.e., networked governance builds accountability where none is present, or enhances governance where it is weak, but it does not displace government), an open source network of information sharing has great potential to complement the existing matrix of overlapping national and international governance mechanisms. Networked governance neither replaces nor substitutes the roles of government, which are based on national and international laws and regulations, including the Law of the Sea.

[28]Annette Heuser, "New Methods of Governance: Networked Governance will decide the competitiveness of states in the future," iPolitics, July/August 2009, pp. 26-31 [translation].

[29]In the case of the Landmines Treaty, Six nongovernmental organizations founded the International Campaign to Ban Landmines in 1992 using a powerful communications network that relied on the cutting-edge technology of the time. About 2,000 groups that were organized in a coordinated network successfully brought international attention to the dangers of abandoned landmines and forced governments to account for their use of the weapons. From that point on, this network focused on the treaty process and on effectively shifting international norms.

[30]The Arctic Council was established by the General Assembly of the United Nations as a high level forum to inter alia "provide a means for promoting cooperation, coordination and interaction among the Arctic states, with the involvement of the Arctic indigenous communities and other Arctic inhabitants on common arctic issues, in particular issues of sustainable development and environmental protection in the Arctic." Declaration on the Establishment of the Arctic Council (Ottawa, Canada, 1996).

[31]The American Declaration of the Rights and Duties of Man ("American Declaration"), Organization of American States (O.A.S.) Res. XXX (1948), reprinted in Basic Documents Pertaining to Human Rights in the Inter-American System, OEA/Ser.L/V/I.4 rev.8 (May 2001) at 16, Preamble); "Both the Inter-American Court and the Inter-American Commission on Human Rights have held that, although originally adopted as a declaration and not as a legally binding treaty, the American Declaration is today a source of international obligations for the OAS member States." Inter-Am. Court H.R., Advisory Opinion OC-10/89, Interpretation of the American Declaration of the Rights and Duties of Man Within the Framework of Article 64 of the American Convention on Human Rights, July 14, 1989, Ser. A. No. 10, at ¶¶ 35, 45 (1989); and United Nations Declaration on the Rights of Indigenous Peoples, Art 8.2(a) – (b).

[32]United Nations Declaration on the Rights of Indigenous Peoples Adopted by General Assembly Resolution 61/295 on 13 September 2007, Article 32. UNDRIP is a Declaration adopted by the General Assembly of the United Nations; a Declaration adopted by the General Assembly reflects the collective views of the United Nations but is not subject to ratification and does not have legally binding status.

PART TWO

MARINE SPATIAL PLANNING IN THE ARCTIC:

A first step toward ecosystem-based management

A technical report of the Aspen Institute
Dialogue and Commission on
Arctic Climate Change

Prepared by Charles N. Ehler, Ocean Visions

This technical report of the Aspen Institute's Dialogue and Commission on Arctic Climate Change was commissioned by the Aspen Institute on behalf of the Commission. The views expressed in this report are those of the author, Charles N. Ehler, and do not necessarily represent the views of the Aspen Institute or any individual member of the Commission. All efforts have been made to ensure accuracy of this report, but the author is ultimately responsible for all inaccuracies in this report.

Executive Summary

Driven by outside economic forces and the effects of climate change, the Arctic, its ecosystems, and its people are faced with substantial change ranging from the loss of ice-dependent species, more intense uses of the Arctic resources, including space, and the loss of natural services provides by Arctic ecosystems. International and national interests in mitigating and adapting to these changes has led to increased calls to manage human activities through an ecosystem-based approach. Marine spatial planning has emerged as an operational approach to translate this concept into management practice in many marine areas around the world.

Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities to specific marine areas to achieve ecological, economic, and social goals and objectives that are specified through a political process. MSP is integrated, future-oriented, participatory, adaptive, ecosystem-based, and area-based. The process of MSP answers three simple questions: (1) where are we today?; (2) where do we want to be?; and (3) how do we get there?

Effective marine spatial planning is a continuous process, not a one-time "master plan", and can only be successful through a highly-participatory networked governance approach, i.e., all who have an interest in the governance of the Arctic are included in all stages throughout the process—from setting goals and specifying measurable objectives, through implementation, monitoring, and evaluation. Monitoring and evaluation of the performance of the MSP process is critical. The performance of management plans and their specific measures should be monitored, evaluated and reported to all stakeholders and rights-holders in a transparent manner.

MSP can provide a variety of environmental, economic and social benefits ranging from identifying biologically and ecologically important areas and identifying the cumulative effects of human activities on the environment, to creating certainty for business investment decisions and streamlining the process to creating new opportunities for local community and citizen participation, including indigenous peoples.

Marine spatial planning is already in place in one Arctic country—Norway has implemented an integrated management plan, including spatial and temporal management measures, for its part of the Barents Sea. The plan integrates previously separate management regimes for fisheries, shipping, oil and gas, and nature conservation. Canada has developed an integrated management plan for its part of the Beaufort Sea that will develop a marine spatial plan as one of its future actions. In the US, the federal government has developed a marine spatial planning framework for its entire exclusive economic zone, including its Arctic seas.

Alternatives for moving MSP forward in the Arctic are identified: (1) a "business as usual", incremental approach; (2) a "bilateral" approach between national governments; (3) a "hot spot" approach; (4) an Arctic-wide approach among national governments; and (5) an Arctic-wide approach beyond national governments.

Introduction

During the course of the deliberations of the Aspen Commission on Arctic Climate Change, marine spatial planning (MSP) assumed a prominent role as a potential tool for meeting natural resource management challenges in the Arctic in the face of growing pressure from various industries, notably energy, minerals and fisheries.

In some ways the Arctic is undoubtedly unique. Yet the changes taking place there will have significant implications for the global community, and the challenges of adaptation for communities and living resources in this remote region may provide important lessons for the future of other regions as well. It became clear to the Commission during their fact-finding missions and deliberations that the scale of change in the region, if not addressed in a suitably comprehensive manner as represented by the MSP approach, would so seriously degrade the Arctic's living systems and so transform the region as to make incremental efforts at adaptation futile.

In parallel with gathering information and views about the changes already underway in the Arctic, the Commission and its working group began a process of reviewing the current institutional framework for management of natural resources in the Arctic, and of exploring models of management approaches that have shown promise in other areas. In reviewing various approaches to the management of marine systems over the past half-century, the participants in the dialogue became convinced that sector-based regulation as traditionally practiced has not shown success in protecting the integrity of marine ecosystems, and would not likely prevent the degradation of the Arctic. With the able assistance of a number of experts, including Jane Lubchenco (now the Administrator of the U.S. National Oceanic and Atmospheric Administration (NOAA)) and Andy Rosenberg (Senior Vice-President for Science and Knowledge at Conservation International), the Commission explored models of integrated marine management that could be applied in the Arctic.

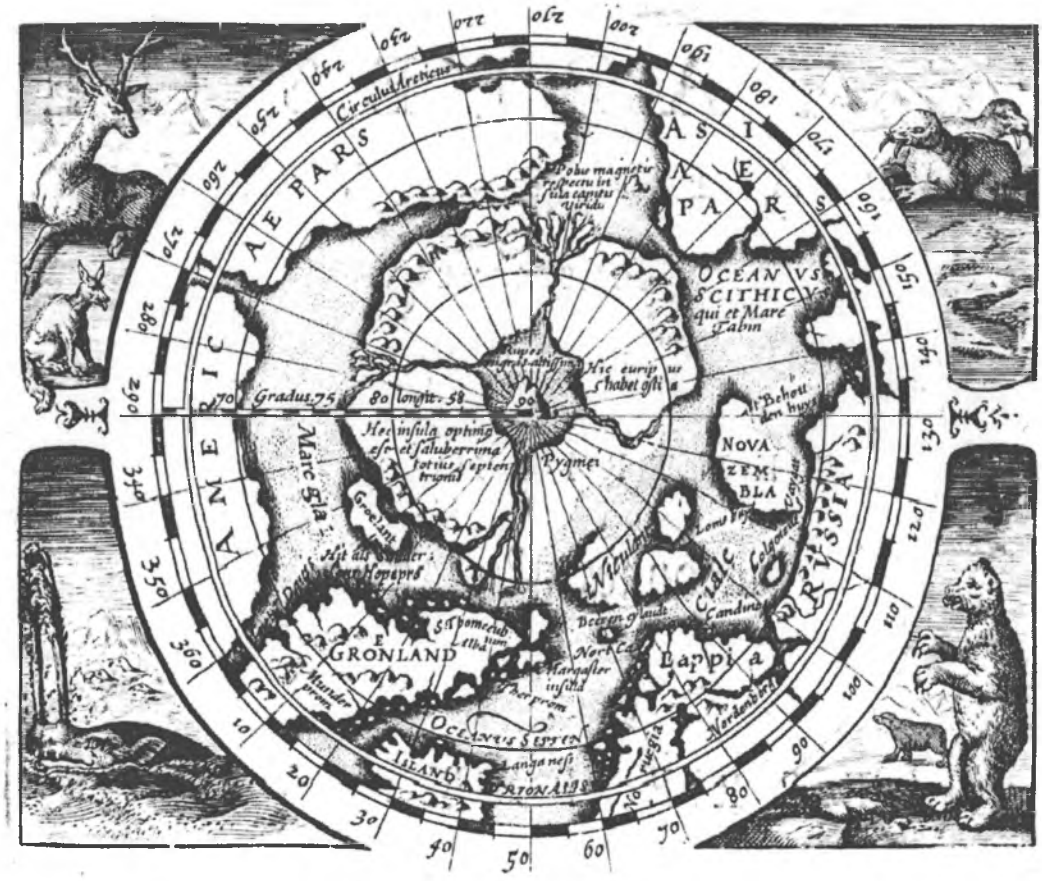
Dialogue participants recognized that most of the new economic activity projected in the Arctic maritime environment will take place in the coastal zones surrounding the high Arctic, and that the resources of these coastal areas are increasingly fragile and stressed by the direct impacts of climate change. They focused on the potential for ecosystem-based management, and integrated marine spatial planning, to ensure rational and sustainable use of this fragile resource base. A second feature of this planning approach further heightened its attractiveness—its accessibility to, and in fact, its reliance on the expert contribution of communities and local stakeholders. It is a premise of this report that the conservation and sustainable use of the resources of the Arctic marine environment should be conducted in a manner that benefits the local communities of the region, and most particularly the traditional communities that have co-existed in the Arctic environment for thousands of years. There is a clear need for traditional and indigenous communities to have a voice in decisions affecting their future, and it is hoped that an integrated planning approach such as the one outlined in this paper will contribute a useful framework for this participation in the future.

Context and Perspective

While parts of the Arctic have been inhabited for over 10,000 years, many parts have never been inhabited. If any of the early inhabitants drew maps, none have survived. Until 500 years ago, the Arctic was unknown to Western man—simply a white space on maps. Total open water, all land, land with rivers and magnetic mountains—all were conceptions of the Arctic.[1] A voyage by Sebastian Cabot to somewhere in the Davis Strait in 1508-09 was probably responsible for the first depiction of a Northwest Passage to the riches of China on a map. Cabot, in 1553 the Pilot Major of England, also recommended that the English search northeast for a passage to China. Over the next 450 years attempts in both directions by the English, Spanish, Portuguese, and Dutch failed. The Northwest Passage (Oslo, Norway, to Nome, Alaska) was finally achieved in 1905 by the Norwegian explorer Roald Amundsen in a refitted herring boat, the Gjoa. The first Northeast Passage (Vladivostok to Arkhangel'sk) was made by two Russian ice-breaking survey ships only in 1915.

Our knowledge of the Arctic has evolved rapidly in the last 100 years as technology has advanced. Theories of an ice-free open polar sea did not die until the 1870s, yet these were still as much guesswork as 16th century theories of an ice-free Arctic and a clear passage over the Pole. Now, because of climate change, the reality of an ice-free Arctic may not be so far away.

Figure 1. *Petrus Bertius, 1618. North Polar Regions (note that four rivers flow out from a polar mountain)*



The Need for an Ecosystem-based Approach to Marine Planning and Management in the Arctic

The Arctic—all 30 million square kilometers of it—is one of the most pristine, yet vulnerable, ecosystems in the world. [2] Protected by its historic inaccessibility, harsh environment, comparatively small human population, and slow rate of economic development, the Arctic has been relatively less affected by human activity than most other regions of the earth.

This is about to change. Driven by outside economic forces and the effects of climate change, the Arctic, its ecosystems, and its people are all faced with substantial change ranging from the loss of ice-dependent species, more intense human uses of the Arctic, and the loss of natural services provided by Arctic ecosystems. As the Arctic warms, its ice melts, and its ecosystems change, as technology improves, and as the demand for natural resources increases, opportunities open up for industry—shorter shipping routes, virgin fishing grounds, new areas of oil and gas exploration and development, and new places for commercial tourism. As well as business opportunities, these changes represent new risks to the Arctic's unique natural environment and to the people who now live and work in the Arctic. Once these activities begin in the Arctic, it will be difficult for policy makers and managers to put limits on them.

The failure of sectoral management in marine areas everywhere is long known and well documented. Before the last century, the oceans were used mainly for two purposes: navigation and fishing. Conflicts between uses were few and far between except around some ports. Traditionally marine management has been characterized as a sector-by-sector approach. Fisheries were managed separately from oil and gas development, which in turn was managed separately from marine navigation, despite real conflicts between uses. [3] Single-sector management has often failed to resolve these user-user conflicts, rarely dealing explicitly with trade-offs among uses, and even more rarely dealing with conflicts between the cumulative effects of multiple uses and the marine environment. New uses of marine areas including renewable energy, offshore aquaculture, and marine tourism, as well as the designation of new marine protected areas, have only exacerbated the situation. Single-sector management has also tended to reduce and dissipate the effect of enforcement at sea because of the scope and geographic coverage involved and the environmental conditions in which monitoring and enforcement have to operate. In sharp contrast to the land, little "public policing" of human activities takes place at sea.

As a consequence marine ecosystems around the world are in trouble. Both the severity and scale of impact on marine ecosystems—from climate change, biodiversity loss, pollution, development, habitat loss, and fragmentation—are increasing, with no corner of the world left untouched.[4,5] Awareness is growing that the ongoing degradation in marine ecosystems is in large part a failure of governance.[6,7] Many scientists and policy analysts have advo¬cated reforms centered on the idea of ecosystem-based management (EBM). [8] To date, however, a feasible method for translating this concept into an operational management practice has not emerged.

Many recommendations for an ecosystem-based approach to marine management in the Arctic already exist. In fact, in most Arctic countries are working to implement ecosystem-based management of their marine areas. The Arctic Council has repeatedly called for an ecosystem-based approach to marine management. For example, in its 2004 Arctic Marine Strategic Plan ecosystem-based management is defined as an approach that "...requires that development activities be coordinated in a way that minimizes their impact on the environment and integrates thinking across environmental, socio-economic, political

and sectoral realms." The key features of this approach includes a consideration of multiple scales, a long-term perspective, the recognition that humans are an integral part of ecosystems, an adaptive management perspective, and a concern for sustaining production and consumption potential for goods and services. [9]

The Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr) Project of the Arctic Council has summarized the practices that Arctic countries have used to apply an ecosystems-based management approach to marine management. [10] The conclusions of that project include:

- Flexible application of effective ecosystem-based oceans management;
- Decision-making must be integrated and science based;
- National commitment is required for effective management;
- Area-based approaches and trans-boundary perspectives are necessary;
- Stakeholder and Arctic resident participation is a key element; and
- Adaptive management is critical.

Successful ocean governance requires a capacity to deal with human and natural systems that are complex, heterogeneous, dynamic, and prone to nonlinear and often abrupt changes. This is not simply a matter of improving the management of fisheries, paying more attention to the effects of vessel routing, or managing the effects of increased tourism. What is needed is a "systems approach" that facilitates thinking about interactions among multiple natural and human drivers and directs attention to emergent and cumulative impacts from these interactions. To be successful under these conditions, governance systems must be able to monitor changes closely, adjust existing management action to changing circumstances, and cope with relatively high levels of uncertainty, i.e., they must engage in adaptive management. Feedback—in the form of monitoring information that informs management about the reactions of the managed systems to external influences and management measures—is critical to adaptation and success under these conditions. [11]

The thinking that underlies marine spatial planning is one that emphasizes spatially and temporally explicit activities and dynamic processes. It recognizes the heterogeneous distribution of marine species, habitats, and human activities in the sea; resources and resource uses occur in "places." Some are fixed in place, e.g., oil deposits; some are mobile, e.g., fish populations. Some places are more important than others. Relatively dense information about the direct effects of human actions upon the interacting elements of the system, whether measured or not, is likely to be found near the occurrence of those activities. Over time, the effect of any activity spreads and often dissipates and, consequently, becomes more difficult to isolate and measure. Management that operates at the scale where dense and direct information about the impact of a particular activity is available enhances the prospect of capturing useful and less costly feedback. If carried out at the same time the management agency is monitoring other elements of the system, such feedback becomes even more valuable. Such improvements can lead to more rapid adaptation and more effective learning about how to govern. [12]

Box 1. A Definition of Ecosystem-based Management

Offshore Oil and Gas Guidelines (2009 version; ANNEX A - Definition of the Arctic)

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors.

Specifically, ecosystem-based management:

- emphasizes the protection of ecosystem structure, functioning, and key processes;
- is place-based in focusing on a specific ecosystem and the range of activities affecting it;
- explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species;
- acknowledges interconnectedness among systems, such as between air, land and sea; and
- integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences.

Scientific Consensus Statement on
Marine Ecosystem-Based Management, 2005 [13]

An integrated, ecosystem-based management approach has been identified in many marine places as an appropriate evolution to address problems caused by today's incremental, single-sector approach to marine management. However, examples of practical applications of an ecosystem-based approach are elusive. How to begin is the first challenge.

As mentioned, several Arctic nations have already begun to implement an ecosystem-based approach to their marine waters. [14] Both Norway in the Barents Sea and Canada in the Beaufort Sea have developed integrated management plans that employ an ecosystem-based approach (see later section of this report). A policy directive of the United States instructs appropriate federal departments to "pursue marine ecosystem-based management in the Arctic." [15] A more recent initiative by the U.S. to develop and implement an ocean policy and framework for marine spatial planning throughout its exclusive economic zone also supports adoption of "ecosystem-based management as a guiding principle, acknowledging regional differences, and practicing adaptive management." It also concludes that "human activities that may affect ocean, coastal, and Great Lakes ecosystems should be managed using ecosystem-based management and adaptive management, through an integrated framework that accounts for the interdependence of the land, air, water, ice, and the interconnectedness between human populations and these environments. Management should include monitoring and have the flexibility to adapt to evolving knowledge and understanding, changes in the global environment, and emerging uses." [16]

However, a large gap exists between the concepts of ecosystem-based management and its implementation. [17] Scientists characterize EBM differently than governmental agencies planning to manage coastal and marine ecosystems. In practice management objectives and measures tend to miss critical ecological and human factors emphasized in the academic

literature. While managers are beginning to put some EBM principles into practice, implementation needs to be much more thorough. The degree to which specific EBM criteria are translated from definitions to management actions is extremely variable in reality. In both science and management we lack a clear approach or toolkit for implementing EBM. Tools for traditional, single-species management are available and widely used, but explicit approaches are still needed to successfully conduct EBM. *Marine spatial planning is one important, practical approach to begin implementing EBM.*

What Is Marine Spatial Planning?

Marine spatial planning (MSP) is a practical way to create and establish a more rational approach to the human use of marine space and the interactions between its uses, to balance demands for development with the need to protect marine ecosystems, and to achieve social and economic objectives in an open and planned way.

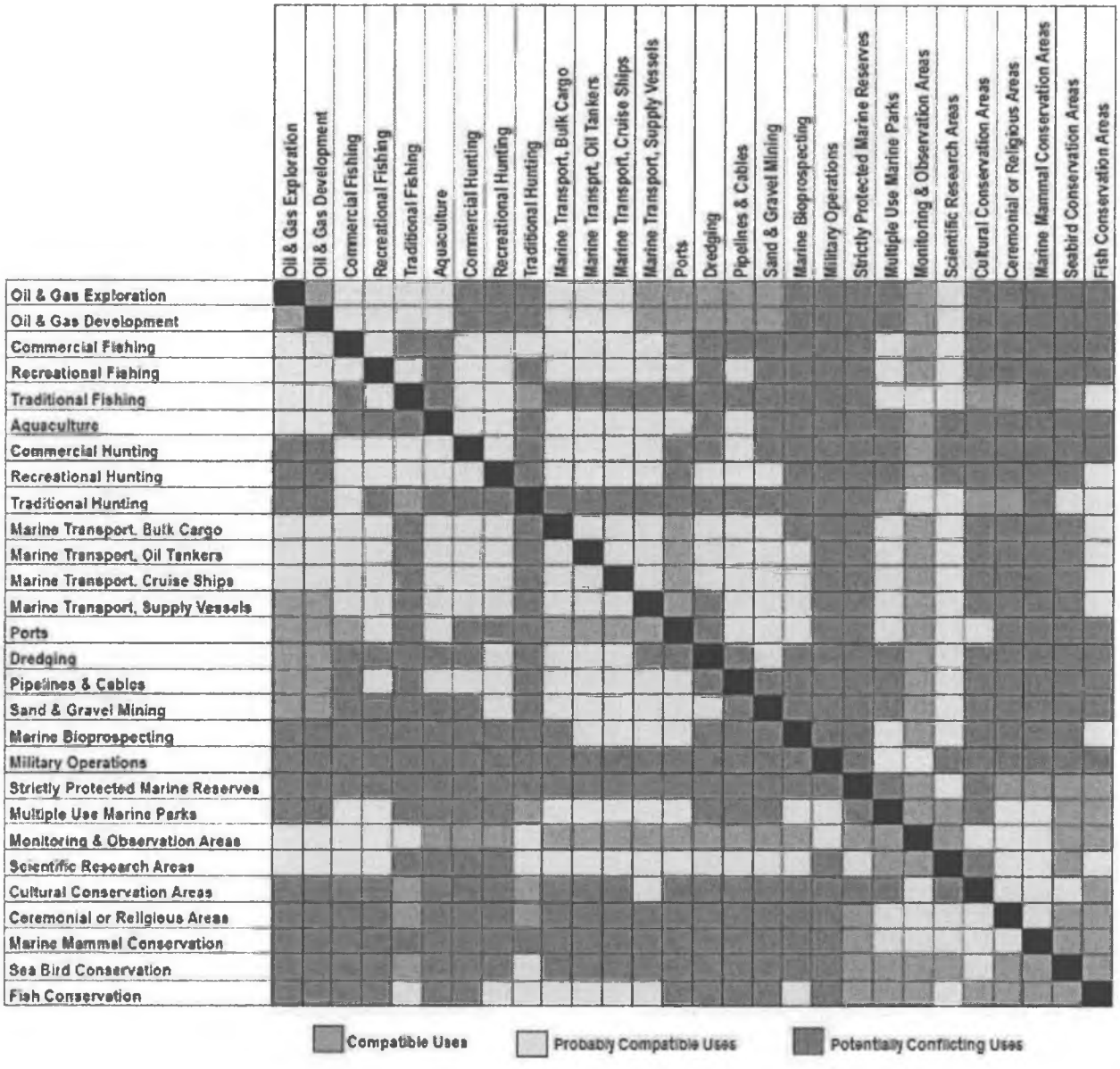
Recent research has estimated the cumulative impacts of human offshore activities on the marine environment at a global scale and concluded that almost half of the world's oceans are strongly affected by multiple stresses. Highly affected regions include the Eastern Caribbean, the North Sea, and Japanese waters. Only a few areas around the North and South poles remain relatively unaffected by human activities. Negative cumulative impacts of human activities on coastal and marine ecosystems would probably be higher if historical effects, unreported extraction, recreational use (including fishing), disease, and point-source pollution were incorporated in future measurements. [18]

Ocean resources are limited both in space and abundance and the pressure on the marine environment, resulting from an expansion of existing uses and the rise of new ones, has been detrimental to many places. Essentially, increased activity in the marine environment has led to two important types of conflict. First, not all uses are compatible with one another and are competing for ocean space or have adverse effects on each other (*user vs. user conflicts*). Numerous examples exist of conflicts between ocean users both globally and locally and include, for example, incompatibilities between the fast-growing, billion-dollar submarine cable industry and fisheries, causing damage to, or loss of, fishing gear or huge repair costs and lost revenues for cable disruptions. [19] Other user conflicts include wind farms located near shipping routes or traffic separation schemes, causing high risks of collisions and loss of cargo. In New Zealand, spatial conflicts have arisen from legislative obligations to uphold the historic and indigenous rights of fishers with more recent obligations toward nature conservation. [20]

Spatial use conflicts also occur within one particular use and refer, for example, to the use of different gear types for fisheries in certain areas, or the competition over use of space between commercial, recreational, and subsistence fisheries. Studies in California have illustrated that new commercial ocean activities will only exacerbate conflicts between users. [21]

Second, not all uses are compatible with the needs of a healthy and sustainable environment and cause conflicts between users and the environment (*user vs. environment conflicts*). Too often, ocean uses are located in sensitive biological and ecological areas with little or no consideration of their impact. Many scientific studies document the degradation of the world's oceans, the decline of marine ecosystems, and the collapse of important fish species, illustrating that this is increasingly impairing the ocean's ability to produce the goods and services essential for life on Earth. [22]

Figure 2. A Preliminary Identification of Potential Use Compatibilities and Conflicts in the Arctic [23]



Many of the conflicts described above can and have been avoided or reduced through marine spatial planning by influencing the location of human activities in space and time. During recent years, marine spatial planning has become increasingly important as a way to make ecosystem-based management[24] a reality in coastal and marine environments.[25] While concepts regarding ecosystem-based management are often considered too broad, too abstract and too complex to enable effective implementation,[26] MSP has proven to be a way to make this process more tangible.[27] Innovative and successful initiatives

Box 2. A Definition of Marine Spatial Planning

Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social goals and objectives that are usually specified through a political process. Its characteristics include:

1. integrated across economic sectors and governmental agencies, and among levels of government;
2. strategic and future-oriented, focused on the long-term;
3. participatory, including stakeholders actively in the process;
4. adaptive, capable of learning by doing;
5. ecosystem-based, balancing ecological, economic, social, and cultural goals and objectives toward sustainable development and the maintenance of ecosystem services;
6. place-based or area-based, i.e., integrated management of all human activities within a spatially demarcated area identified through ecological, socio-economic, and jurisdictional considerations.

Ehler and Douvere, 2007. Visions for a Sea Change [28]

toward the development and implementation of ecosystem-based marine spatial planning have been taken in both highly-used marine areas such as the North Sea, the Baltic Sea, the coastal seas of China, and in large ocean areas such as the exclusive economic zones of Canada, Australia and New Zealand.

It is important to remember that we can only plan and manage human activities in marine areas, not marine ecosystems or components of ecosystems. We can allocate human activities to specific marine areas *by objective*, e.g., development areas or conservation areas, or *by specific uses*, e.g., oil and gas development, offshore aquaculture, or sand and gravel mining.

MSP does not produce a one-time plan. It is a continuing, iterative process that learns and adapts over time. It is comprised of three continuing processes:

1. **Plan-making**, or generating and adopting one or more integrated plans or policy frameworks that have strong spatial dimensions, for the protection, enhancement, and sustainable use of development of a marine area and its resources;
2. **Plan implementation**, including the execution of programmed works or investments, enabling change, encouraging improvement, and through regulation and enforcement of proposed changes and ongoing activities in, on, or over and under the sea, in accordance with the plans; and
3. **Monitoring and evaluation of plan performance**, or assessing the effectiveness of the plans, their time scales and implementation incentives, considering ways in which they need to be improved and establishing review and adaptation procedures.[29]

Box 3. Ten Steps of Marine Spatial Planning

The development and implementation of MSP involves a number of steps, including:

1. Identifying need and establishing authority;
2. Obtaining financial support;
3. Organizing the process through pre-planning;
4. Organizing stakeholder participation;
5. Defining and analyzing existing conditions;
6. Defining and analyzing future conditions;
7. Preparing and approving the spatial management plan;
8. Implementing and enforcing the spatial management plan;
9. Monitoring and evaluating performance; and
10. Adapting the marine spatial management process.

Ehler and Douvere, 2009 [30]

These 10 steps are not simply a linear process that moves sequentially from step to step. Many feedback loops should be built into the process. For example, goals and objectives identified early in the planning process are likely to be modified as costs and benefits of different management measures are identified later in the planning process. Analyses of existing and future conditions will change as new information is identified and incorporated in the planning process. Stakeholder participation will change the planning process as it develops over time. Planning is a dynamic process and planners (and stakeholders) have to be open to accommodating changes as the process evolves over time. Comprehensive MSP provides an integrated framework for management that provides a guide for, but does not replace, single-sector management. For example, MSP can provide important contextual information for guiding marine protected area management or for fisheries management, but does not replace it.

MSP answers three simple questions:

- **Where are we today?** What are the baseline conditions?
- **Where do we want to be?** What are the alternative spatial scenarios of the future? What is the desired vision?
- **How do we get there?** What spatial management measures move us toward the desired future?

MSP does not address all of the management measures that would be included in a comprehensive, integrated marine management plan—*only those management measures that specify where in space and when in time human activities should occur.* Other categories of management measures (Table 1) include:

- **Input measures**, or measures that specify the inputs to human activities in marine areas, such as limitation on the number of boats allowed to fish in a particular area;
- **Process measures**, or measures that specify the nature of the production process of human activities in marine areas, such as standards for "best environmental practices", the labeling or certification of the products and services of sustainable human activities, and codes of conduct; and
- **Output measures**, or measures that specify the outputs of human activities in marine areas, such as limitations on the amount to gravel extracted for the construction of artificial islands or causeways.

Table 1. Examples of Marine Management Measures

Input Measures	Output Measures
Management measures that specify the inputs to human activities in marine areas	Management measures that specify the outputs of human activities in marine areas
Limitation on fishing activity or capacity, e.g., number of vessels allowed to fish in the marine area	Limitation of the amount of pollutants discharged to a marine area from industrial sources, both onshore and offshore
Limitation on shipping vessel size or horsepower	Limitation on ballast water discharges, including alien species and pathogens, from marine transportation
Limitation on number of cruise ships operating in the marine area	Limitation on allowable catch within the marine area
Ship construction standards, e.g., special standards for vessels operating in Arctic waters	Limitation on allowable by-catch within a marine area
Other measures	Limitation on sand and gravel extraction within the marine area
	Other measures
Process Measures	**Spatial/Temporal Measures**
Management measures that specify the nature of the production process of human activities in marine areas	Management measures that specify where in space and when in time human activities can occur in marine areas or zones
Specification of fishing gear, mesh size, etc.	Specification of areas or zones for specific activities, e.g., commercial fishing, indigenous fishing and hunting, oil and gas development, sand extraction, marine transportation, cables and pipelines, military operations—all of the time
Specification of "best available technology" or "best environmental practice"	Specification of areas or zones closed to specific activities, e.g., commercial fishing, oil and gas development, sand extraction, cables and pipelines—all of the time
Standards for ice navigators and for safety and survival for seafarers in polar conditions	Specification of areas or zones open for specific activities, e.g., commercial fishing, oil and gas development, sand extraction, cruise ships, military operations—during specific times
Improved marine charts, aids to navigation, and other marine services	Specification of areas or zones closed to specific activities, e.g., commercial fishing, oil and gas development, sand and gravel extraction, cruise ships—during specific times, seasonal limitations on oil development operations
Increased search and rescue services	Specification of areas or zones closed to all development—all of the time, e.g., strictly protected areas, research areas, no-take, no impact areas
Improved spill response services, e.g., pre-positioning of equipment	Specification of areas or zones open to all development—all of the time, e.g., multiple use areas
Industry codes of practice or conduct	Designation of security zones, precautionary areas, safety zones
Other measures	Designation of critical habitat, environmentally or ecologically sensitive areas
	Designation of a Particularly Sensitive Sea Area (PSSA)
	Limiting activities in areas adjacent to cultural, spiritual, and archeological sites
	Special protection measures for areas of the high seas
	Other measures

Table 2. Benefits of Marine Spatial Planning

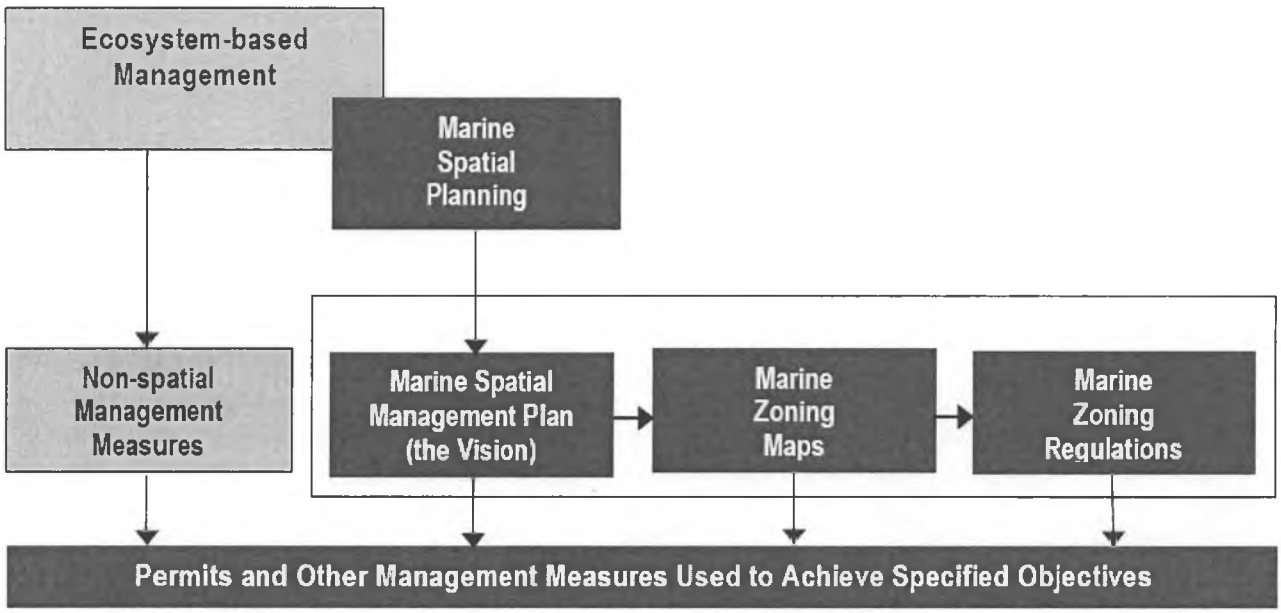
Ecological/environmental benefits	Identification of biological and ecological important areas as a basis for space allocation
	Incorporation of biodiversity objectives into planning and decision-making
	Identification and reduction of conflicts between human use and nature
	Ensures space for biodiversity and nature conservation
	Establish context for planning a network of marine protected areas
	Identification and reduction of the cumulative effects of human activities on marine ecosystems
Economic benefits	Greater certainty of access to desirable areas for new private sector investments, frequently amortized over 20-30 years
	Identification of compatible uses within the same area for development
	Identification and early resolution of conflicts between incompatible uses
	Improved capacity to plan for new and changing human activities, including emerging technologies and their associated effects
	Promotion of the efficient use of resources and space
	Streamlining and transparency in permit and licensing procedures
	Resolution of conflicts at planning level instead of individual project review
	Enables government, industry, and NGOs to work together to identify suitable locations for development and to identify areas where environmental values need to be protected and conservation should take precedence
Social benefits	Improved opportunities for local community and citizen participation
	Identification of effects of decisions on the allocation of ocean space (e.g., closure areas for certain uses, protected areas) on communities
	Identification and improved protection of cultural heritage
	Identification and preservation of social, cultural, and spiritual values related to ocean use
Administrative benefits	Improve consistency and compatibility of regulatory decisions
	Improve information collection, storage and retrieval, access, and sharing
	Improve integration and reduce duplication of effort and its associated waste of resources
	Improve speed, quality, accountability, and transparency of decision making, and reduction of regulatory costs

Modified from Ehler & Douvere (2009) and Tyldesley (2004)

What Are the Outputs of Marine Spatial Planning?

The principal output of MSP is a comprehensive spatial management plan (Figure 2) for a marine area or ecosystem. The plan moves the whole system toward a "vision for the future". It sets out priorities for the area and—more importantly—defines what these priorities mean in time and space. Typically, a comprehensive spatial management plan has a 10- to 20-year horizon and reflects political and social priorities for the area. The comprehensive marine spatial plan is usually implemented through a zoning map(s), zoning regulations, and/or a permit system similarly to a comprehensive regional plan on land. Individual permit decisions made within individual sectors (for example, the fisheries, or oil and gas, or tourism sectors) should be based on the zoning maps and regulations.

Figure 3. *The Outputs of Marine Spatial Planning*



Why Is Stakeholder Participation Critical to Marine Spatial Planning?

Involving key stakeholders in the development of MSP is essential for a number of reasons. Of these, the most important is because MSP aims to achieve multiple objectives (social, economic and ecological) and should therefore reflect as many expectations, opportunities or conflicts that are occurring in the MSP area. The scope and extent of stakeholder involvement differs greatly from country to country and is often culturally influenced. The level of stakeholder involvement will largely depend on the legal or cultural requirements for participation that often exist in each country.

Generally speaking, all individuals, groups or organizations that are in one way or another affected, involved or interested in MSP can be considered stakeholders. However, involving too many stakeholders at the wrong moment or in the wrong form can be very time consuming and can distract resources from the expected or anticipated result. To involve stakeholders effectively (e.g., leading toward expected results) and efficiently (e.g., producing expected results at least-cost), three questions should be asked:

- Who should be involved?
- When should stakeholders be involved?
- How should stakeholders be involved?

Where no legal obligations exist, it is important to define what type of stakeholder participation will be most suitable for a successful result. For instance, involving indigenous people in MSP efforts may not be a legal requirement, but they could however be greatly affected (positively or negatively) by MSP management measures, and should therefore participate.

Wide-ranging and innovative approaches to stakeholder participation and proactive empowerment should be used in the MSP process. Stakeholder participation and involvement in the process should be early, often, and sustained throughout the process. Stakeholder participation and involvement encourages "ownership" of the plan and can engender trust among the various stakeholders. Different types of stakeholder participation, including networked governance (Box 5), should be encouraged at various stages of the MSP process. The key stages at which stakeholders should be involved in the process include:

1. **The planning phase:** Stakeholders need to be involved and contribute to the setting of goals and objectives of MSP. They also need to be involved in the evaluation and choice of specific management measure options and the consequences of these choices on their areas of interest;
2. **The implementation phase:** Stakeholders should be involved in the actual implementation of MSP and its management measures. For example, an approach to enforcement may be identified that would involve local communities in the regulatory and enforcement process. When the local communities understand the problems and benefits of taking action—and agree upon the management measures to be taken—they will be part of the enforcement process, at least to the extent of encouraging compliance; and
3. **The monitoring and evaluation (post-implementation) phase:** Stakeholders should be involved in the evaluation of the overall effectiveness of MSP in achieving goals and objectives. The post-evaluation effort should involve all stakeholders in a discussion to identify plan results, evaluate results against objectives, and plan for the next phase of planning.

Box 5. MSP and Networked Governance

Networked governance is a strategy that recognizes and allows all rights-holders and stakeholders to be part of the decision-making process, in this case, the marine spatial planning process. As opposed to traditional "top-down", command-and-control systems, networked governance involves relevant stakeholders at all levels through less formal channels. The perspectives and positions of all stakeholders are included in defining the management goals and objectives and are used to develop a joint solution, i.e., a marine spatial management plan. The solution then calls for contributions from all stakeholders for its implementation. While ultimate responsibility for political decisions continues to lie with the executive authority (usually the government), it is also possible to construct incentives for ensuring compliance with the plan through heightened standards of accountability. Thorough stakeholder involvement increases each stakeholder's responsibility for their own contributions and makes each one more likely to hold government and other stakeholders accountable for their respective commitments.

Such a regime applied to the Arctic, and highly inclusive of indigenous peoples, would:

- Recognize that Arctic indigenous peoples are not merely stakeholders, but rights-holders to Arctic lands, waters, and resources, and thus have a clear right to participate at any planning or bargaining table;
- Build on the already formal role of Arctic indigenous peoples in regional planning and decision-making, e.g., through the Arctic Council;
- Ensure strong communication between indigenous communities and those making the management decisions affecting their environment;
- Encourage future Arctic developments to provide social equity and sustainable benefits for Arctic peoples;
- Insure that decisions made about the future of the Arctic include protection of the region's unique cultures and environment through recognition of the rights of its peoples;
- Preparing and approving the spatial management plan;
- Implementing and enforcing the spatial management plan;
- Monitoring and evaluating performance; and
- Adapting the marine spatial management process.

Excerpted and modified from a discussion draft paper prepared for the Aspen Institute's Dialogue and Commission on Arctic Climate Change by

Cochrane, Watt-Cloutier, et al.,

February 2010

The critical nature of stakeholder participation and involvement in MSP is discussed at length in Ehler and Douvere and Pomeroy and Douvere. [31,32]

Box 6. An Early Example of MSP and Networked Governance

In 2002 Coastal First Nations, an alliance of First Nation peoples on British Columbia's North and Central Coasts and Haida Gwali, signed an agreement with the Government of Canada to develop a marine use planning process under Canada's Ocean Strategy. Coastal First Nations began marine planning in 2005 along the British Columbia coast, an area now referred to as the Pacific North Coast Integrated Management Area (PNCIMA). Fisheries and Oceans Canada, the Coastal First Nations, and the North Coast-Skeena First Nations Stewardship Society officially agreed on the planning process in 2008. The agreement created a collaborative model for ocean governance that ensures the meaningful participation of First Nations in the development of management plans for marine use in the PNCIMA.

Ethics and values are the roots of traditional land and sea management systems. Although expressed in their own ways, First Nations ethics and values correspond to the scientific principles of ecosystem-based management and provide linkages between the two perspectives.

First Nations Ethics & Values	Scientific Principles
Balance & Interconnectedness	• Integrated Management • Long-term Sustainable Use
Respect & Responsibility	• Inclusive & Participatory • Precautionary Approach
Intergenerational Knowledge	• Adaptive Management • Best Information
Giving and Receiving	• Equitable Sharing

In 2004-05 the Coastal First Nations entered into an Aboriginal Aquatic Resource and Oceans Management agreement with DFO that supported Coastal First Nation consultations with other First Nations within PNCIMA on the collaboratively developed integrated management framework. The Coastal First Nations have built strong alliances with the North Coast - Skeena First Nation Stewardship Society and the Nuxalk First Nation, and all three organizations have agreed to work under the same operational framework. This alliance between all of the Central and North Coast and Haida First Nations on an initiative of this magnitude is unprecedented.

Community involvement and participation in the marine planning process is essential to its success. The primary role of First Nations in this process is to protect and conserve the marine environment on behalf of its community members. However, marine spatial planning is a process that brings together everyone that has an interest in the marine environment and integrates the wide variety of knowledge and interests into a common management plan that meets the needs of all participants. These interests could include not only First Nations peoples, but also federal and provincial governments, coastal communities, non-governmental groups including environmental groups and community groups, and other interests such as fishermen, shipping companies, forestry and fishing companies, recreational groups, mining and energy groups.

First Nations communities are developing MSP processes and products for their communities that are involved at all levels of the MSP process. Communities are the primary drivers in the development of local MSP plans. Marine planning committees/ work groups have been established in each community or area and work on behalf of the community to develop marine plans that reflect the values and interests of the community as a whole. Communication strategies have been developed to ensure transparency in the process and to ensure community members play an active role.

The DFO Aboriginal Aquatic Resources and Ocean Management Program, DFO Oceans, and the Gordon and Betty Moore Foundation provide funding for the MSP work of Coastal First Nations.

For more information go to: coastalfirstnations.ca/activities/marineuse.aspx

Important stakeholders in any Arctic MSP process would include representatives of Indigenous Peoples such as the Aleut International Association, the Arctic Athabaskan Council, the Gwich'in Council International, the Inuit Circumpolar Council, the Russian Association of Indigenous Peoples of the North (RAIPON), and the Saami Council. Representatives of non-governmental organizations such as the Natural Resources Defense Council (NRDC) and the World Wildlife Fund (WWF), representatives of Arctic industries including oil and gas (Royal Dutch Shell, ConocoPhillips, Statoil, GazProm, ExxonMobil), fishing, mining, marine transportation (Murmansk Shipping, Far Eastern Shipping) and tourism, and representatives of Arctic research institutions, such as the University of the Arctic, the University of Tromso, the University of Calgary, the University of Greenland, and the University of Alaska, would all have a stake in the outcomes of MSP. These specific stakeholder examples are illustrative, not exhaustive.

What Are Some Key Principles of Marine Spatial Planning?

MSP should be guided by a set of principles that: (a) determine the nature and characteristics of the MSP process; and (b) reflect the results desired through MSP. The Aspen Institute has identified some examples of specific principles for Arctic governance (p. 50 of this report). Many of these principles can be put into practice through MSP. For example,

- **Ecosystem resilience, integrity and productivity** can be optimized by maintaining food-web (trophic) structure and protecting and restoring biodiversity and available habitat—MSP can be used to identify biologically and ecologically important areas, including fish spawning areas, polar bear denning areas, and migration corridors;
- **A full suite of Arctic ecosystem services**, including the regulation of climate, the provision of food, habitat, and genetic resources, and spiritual and cultural development, to support human well-being on a continuing basis can be maintained through MSP by allocating human activities in time and space with the goal of sustaining those services;
- **Investment in Arctic scientific research and related infrastructure** to ensure sustainable development and environmental protection can be promoted through MSP by the identification of gaps in natural and social science information that is required to implement MSP in the Arctic;
- **Assessing, monitoring and managing multiple human activities using an integrated, adaptive, ecosystem-based management system** that takes into account risks and cumulative and interacting effects can be implemented through MSP, which carries out these activities to deliver an ecosystem-based approach to the management of human activities in marine areas of the Arctic;
- **Ecosystem management processes, based on science and traditional knowledge, can be applied through MSP**, which assesses new and expanded human activities routinely as part of the planning process. MSP identifies spatial and temporal management measures (Table 1) to reduce or eliminate impacts that would be hazards to human health, harm living resources and ecosystems, damage amenities, or interfere with other legitimate uses;
- **The rights, including human rights, of Arctic residents and Arctic indigenous peoples can be respected through a highly participatory and transparent MSP process** that includes all interested stakeholders;
- **Cooperation among Arctic states** to arrive at appropriate standards for managing human activities to meet the special conditions of the Arctic region, while promoting sustainable development, can be promoted through an Arctic-wide MSP process that would identify spatial and temporal management measure that would require international cooperation; and

Box 8. Ten Principles for Marine Spatial Planning

1. **Regulatory authority.** Whether it is an existing agency, an interagency coordinating committee or some newly created body, the department charged with implementing MSP must have clear legal authority to engage in integrated ecosystem management, including the authority to evaluate the efficacy of its decisions and adjust them over time.
2. **Dependable funding.** If MSP is to succeed, government needs to guarantee sufficient and dependable funding to the effort. This funding must be sufficient to cover necessary agency staff, as well as the cost of obtaining the requisite data, ensuring public participation obligations and needs, monitoring, enforcement, and evaluation.
3. **Public and stakeholder participation.** Early and regular consultation with the public and advisors (such as traditional leaders) is the norm, as is rapid dissemination of information, materials, public comments, etc.
4. **Transparency.** The MSP management system should provide for maximum transparency so that the basis for analysis and decision-making is unambiguous and the process by which decisions are made is obvious as the decisions are under consideration.
5. **Real accountability.** Entities charged with implementing MSP must be accountable to the country/state/community for effective implementation and achievement of the goals and objectives outlined in policy and legislation. Accountability can be achieved through several different tools, including setting clear milestone deadlines, linking funding with achievement or performance, issuing performance reports (score cards) for public consumption, or allowing citizen suits to compel agency compliance with substantive and procedural requirements.
6. **Clear objectives and directives.** Critically, any MSP management system should set forth overarching principles, clear tasks, deadlines for completing tasks, directives explaining the standards by which decisions will be measured and made, and the processes for making those decisions, as well as periodic review for determining progress.

7. **Evidence/Science-based decision making.** MSP decision-making should be based on the best readily available science and/or evidence. This standard combines a requirement for using the best science/evidence with the practicality of knowing that decision makers cope with uncertainty and less than perfect information every day. Because it is not always possible to wait for high levels of scientific certainty when resource and economic health are hanging in the balance, the use of best available science is the linchpin to effective policy. Where significant scientific uncertainty exists, the precautionary principle should guide decision-making.
8. **Independent decision-making.** To the greatest extent possible, an MSP management system should attempt to foster independent decision making and reduce the potential for agency capture (by the regulated industry or individuals), political gridlock, or legislative interference (avoid interference induced by favoritism, corruption, or undue influence).
9. **Clear decision-making rules.** Decision making rules should be established up front, leaving no ambiguity regarding how decision outcomes will be achieved.
10. **Adaptive to change.** The systems we develop and use to "manage" linked human-natural ecosystems must include effective feedback and be flexible enough to adjust management practices over time, if necessary. Therefore, an MSP management system should include a robust monitoring program that will allow managers to determine whether both management (e.g., compliance, efficiency, conflict reduction) and ecosystem goals and objectives are being met. In addition, the management system should facilitate the incorporation of new science and information as it becomes available. Similarly, the system should account for the variability of natural systems and the possibility of regime shifts, such as those we are likely to face in the wake of climate change.

Modified from Sivas and Caldwell, 2008 [33]

Why Are General Goals and Measurable Objectives for MSP Important?

Specifying MSP goals and objectives is essential to help focus and tailor MSP efforts toward achieving results in any marine area, including the Arctic. Typically, goals and objectives should be derived from the problems and conflicts identified in the early stages of the MSP process. Despite what is often assumed, goals and objectives are different from one another.

Goals provide the umbrella for development of all other objectives and reflect the principles upon which subsequent objectives are based. For example, the goals of the Arctic Council's Arctic Marine Strategic Plan included:

- Conserve Arctic marine biodiversity and ecosystem function;
- Promote the health and prosperity of all Arctic inhabitants;
- Reduce and prevent pollution in the Arctic marine environment; and
- Advance sustainable Arctic marine resource use. [34]

Examples of MSP-specific goals in the Arctic could include:

- Protect environmentally and ecologically valuable areas;
- Encourage the co-location of compatible human activities;
- Reduce and resolve conflicts among current and future human activities; and
- Reduce and resolve spatial conflicts between current and future human activities and nature.

Characteristics of good objectives are that they are specific, measurable, achievable, relevant, and time-bound, i.e., SMART. Monitoring and evaluating progress toward the achievement of desired outcomes can only be measured when objectives are well specified. Often objectives will be preliminary and indicative when you specify them for the first time, and firmer and better-specified when re-examined later in the MSP process. Examples of well-specified objectives would include:

- Protect 90% of essential habitat for diving birds by 2012;
- Ensure that adequate marine space is available to produce 25% of energy needs from offshore sources by the year 2020;
- Implement a representative network of marine protected areas by 2012; and
- Reduce the time required to make decisions on marine construction permits by 50% by 2015.

Why Are Performance Indicators Important?

The main purpose to establish indicators is to measure, monitor and report on progress toward meeting the goals and objectives of MSP. Indicators have numerous uses and the potential for improving management. They include the ability to monitor and assess conditions and trends, forecast changes and trends (such as providing early warning information), as well as help evaluate the effectiveness of spatial and temporal management measures.

The selection of relevant and practical (i.e., measurable) indicators is one of the most important components of a "results-based" approach to MSP. Table 3 below identifies some characteristics of good indicators. Indicators are needed to monitor progress with respect to inputs, activities, outputs, and outcomes. Progress needs to be monitored at all levels of the system to provide feedback on areas of success, as well as areas where improvements may be needed. Caution should be exercised in defining too many indicators. Choosing the correct indicators is often a trial-and-error process—and may take several iterations. Indicators can be changed—but not too often.

Extensive reviews and examples of ecological, socio-economic, and governance indicators for the performance evaluation of integrated marine management and its measures can be found in Ehler, Pomeroy *et al.*, and Belfiore *et al.*[35,36,37]

Table 3. Characteristics of Good Indicators for MSP

Readily measurable	On the time-scales needed to support spatial management of human activities, using existing instruments, monitoring programs, and available analytical tools
Cost-effective	Monitoring resources are usually limited
Concrete	Indicators that are directly observable and measurable in time and space (rather than those reflecting abstract properties) are desirable because they are more readily interpretable and accepted by diverse stakeholder groups
Interpretable	Indicators should reflect properties of concern to stakeholders; their meaning should be understood by as wide a range of stakeholders as possible
Grounded in theory	Indicators should be based on well-accepted scientific theory, rather than on inadequately defined or poorly validated theoretical links
Sensitive	Indicators should be sensitive to changes in the properties monitored (e.g., able to detect trends in time and space in the properties or effects)
Responsive	Indicators should be able to measure the effects of spatial management measures to provide rapid and reliable feedback on their performance and effects
Specific	Indicators should respond to the properties they are intended to measure rather than to other factors, i.e., it should be possible to distinguish the effects of other factors from the observed responses to spatial management measures

Why Are Monitoring and Evaluation Critical?

Monitoring is a critical and integral element of MSP in the Arctic. In a broader sense, a "monitoring system" includes a range of activities needed to provide information to MSP. These activities include modeling, laboratory and field research, time-series measurements in the field, quality assurance, data analysis, synthesis, and interpretation. What distinguishes a monitoring system from any of these activities taken alone is that a *monitoring system* is integrated and coordinated with the specific goal of producing pre-specified spatial planning information; it is the sensory component of management.

At least two types of monitoring are relevant to marine spatial planning: (1) *assessing* the *state of the system*, e.g., "What is the status of biodiversity in the marine area?"; and (2) measuring the *performance of management measures*, i.e., "Are the spatial and temporal management measures we have implemented producing the outcomes we desire?" These two types of monitoring are closely related.

Sound monitoring program design depends on the following factors:

- The objectives of the monitoring program need to be clearly articulated in terms that pose questions that are meaningful to the public and that provide the basis for the measurement of management performance;
- Not only must data be gathered, but attention must be paid to their management, analysis, synthesis, and interpretation;
- Adequate resources are needed not only for data collection, but for detailed analysis and evaluation over the long term;
- Monitoring programs should be sufficiently flexible to allow for their modification where changes in conditions or new information suggests the need; and
- Provision should be made to ensure that monitoring information should be reported to all stakeholders and rights-holders in a form that is useful to them.

Evaluation is the element of MSP in which the greatest learning occurs. Ideally, it should be a continuous process in which measures or indicators of management performance are defined and systematically compared with program goals and objectives. Evaluation should be undertaken periodically during the lifetime of a MSP program—at least every five years.

MSP initiatives often have goals and objectives that are very vague or general, and therefore are not easily measured. In these cases it is difficult, if not impossible, to determine the extent to which goals and objectives are being achieved. Evaluations, if undertaken at all, tend to fall back on indicators that measure effort (input) rather than results (outputs or outcomes). For example, the number of permits granted or denied might be used as an indicator of the performance of a MSP program rather than the number of use conflicts avoided or area of biologically important marine areas protected.

Meaningful evaluations can be conducted only if the objectives of the MSP program are stated in unambiguous (measurable) terms and if indicators for assessing progress are identified in the planning phase, and monitored afterward. Baseline data are essential. Many evaluations yield ambiguous results because these preconditions for assessing management performance do not exist.

Evaluation should be seen as a critical element of the process of MSP. Integrated and adaptive MSP is based on a circular or iterative—rather than a linear—management process that allows information concerning the past to feed back into and improve the way management is conducted in the future. Evaluation helps management to adapt and improve through a "learning process."

Where Is Marine Spatial Planning Currently Underway?

In many marine places, MSP has already proven to be an operational approach to implementing integrated, ecosystem-based management.[38] Twenty-four MSP programs in nine countries are identified in Table 4. Descriptions of these programs can be found on the UNESCO website on marine spatial planning: www.ioc3.unesco.org/marinesp. A key characteristic of these marine spatial management initiatives is their ability to provide integration across multiple uses and sectors, to minimize conflicts, to maximize sustainable economic development, and to protect important habitat and biodiversity areas.[39]

Table 4. International Examples of Marine Spatial Planning

Country	Plan	Area (km^2)	Time Period
Australia	Great Barrier Reef Marine Park Original Zone Plan	344,400	1983-1988
	Great Barrier Reef Representative Areas Program	344,400	1988-2005
	Southeast Marine Bioregional Plan	1,600,000	2000-2004
	Southwest Marine Bioregional Plan	1,300,000	2005-date
	Northwest Marine Bioregional Plan	1,070,000	2005-date
	North Marine Bioregional Plan	715,000	2005-date
	East Marine Bioregional Plan	2,400,000	2005-date
USA	Florida Keys National Marine Sanctuary Management Plan	9,600	1991-date
	Channel Islands National Marine Sanctuary Marine Reserves	3,800	2002-2005
	California Marine Life Protection Act Plans (5 regions)	14,297	2007-date
	Massachusetts Integrated Ocean Plan	5,555	2008-2009
	Rhode Island Ocean Special Area Management Plan	3,800	2008-date
	Oregon Territorial Sea Plan	3,250	1991-1994
	Oregon Territorial Sea Plan Revision	3,250	2009-date
Canada	Coastal First Nations Marine Spatial Plans	88,000	2008-date
China	Territorial Sea Functional Zoning Plans (9 coastal provinces)	396,000*	2002-date
Belgium	Master Plan for Belgian Part of the North Sea	3,600	2003-2005
The Netherlands	Integrated Management Plan for the North Sea, 2015	57,000	2003-date
Germany	Marine Spatial Plan for the North Sea	28,600	2006-2009
	Marine Spatial Plan for the Baltic Sea	4,500	2006-2009
	Mecklenburg-Volporam Marine Spatial Plan	5,700	2005-2008
Norway	Integrated Management Plan for the Barents Sea	1,400,000	2003-2006
	Integrated Management Plan for the Norwegian Sea	1,170,000	2007-2009
Poland	Gulf of Gdansk Marine Spatial Plan Pilot Project	406	2007-2008

**estimated*

Current Marine Spatial Planning Activities in the Arctic

Marine spatial planning is already underway in several areas of the Arctic, including Norway, Canada, and to a limited extent, the United States.

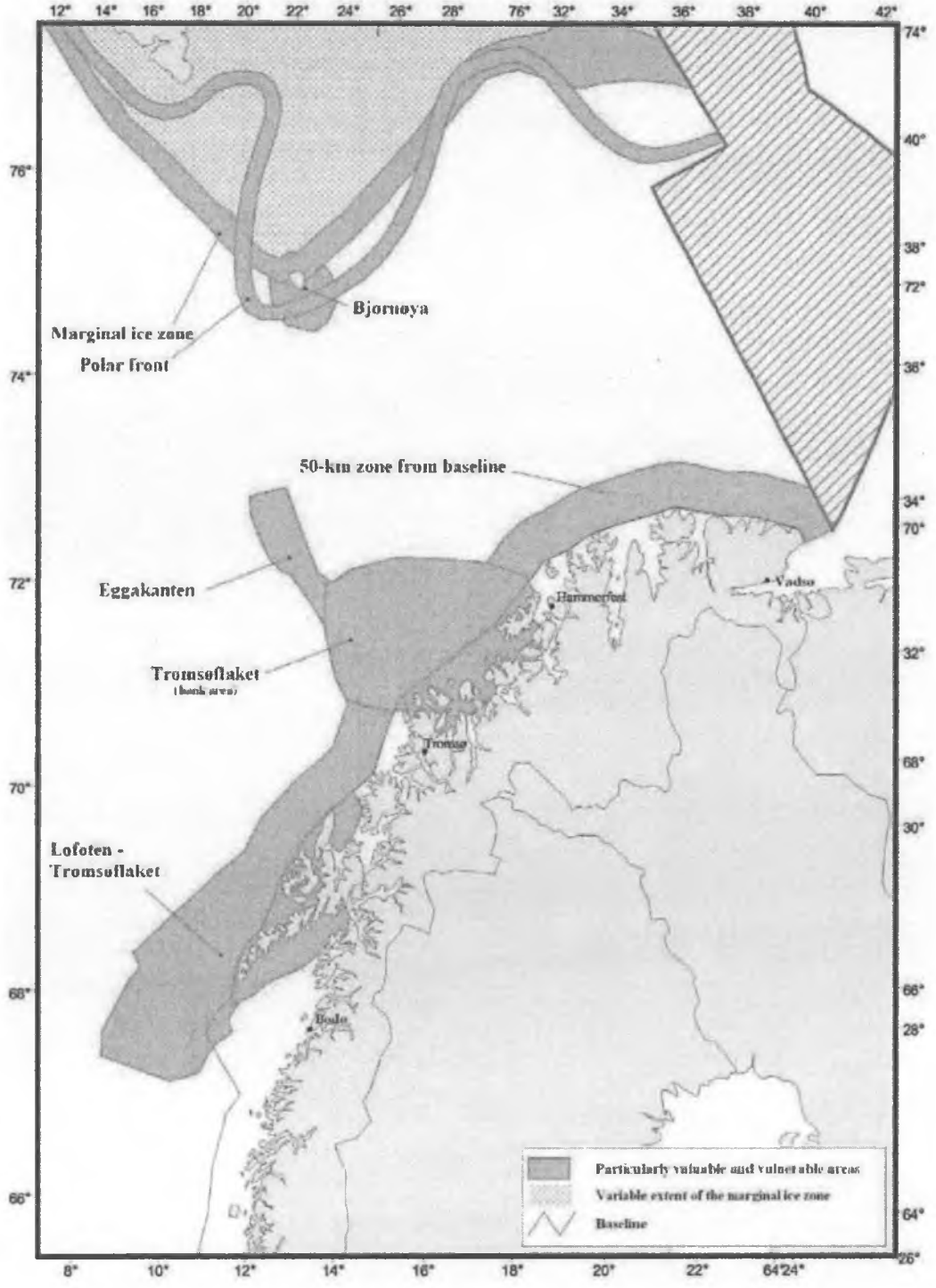
Norway: Marine spatial planning would be a new approach in most areas of the Arctic. However, in Norway, an ecosystem-based, integrated marine management plan, including a marine spatial plan, has been developed for the Barents Sea and the Sea Areas off the Lofoten Islands. It covers all areas offshore of one nautical mile of the coast within the Norwegian EEZ, as well as the fishery protection zone around the Svalbard archipelago—a marine area covering 1.4 million km2. Norway is one of the few countries that have successfully integrated all major economic activities—oil and gas development, fisheries, and marine transport—together with nature conservation in its marine spatial planning activities. The plan for the Barents Sea was initiated in 2002 and completed in 2006; the initial plan is now being revised. An integrated management plan for the Norwegian Sea (1.17 million km2) has also been developed recently. [40]

One of the major issues in the Barents Sea was the potential expansion of oil and gas activities into areas of the Barents Sea used by fisheries and living marine resources. MSP is at the core of the plan, identifying particularly valuable and vulnerable areas, either from ecological and/or human perspectives. Within the plan access to specific areas for human activities is carefully managed, for example, by moving shipping lanes outside Norwegian territorial waters (12 nautical miles), limiting trawling in sensitive areas, not opening most particularly valuable and vulnerable areas to petroleum activities, including the ice edge, and extending marine protected areas and fishery closure areas to protect spawning aggregations, fish eggs and larvae, and juvenile fish and shellfish. [41]

A government-appointed inter-ministry steering group chaired by the Ministry of the Environment and with representatives of relevant ministries led the work on the plan that included evaluation of the cumulative effects of development up to 2020. Development of the plan (2003-2006) followed a three-phase process. First, status reports were prepared by governmental management and research institutions or by consultants, covering the state of the marine environment, the coastal zone, fisheries, aquaculture, especially valuable areas, and shipping. The initial reports uncovered major gaps in current knowledge. Therefore, a key principle of the planning process was to use caution in the face of uncertainty. The plan also had to be adaptive to allow the evaluation of new knowledge as it became available. Determining the boundaries for the plan was another important issue, which included considerations of the ecosystem, economics, and politics, and discussions with the International Council for the Exploration of the Sea (ICES) and other organizations.

The second phase was an analytical one based on the first one. Four extensive government-funded environmental impact assessments (EIAs) were carried out, covering the impact of fisheries, shipping, hydrocarbon extraction, and external pressures (e.g. pollution) on the environment, resources, and local communities. To ensure compatibility among the EIAs, a set of common variables was used to compare impacts among sectors. Impacts were assessed relative to a base year (2003) and relative to expected future impacts up to 2020, with uncertainty obviously increasing over time.

Figure 4. Particularly Valuable and Vulnerable in the Barents Sea
(Royal Norwegian Ministry of the Environment)



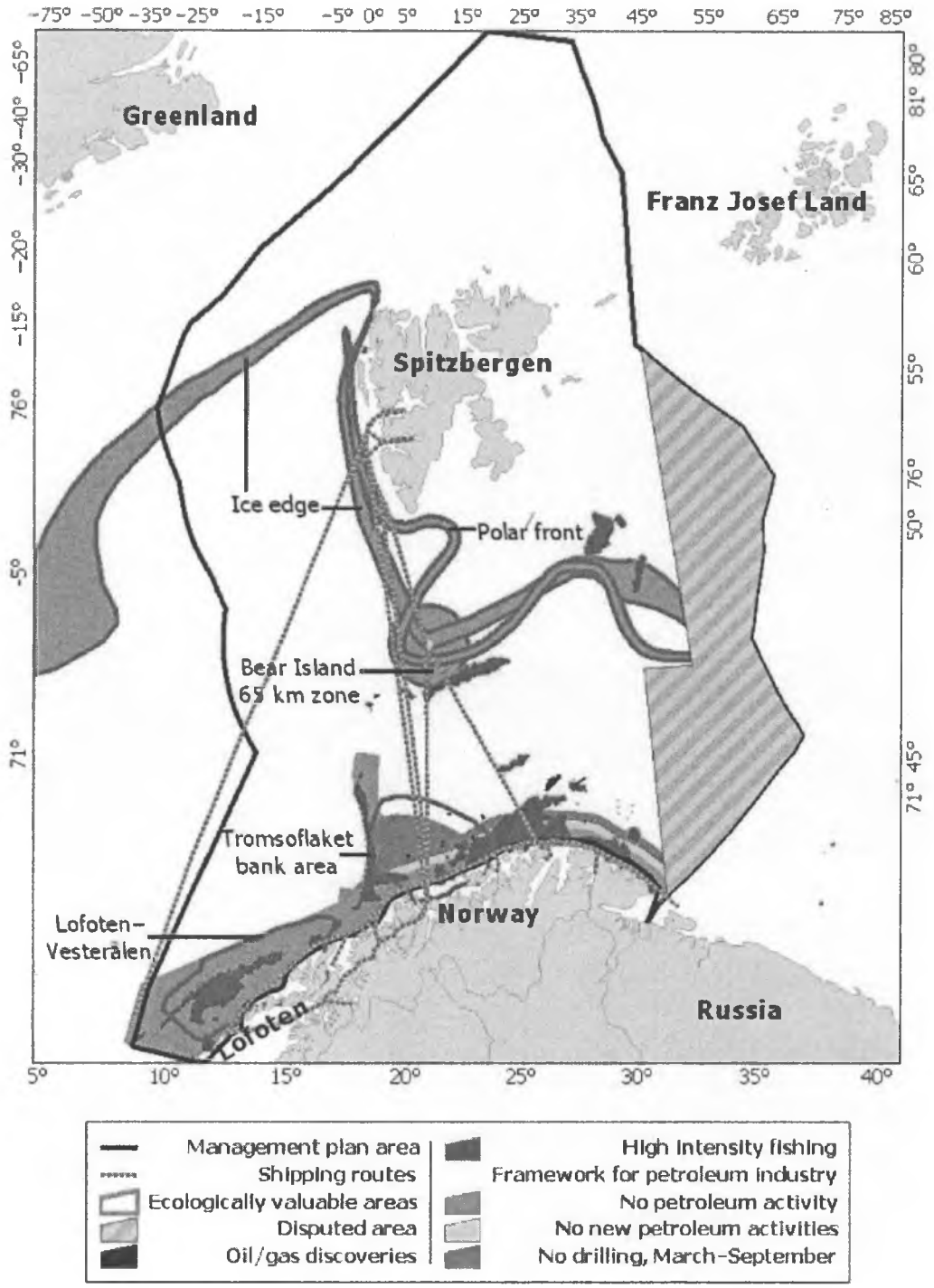
In the third phase, the EIA results were brought together and analyzed in more detail, focusing on: (1) the total impact of all human activities combined, both for the current situation and up to 2020; **(2)** area conflicts among human activities, and between human use and ecologically valuable areas; **(3)** the definition of management goals required for implementation; and **(4)** identification of gaps in current knowledge.

The analysis of total impact was difficult, because knowledge of the cumulative ecological impact of several interacting human effects was limited. Parallel to the second and third phases, a set of operational environmental quality objectives (EcoQOs) was developed, based on the management goals. These covered climate, ice edge, phytoplankton, zooplankton, commercial fish species, non-commercial fish species, benthic organisms, marine mammals, seabirds, alien species, threatened and vulnerable species, and pollutants. Progress toward the EcoQOs is monitored annually.

A central concept of the plan is that it is based on the best available scientific information and takes a precautionary approach, implying a need for revision as new knowledge becomes available. The plan represents a synergy of previously separate management regimes: management of fisheries, shipping, and the hydrocarbon industry are brought together under one umbrella to coordinate efforts and to achieve a healthy ecosystem (Figure 5). **In practice, achieving measurable improvements in all these sectors is the main challenge, and these are envisaged by implementing: (1)** marine spatial planning to resolve conflicts between activities and protecting the environment; **(2)** continuation of established management measures regulating the various activities; **(3)** implementation of EcoQOs; and **(4)** increased focus on international cooperation, especially with Russia, regionally and globally.

The plan identifies ecologically valuable areas and requires strict regulation of activities in these areas. To reduce conflict between fisheries and shipping, Norway has applied (through the International Maritime Organization) to move shipping lanes outside Norwegian territorial waters (its 12-nautical mile limit). To avoid future conflict, some areas will be closed to hydrocarbon exploration and exploitation (Lofoten, Bear Island, the polar front, and the ice edge). The framework for hydrocarbon extraction has been the focus of political debate around the plan, and will probably continue to be so. Several new sector-specific area-based measures are also considered, including plans for extension of marine protected areas and the use of seasonally closed areas to protect spawning aggregations, fish eggs and larvae, and juvenile fish and shellfish.

Figure 5. The Barents Sea Management Area, Showing the Main Fishing Areas, Shipping Lanes, and the Area-based Framework for Hydrocarbon Extraction, and Valuable and Vulnerable Areas

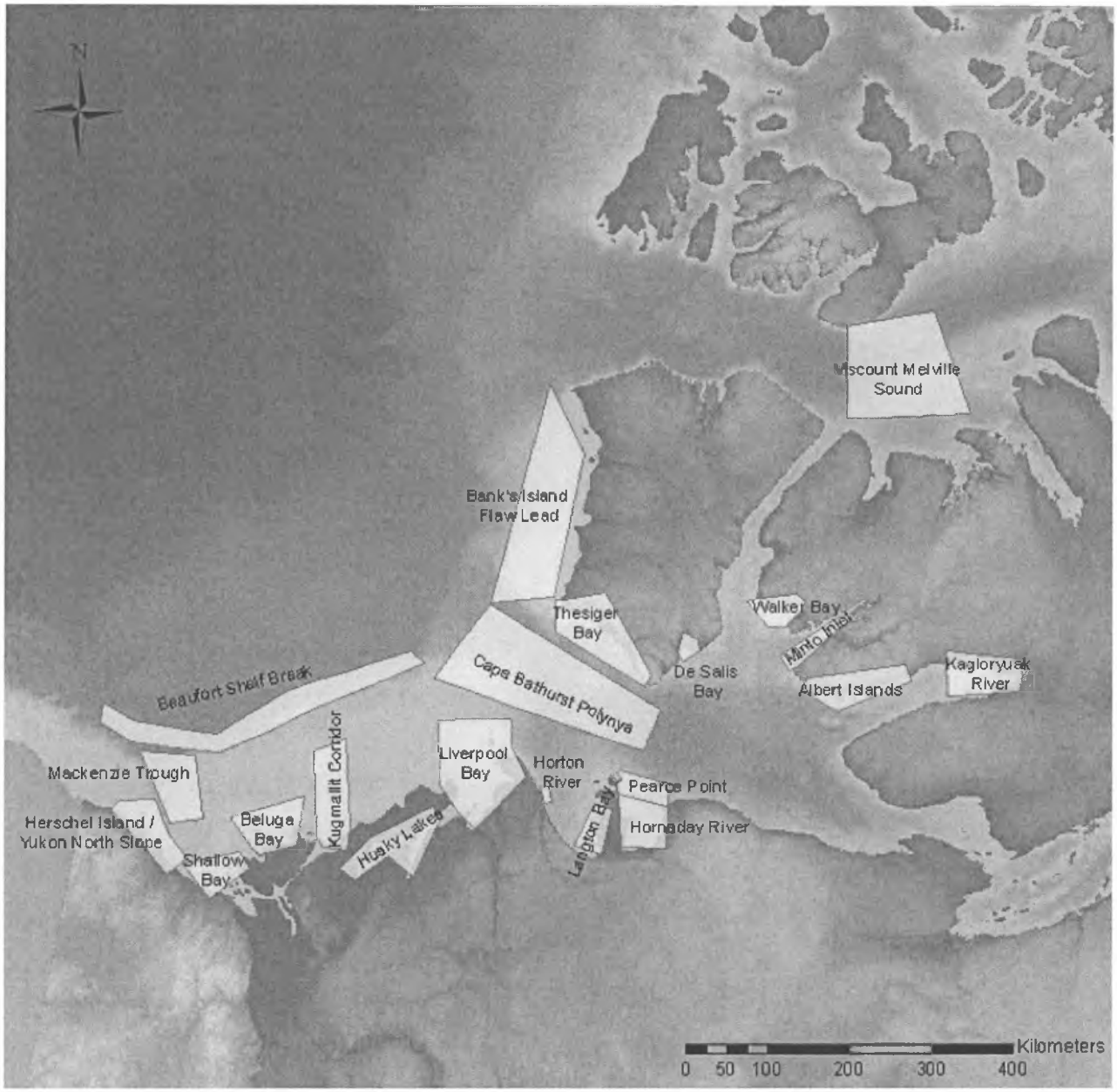


Cooperation among government institutions has been ensured by creating three new advisory groups, all reporting to the governmental steering group: a "monitoring group" responsible for coordinating monitoring activities and reporting annually on the state of the ecosystem, based on the EcoQOs; an operational "risk group" responsible for monitoring potential risks to the ecosystem and ensuring dissemination of information; and an "expert forum" responsible for advice on revisions to the plan. One of the shortcomings of the first Barents Sea planning process was its lack of consultation with the Saami Parliament. [42]

Canada: Canada's Department of Fisheries and Oceans has just completed an integrated management plan for the Canadian portion of the Beaufort Sea (1.75 million km2) as part of a large ecosystem-based management program for five large ocean management areas (LOMAs) in Canada.[43,44] The integrated management plan does not address marine spatial planning, but recommends marine spatial planning be conducted for the Beaufort Sea LOMA. Canada also completed in 2005 an overview of the Beaufort Sea marine ecosystem and more recently in 2009 an atlas of the Beaufort Sea.[45,46] The atlas contains a map of "ecologically and biologically significant areas", based on their biophysical structure and ecological function, created by the Department of Fisheries and Oceans Canada (Fig. 6). A "Beaufort Sea Partnership" is the primary forum for stakeholder engagement in integrated management of the Beaufort Sea LOMA. It is comprised of regional-level representatives and has an open membership, i.e., any organization with an interest in the management of the Beaufort Sea can become a member. The Partnership has about 40 member organizations, including Indigenous Peoples.

The Government of Canada brought its Oceans Act into force on January 31, 1997 making it the first country in the world to have comprehensive oceans management legislation. Canada's Oceans Strategy was finalized in 2002. This policy document defined the vision, principles, and objectives for the management of Canada's estuarine, coastal and marine ecosystems. Funding needed to apply Canada's oceans management legislation and policy became available in 2006 under a Federal initiative known as the Oceans Action Plan. The Beaufort Sea was subsequently named as one of five areas to receive funding. The area contains an estimated one-third of Canada's undeveloped conventional oil and gas potential.

Figure 6. *Ecologically and Biologically Significant Areas of the Beaufort Sea (Department of Fisheries and Oceans Canada, 2009)*



Aboriginal, federal and territorial governments and co-management interests, as well as industry, coastal communities and other interested parties agreed to work together on the implementation of a process that would lead to a plan for managing activities occurring in the Beaufort Sea. Development of the integrated management plan took three years to complete.

The plan is organized around six goals:

- **Governance:** To achieve effective governance for the sustainable use of the Beaufort Sea;
- **Economic:** To foster sustainable economic opportunities and options for Canadians, northerners and coastal communities;
- **Cultural:** To maintain and increase peoples' sense of place and preserve cultural identity and spiritual connections as they relate to oceans and coastal areas;
- **Social:** To improve human capacity, health, quality of life and opportunities as they connect to oceans and coastal areas;
- **Traditional and Local Knowledge:** To promote the value, credibility and use of traditional knowledge (TK) and local knowledge (LK) to current and future generations; and
- **Ecosystem:** To understand the Beaufort Sea ecosystem, to identify important areas and priority species and to maintain or enhance ecosystem integrity.

After securing general agreement on the need for a plan, stakeholders needed to know the current status and trends of the Beaufort Sea's ecosystem to determine what impacts human activities might have on that ecosystem. An ecological assessment was conducted to compile available science and traditional knowledge of the area. The Ecosystem Overview and Assessment Report (EOAR) describes areas and activities that need priority actions. A key part of the EOAR was the identification of Ecologically and Biologically Significant Areas (EBSAs) in the Beaufort Sea (Figure 6). Work leading to the EBSAs was a centerpiece of the planning process. It calls attention to areas that have particularly high ecological or biological significance and require specific management measures and standards to manage them responsibly.

A Social, Cultural and Economic Overview and Assessment Report similar to the EOAR was also completed for the Beaufort Sea LOMA. It is a valuable source of information on key social, cultural, and economic conditions, issues and objectives for the integrated management process. The report is an excellent reference for decision makers requiring information about current and historic ocean-based activities and stakeholder perspectives. Community profiles that outline the social, cultural and economic status of the communities are part of the report.

The Beaufort Sea Planning Office identified some of the benefits of working together on the implementation of the Beaufort Sea integrated management plan as:

- Increased cooperation across departments, governments and other organizations;
- Better integrated responses to cross-cutting issues;
- Better and more timely collection of information on key risks and their relationship to programs and values;

- Ongoing measurement of the actual effects of policies, programs and operations;
- Identification of areas of shared responsibility; and
- Greater accountability for management of shared responsibilities. [47]

USA: In 1988 the U.S. National Oceanic and Atmospheric Administration (NOAA) published the first comprehensive data atlas of the Bering, Chukchi, and Beaufort seas.[48] The NOAA atlas contained 112 maps of the Arctic region, including the Canadian Beaufort Sea and the Soviet Bering and Chukchi seas. Special maps developed for the Arctic atlas included sea-ice dynamics and sea-ice type, marine sediments, chlorophyll-a, and subsistence activities of Alaskan Natives, a particularly important human activity in the Arctic, developed from detailed anthropological field surveys conducted by the Alaska Department of Fish and Game. Unfortunately the NOAA atlas has not been updated, but other mapping activities are now underway in Alaska.[49] In August 2009 Audubon Alaska completed a draft Atlas of the Chukchi and Beaufort Seas. The project area includes the southern Beaufort, southern Chukchi, and northern Bering seas and includes 44 maps covering Alaska's Arctic marine environment. Thematic maps are presented in six categories: physical oceanography, water column and benthic life, fish, mammals, birds, and people. The Coastal Management Program of the North Slope Borough has also developed 31 detailed maps covering its jurisdiction, including subsistence use areas.[50]

Figure 7. *Polar Bear Map from the Audubon Arctic Atlas, 2009*

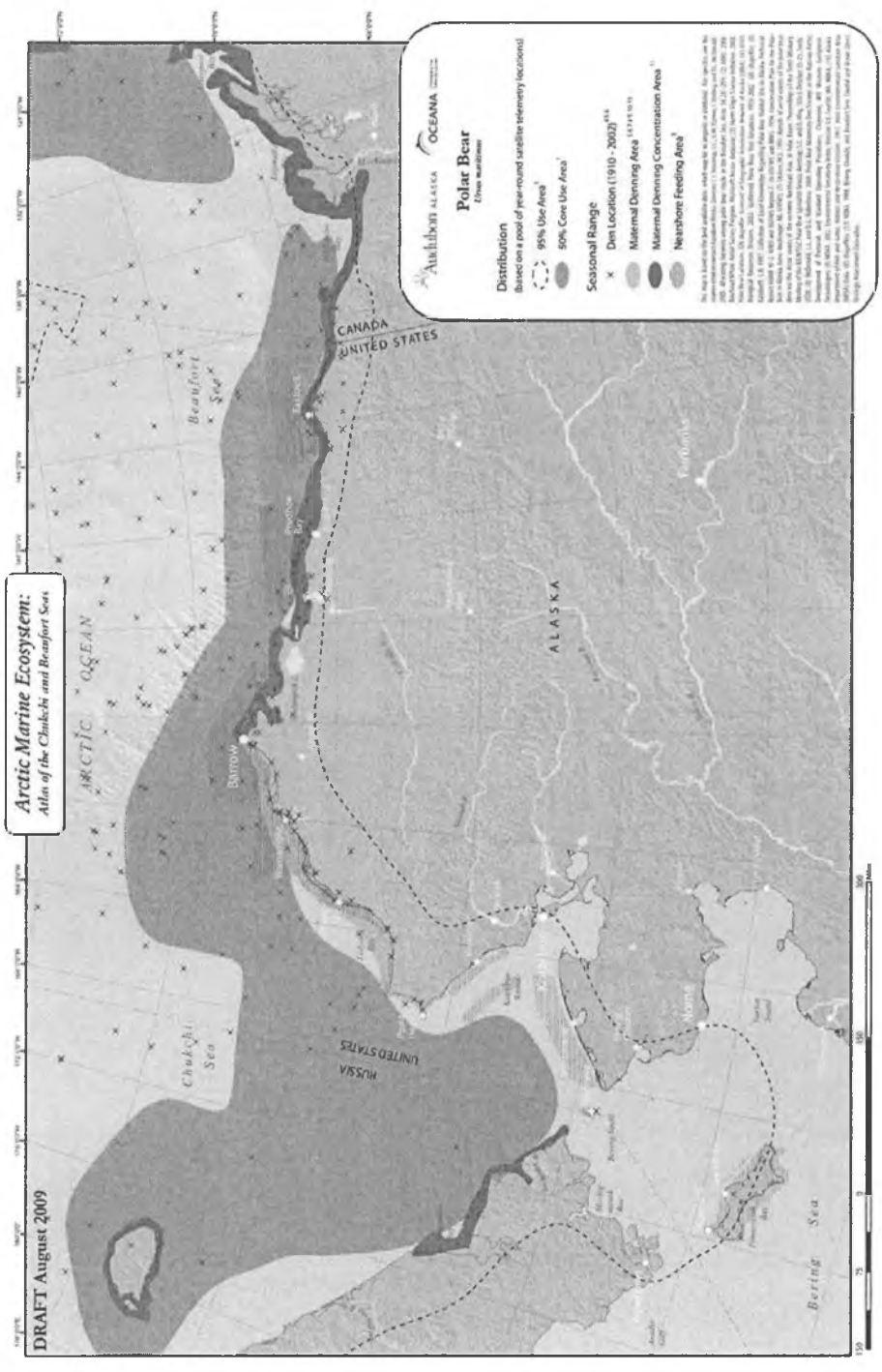
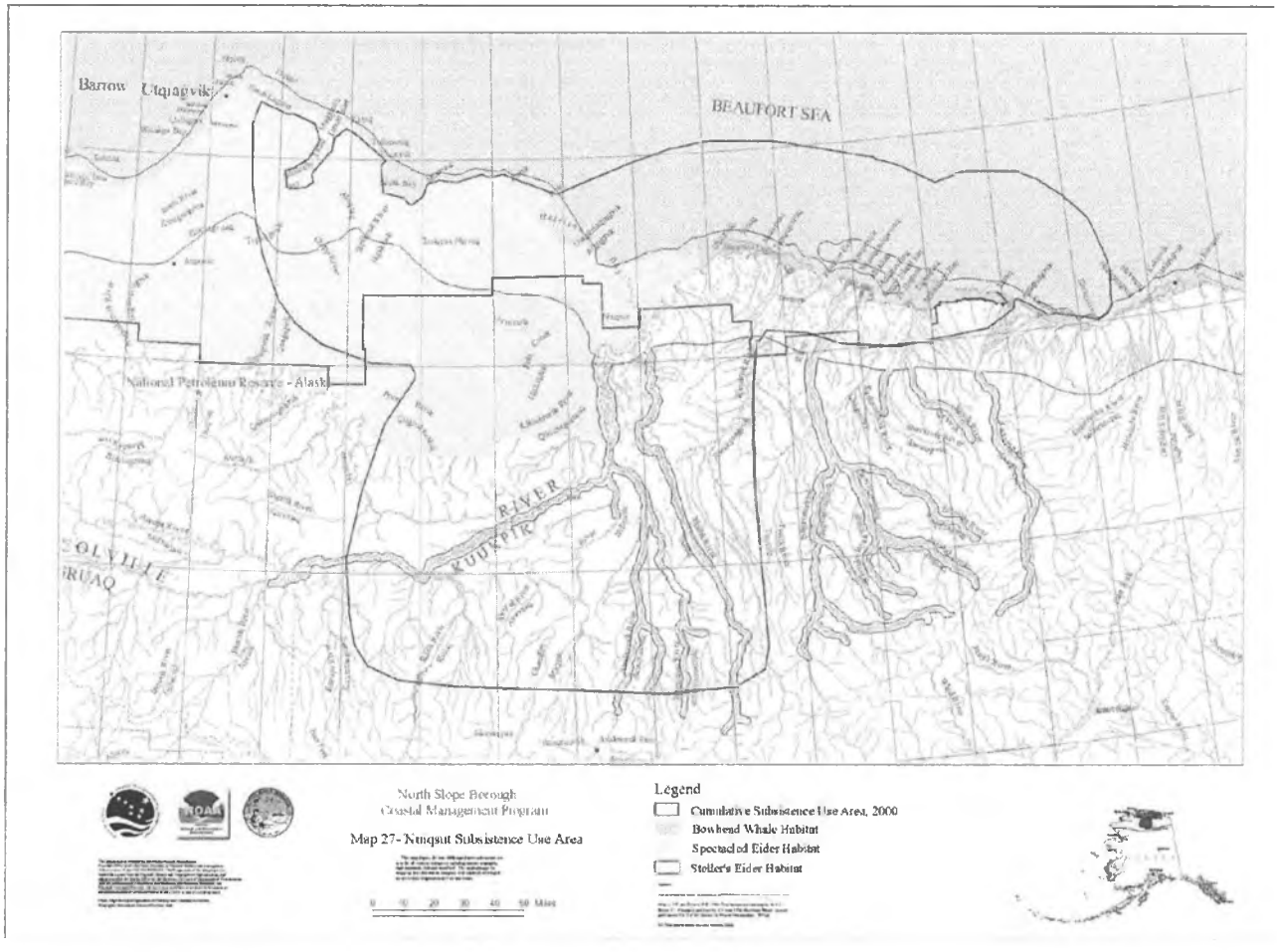


Figure 8. Kaktovik Subsistence Use Area, Resource Atlas, North Slope Borough Coastal Management Program, 2009

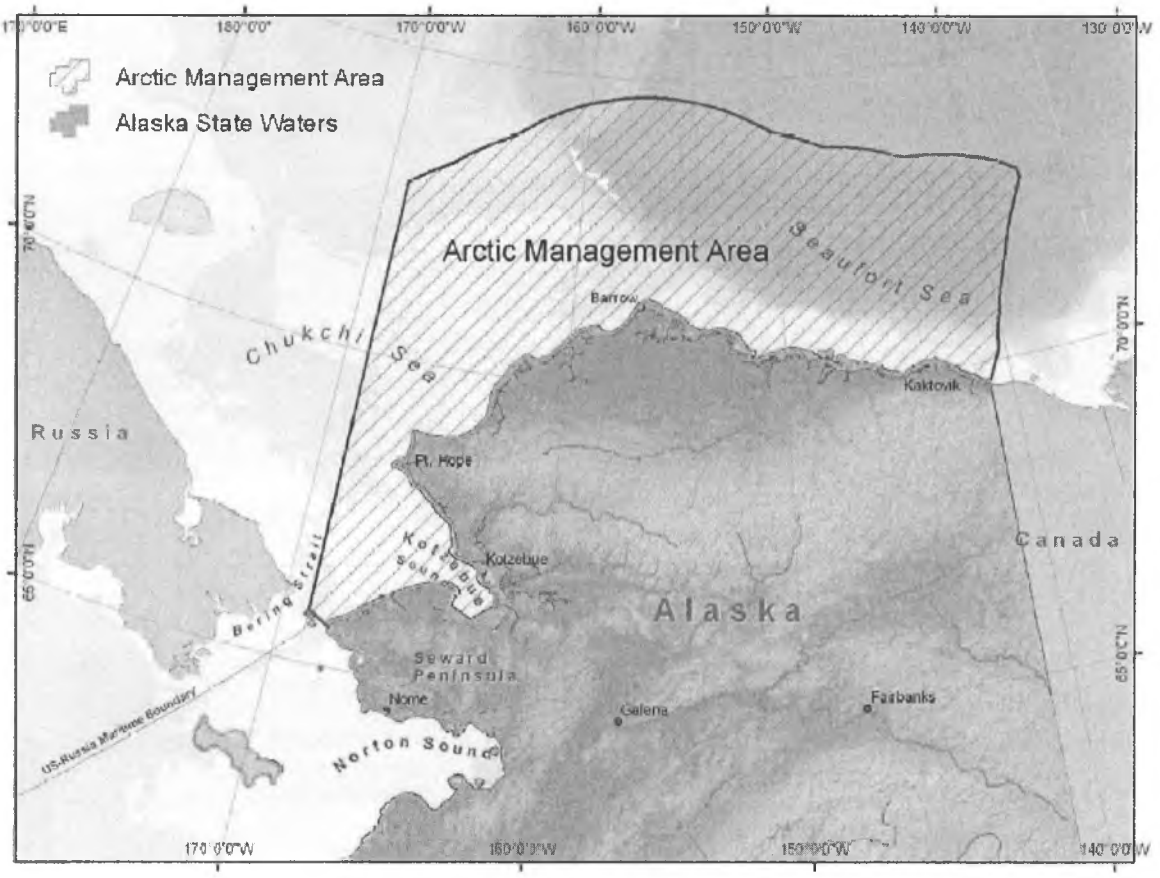


On June 12, 2009, President Obama sent a memorandum to the heads of executive departments and federal agencies establishing an Interagency Ocean Policy Task Force, led by the White House Council on Environmental Quality. The Task Force is charged with developing a recommendation for a national policy that ensures protection, maintenance, and restoration of oceans, coasts and the Great Lakes. It will also recommend a framework for improved stewardship, and effective marine spatial planning. On December 14, 2009, President Obama's Ocean Policy Task Force released its Interim Framework for Effective Coastal and Marine Spatial Planning for a 60-day public review and comment period. The Interim Framework suggests a comprehensive, integrated approach to planning and managing uses and activities. Under the framework, marine spatial planning would be regional in scope, developed cooperatively among Federal, state, tribal, local authorities, and regional governance structures, with substantial stakeholder and public comments. The framework proposes the establishment of nine regional planning bodies, including one for Alaskan waters. A final U.S. Framework for Marine Spatial Planning was issued in July 2010 and on 19 July President Obama signed an executive order that, among other instructions to federal agencies, provides for the development of coastal and marine spatial plans that build upon and improve existing Federal, State,

tribal, local, and regional decision-making and planning processes. The Obama Administration has proposed $20 million in the 2011 NOAA budget to support regional ocean partnerships and MSP.

In August 2009, the U.S. Secretary of Commerce approved a management plan for the fishery resources of the Arctic Management Area. The plan covers the Arctic waters of the United States in the Chukchi and Beaufort seas (Fig. 8). Warming ocean temperatures, migrating fish stocks and shifting sea ice conditions from a changing climate may potentially favor the future development of commercial fisheries. The plan establishes a framework for sustainably managing Arctic fish resources. Using a spatial management measure, the plan initially prohibits commercial fishing in the Arctic waters of the region until more information is available to support sustainable fisheries management.[51] The North Pacific Fishery Management Council approved the plan in February 2009. Final regulations protecting over 500,000 km2 of U.S. Arctic waters from industrial fishing went into effect December 3, 2009. The new regulations close all U.S. waters north of Alaska's Bering Strait to commercial fishing to allow time for more science to assess the health of Arctic Ocean ecosystems.

Figure 9. *Area of the US Arctic Fishery Management Area Closure*



Russia: No references to integrated management or marine spatial planning exist in Russian legislation or regulations. Governmental organizations of the Russian Federation that have responsibilities for marine management operate on a sector-by-sector basis. However, existing legislation does contain areas in which marine spatial planning could be an important instrument for solving the tasks and problems of marine management.

Marine planning is under discussion now only in the Russian academic community. The role of the academic community in this process is to formulate the basic principles of MSP, identify actions toward its implementation, and explain the need to incorporate this system into both national and international law.

Russia has identified biologically important areas. However, no marine areas have been designated as protected areas. Only coastal terrestrial have been designated; a few areas extend one kilometer into the territorial sea.

Pan-Arctic: While most MSP efforts have been focused at the national level, several initiatives have a Pan-Arctic perspective. For example, the Arctic Council has several different spatial data initiatives that are developing regional or circumpolar datasets or to provide a framework that would allow integration, access, and coordination of spatial data on the Arctic. It has discussed the possibility of developing a common interface for access to spatial data.[52] However, existing efforts of the Arctic Council to address cartography, geographic information systems, and spatial analysis have been conducted in isolation with no attempt at harmonization or integration. The Working Group on Emergency Prevention, Preparedness and Response, the Working Group on the Conservation of Arctic Flora and Fauna, and the Arctic Monitoring and Assessment Program have discussed the possibility of developing a common interface for access to spatial data, the first tentative steps toward providing a framework to allow for data standardization and integration within the Arctic Council.

The International Union for the Conservation of Nature (IUCN) and the Natural Resources Defense Council (NRDC) are about to undertake a cooperative Arctic Marine Ecosystem-Based Management Project to explore ways of advancing implementation of ecosystem-based management, and to begin the process of identifying specific ecologically significant and vulnerable marine areas that should be considered for enhanced protection in any new management arrangements. Partners in the project include the Ecologic Institute and the Center for Marine Biodiversity and Conservation (CMBC) at the Scripps Institution of Oceanography, University of California, San Diego. The main outcomes of the IUCN/NRDC Arctic Marine Ecosystem-Based Management Project will include: (1) policy recommendations on management arrangements needed to advance ecosystem-based marine management in the Arctic region; and (2) scientific findings (including maps and reports) on areas of ecological and biological significance or vulnerability that should be considered for enhanced protection in the Arctic. Shell International Exploration and Development and the Prince Albert of Monaco Foundation are co-funding the project.[53]

Another planned IUCN project, the first phase of which will be funded by Shell, will address the assessment of cross-sectoral, cumulative impacts in the Arctic. The project will assess the cumulative impacts of current and future developments on the Arctic environment, and will include a strategy to potentially develop an Arctic management plan or management plan(s) for Arctic regions. The project is divided into four phases and is expected to take at least four years to complete.

The first phase will build the required information network and organize a workshop to develop alternative scenarios for the Arctic. The second phase will identify regional developments and impacts, based on a limited and agreed set of scenarios. A larger group of stakeholders will then work in a third phase to make a strategic and integrated assessment of the potential impacts of the various sectors on the Arctic, their consequences, and advice regarding future choices. The final phase would involve additional stakeholders in assessing the political issues associated with such a forward-looking process.

How Can Marine Spatial Planning in the Arctic be Advanced?

Marine spatial planning is already occurring in the Arctic—at least in Norway (Barents Sea) and to a promising extent in the Canadian Beaufort Sea, and the USA. Only Russia and Greenland lag behind. Several options exist for moving forward:

1. A "Business as Usual", Incremental Approach

Under this option, the national government of Norway will continue to lead the way in the implementation of MSP. It is currently in the process of revising its integrated management plan for the Barents Sea and has just approved an integrated management plan for the Norwegian Sea. It is at least several years ahead of other Arctic countries in focusing on spatial and temporal management measures in its integrated approach to marine management. Canada will probably develop over the next several years a marine spatial management plan for its sector of the Beaufort Sea. However, no current plans exist for marine spatial planning in the remaining part of Canadian Arctic waters. The United States, depending on the outcome of nascent efforts of the Obama Administration to stimulate MSP in American marine areas through its executive order of July 19, 2010 and competitive grants to regional marine management organizations in 2011, could begin MSP in the Arctic seas of Alaska over the next several years. Progress on MSP in Greenland and Russia will continue to lag behind these other national efforts.

2. A Bilateral Approach between National Governments

Several areas have already been identified as potential bilateral projects for integrated marine planning: (1) the area of the USA-Canadian Beaufort Sea, known as the "Beaufort Sea Triangle",[54] and (2) the Norwegian-Russian Barents Sea. In 2005, a Norwegian-Russian working group on the marine environment was established as part of the bilateral marine protection cooperation between Norway and Russia. The working group was established to contribute to closer cooperation on ecosystem-based management of the Barents Sea.[55] In fact, Russian experts were involved in the preparation of parts of Norwegian plan for the Barents Sea, and Norway has discussed the possibility of producing a similar plan for the Russian side of the Barents Sea. Norway and Russia agreed in April 2010 to settle their dispute over the Barents Sea border that had dragged on for decades. However, immediate interests of the two countries appear to be focused on oil and gas development rather than any effort to develop an integrated management plan for the formerly disputed area.[56]

Preliminary work on MSP has begun through the Arctic Council's PAME (Protection of the Arctic Marine Environment) Work Plan for 2009-2011.[57] It is developing pilot projects to make the large marine ecosystem (LME) assessment approach operational (in the Canadian/US Beaufort Sea and the US/Russian Federation West Bering Sea).[58] These initiatives would move MSP in the Arctic forward, but without substantial new infusion of resources, progress is likely to be slow.

3. A "Hot Spot" Approach

Another way to develop a MSP initiative that could produce short-term results would be to identify a "hot spot" area in an Arctic nation that currently has no marine planning activities underway, but one that has the potential for new development. Hot spots of biodiversity and productivity in the Arctic would include flaw lead systems (waterways opening between pack ice and fast ice), polnyas (areas of open water surrounded by sea ice), areas of oceanographic fronts where mixing between cold polar and temperate waters occur, and marginal ice zones. A MSP initiative would be the appropriate approach through which to plan the future of multiple uses, identify areas for conservation, and help identify and rank baseline data gathering and applied research. It would demonstrate a commitment to an ecosystem-based management approach in the Arctic in a practical sense and could test new concepts of networked governance. This alternative could only be undertaken with the approval and cooperation of the host Arctic country.

4. An Arctic-wide, Systems Approach among National Governments

Planning for integrated, ecosystem-based management should be encouraged across Arctic countries—and a focus on MSP could be a first step in that direction. This approach would tackle the entire Arctic region, probably under the aegis of the intergovernmental Arctic Council. While the Arctic Council is not an operational body that can impose obligations on its participants, it could undertake marine spatial *planning* for the entire Arctic region with the understanding that *implementation* of any plan would be the responsibility of individual Arctic coastal nations.

Preliminary work on MSP has begun through the Arctic Council's PAME (Protection of the Arctic Marine Environment) Work Plan for 2009-2011.[59] The PAME continues to review the Arctic Marine Shipping Assessment and the Arctic Offshore Oil and Gas Guidelines. It is developing pilot projects to make the large marine ecosystem (LME) assessment approach operational (in the Canadian/US Beaufort Sea and the US/Russian Federation West Bering Sea).[60] However, *no current plan exists to develop a marine spatial plan for the entire Arctic region.* Given the working arrangement for PAME (two meetings a year) and the level of investment in its work plan (>$140,000 per year), little progress on an Arctic-wide approach to MSP can be expected over the next few years without a substantial infusion of new resources.

5. An Arctic-wide, Systems Approach beyond National Governments

Most current applications of MSP are carried out by national governments and can be characterized as "top down". For example, MSP initiatives in Western Europe, including Norway, have all been led by federal ministries, with varying levels of participation by non-governmental actors and stakeholders.

Another alternative to advancing MSP in the Arctic would explicitly recognize the importance of moving beyond sole reliance on the initiatives of national governments and toward a "networked governance" approach to guide the future of the Arctic development. Networks and partnerships of non-governmental actors including indigenous peoples, environmental non-governmental organizations, academia, and private industry, all of whom have substantial influence over governmental policies and actions, could be used to initiate MSP. Precedents exist. In Belgium, the University of Ghent laid the groundwork for MSP that was later implemented by the national government. In the United States, NGOs and the private sector,

particularly new private users of ocean space, e.g., wind farms and offshore aquaculture, have been particularly influential in the development of a national MSP framework. Local indigenous peoples (Coastal First Nations) have led by example the MSP process in British Columbia from the "bottom up" (See Box 6).

Similarly, Indigenous Peoples from the Arctic could take the initiative to develop an Arctic-wide approach to MSP through a network of their organizations including the Aleut International Association, the Arctic Athabaskan Council, the Gwich'in Council International, the Inuit Circumpolar Council, the Russian Association of Indigenous Peoples of the North (RAIPON), and the Saami Council. While capacity building to begin MSP might be needed, technical advice could be sought from the Coastal First Nations Planning Office in Vancouver, British Columbia, and the Beaufort Sea Planning Office in Inuvik, Northwest Territories, Canada. Initially the Arctic Council Indigenous Peoples Secretariat in Copenhagen, Denmark could provide coordination of this initiative. Alternatively, the initiative could be self-organizing, relying on the interests and initiative of a few indigenous organizations and their leadership. The important role of MSP "champions" within these organizations cannot be over-stated. Getting started and maintaining momentum of a MSP initiative requires early buy-in by leaders and their organizations. Listening to successful stories from the MSP initiative of the Coastal First Nations could build support for an Arctic-wide MSP initiative. New Internet-based, low-cost (or free) communications technology, e.g., face-to-face video calls, video conferencing, and webinars, could be used to supplement or substitute for long-distance Arctic travel.

An initial task would be to find adequate financial support for the initiative that could take 3-4 years to complete a first integrated, ecosystem-based marine spatial plan for the Arctic at the cost of about US$1.5-2 million per year.[61] Total funding required would be about US$ 6-8 million dollars. Funding should be sought from several foundations and the private sector, especially Arctic users.

If funding can be found, then a number of pre-planning tasks should be undertaken including the creation of a MSP team, the development of a work plan, and a definition of boundaries and a time frame for planning, e.g., 10 years, 20 years. Other early tasks would include defining MSP principles and goals (see pp. 25-29 of this report and the UNESCO Guide to MSP for additional details). These tasks should be completed during the first year of planning, if not earlier.

A key task of moving toward an ecosystem-based management approach is the identification of "ecologically or biologically important areas" based on the best available scientific information and local knowledge. Some places in the sea have much greater importance than others for particular species, ecosystems, or processes, as well as for humans, too. "Real estate values" in the sea vary enormously, just as they do on land. Knowing which places are most important to conserve and which places are compatible with development is central to the art of MSP. The output of this task, an Arctic-wide map of these areas, is a requisite for ecosystem-based MSP (additional information on identifying ecologically and biologically important areas can be found on pp. 50-55 of the UNESCO MSP guide. The Pan-Arctic initiatives of IUCN, NRDC, and Shell (an international organization, a NGO, and a business) described in the previous section could substantially contribute to the development of an Arctic-wide marine spatial plan.

Leadership through a MSP initiative by Indigenous Peoples could provide the basis for other stakeholders, e.g., the business and NGO communities, to collaborate in the planning process. Eventually the Arctic Council and national governments would participate, particularly in the implementation of many spatial and temporal management measures.

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F.

An Evaluation of the Science Needs to Inform Decisions… USGS Circular 1370 (Ch. 5-8 & Appendices)

Chapter 5

Oil-Spill Risk, Response, and Impact

By Leslie Holland-Bartels and Jonathan J. Kolak

Introduction / Rationale

Parties with interest in oil and gas development decisions in the Arctic Offshore Continental Shelf (OCS) have varying views and concerns over the probability that such activities will result in an oil spill in the Arctic. They also differ in their views of how prepared government and industry are to respond to and understand the consequences of any such spills. The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) expresses the challenge the Nation faces in understanding and balancing the risks to its environmental assets as it explores and utilizes energy endowments.

> *"Estimating large oil-spill occurrence or large oil-spill contact is an exercise in probability. Uncertainty exists regarding whether exploration or development will occur at all and, if it does, the location, number, and size of large oil spill(s) and the wind, ice, and current conditions at the time of a spill(s). Although some of the uncertainty reflects incomplete or imperfect data, a considerable amount of uncertainty exists simply because it is difficult to predict events 15–40 years into the future" (Minerals Management Service, 2008a).*

The tiered decision process used to inform OCS actions regarding whether and how to proceed with oil and gas development involves making decisions that in the early planning phases have high unknowns but progress to actions whose potential effects and footprint can often be more easily judged. For example, the Federal planning process for oil and gas development steps from general, national OCS-wide 5-year plans, which have the highest unknowns, to lease sale plans, to individual exploration activities, with significantly more project detail. After the U.S. Geological Survey (USGS) OCS Team completed its preliminary examination of documents, it was evident that scientific and technical information related to our Issue Topic of Oil-Spill Response (research needs to allow for an effective and reliable oil-spill response in ice-covered regions) occurs throughout the tiered planning and decision process. Similarly, science needs exist for other agencies that are "downstream" of these planning and decision processes. Within the leasing decision process, for example, there are biological opinions (such as those from the National Marine Fisheries Service, 2008; U.S. Fish and Wildlife Service, 2009) or water and air permit actions (from the U.S. Environmental Protection Agency). There are other processes outside the leasing process that also have a critical nexus to decision making about energy development, and these also require information. For example, while not specific to any leasing process, the Alaska Regional Response Team (ARRT; 2010) provides Federal, State, and local governmental agencies with the means to participate in response to pollution incidents. The ARRT also provides these governments' overall joint spill preparedness and response plans, and its policies on spill countermeasure use are important to spill response in the Arctic and elsewhere. Industry may have the capability to use dispersants; however, they cannot do so without following ARRT guidelines. Similarly, the Natural Resource Damage Assessment (NRDA; National Oceanic and Atmospheric Administration, 2011), which takes place after a spill event and is outside of the BOEMRE program, is an important consideration within the decision framework of many of those that participated in our expert consultations. The main questions are, can the environmental consequences of any potential oil spill in the Arctic be understood and quantified sufficiently to judge the risks and benefits of energy development, and can restoration be accomplished should a spill occur? Uncertainty in the answer to those questions influences public perception, which in turn feeds

into the various permitting processes, or into legislative or litigation action. Planning and (or) regulatory actions are taken by a wide range of entities that require scientific and technological information. Based on these considerations we reframed our assignment to consider science needs within the full array of issues that influence the public's perception on the ability to develop effective and reliable responses to oil spills in the Arctic.

First, we provide a brief description of major on-going efforts that identify necessary science and related technologies to help minimize the probabilities of an oil spill and to improve spill preparedness activities. We then focus our examination on how scientific information informs and what gaps might exist for these subjects: (1) estimating the potential effects of oil spills in pre-decisional planning, (2) informing spill contingency planning and spill response, and (3) informing post-spill damage assessment and restoration considerations. At the conclusion of this chapter, we bring in materials first presented in Chapter 4, Climate Change Considerations related to potential future climate conditions in the Arctic and how any changes in environmental conditions might influence our present understanding of oil-spill risk, response, and impact.

Overarching Efforts and Real-Time Communications

The engagement and investment to develop data, approaches, and technologies that inform effective spill response comprise an ongoing and rapidly evolving effort that the USGS OCS Team wanted to ensure was not lost as we delve into specific details later in this chapter. It is best reflected in the numerous on-going study programs and recent documents, forums, and bibliographies that examine research and other preparedness issues. The BOEMRE environmental (Bureau of Ocean Energy Management, Regulation and Enforcement, 2010b) and technology (Bureau of Ocean Energy Management, Regulation and Enforcement, 2010c) programs and ongoing Joint Industry Program (JIP) activities, such as SINTEF (2010), provide up-to-date links to proposed, ongoing, and completed projects. The Prince William Sound Oil Spill Recovery Institute, established by Congress under the Oil Pollution Action of 1990 to support research, education, and demonstration projects designed to address oil spills in Arctic and sub-Arctic marine environments, maintains an active program to examine science associated with issues like the fate and effects of spilled oil in the Arctic and the ability of spill responders to mitigate impacts of spilled oil as reflected in their 2011–2015 Research Plan (Prince William Sound Oil Spill Recovery Institute, 2010).

Scientists, managers, and regulators meet often in a variety of venues to present the most recent progress and challenges. For example, the 2011 Alaska Marine Science Symposium sponsored a workshop "Lessons Learned from the Gulf of Mexico" (http://vislab-ccom.unh.edu/~schwehr/2011AkMarSciSym/, accessed March 30, 2011). Speakers discussed aspects of the *Deepwater Horizon* oil-spill response approaches and challenges as they might inform Alaska spill preparedness. The 2007 International Oil and Ice Workshop (http://www.boemre.gov/tarprojects/587/webpages/home.html, accessed May 5, 2011), the second such workshop, brought together an international audience to advance knowledge of spill response in cold water and ice, including remote sensing, enhancements to mechanical recovery systems, chemical herders in ice, cold-water dispersants, experimental spills, case studies, and ongoing and future research programs. The bi-national U.S. and Canada Northern Oil and Gas Research Forum and the BOEMRE Information Technology Meetings offer opportunities to share new information in many topical areas. Discussions cover, for example, environmental conditions in exploration areas, interaction of oil and gas activities with sensitive coastal habitats, ice engineering for offshore operations, oil-spill prevention and management in the Arctic, and monitoring for cumulative effects. Presentations are publicly available (for example, North Slope Science Initiative, 2010; Bureau of Ocean Energy Management, Regulation and Enforcement, 2011a). Focused workshops, such as the U.S. Coast Guard (2010) on operating in the Arctic or Coastal Response Research Center (2009, 2010), examine factors to improve preparation and response to marine incidents and document practitioner perspectives on operational and science gaps. A wide variety of near real-time information related to oil and gas development considerations is generated and shared in a variety of these forums. The question is not if such information is being produced, but rather what that information is and how it moves into the appropriate planning and decision processes of regulators and other vested parties.

5.01. Finding: The level of information and the number of entities generating scientific and technical information on spill preparedness topics are increasing exponentially as enhanced attention is turned towards the Arctic in general, and resource development more specifically. Individually, sources are well structured, but they roll up to a complex information challenge. It is difficult to know which identified needs are being addressed fully or partially, what new issues or insights have emerged, or how one should weigh the importance of identified gaps.

5.01. Recommendation: The coordinated organization of data for access and distribution by all parties of particular workshop findings and recommendations would improve the value of such forums to help guide science planning and funding decisions. A holistic and up-to-date analysis of recommendations and insights presented in these "real-time" symposia also would help clarify and bring more transparency to what new or continued science investments are needed. Potential approaches to consider are systems similar to the National Biological Information Infrastructure portal (http://www.nbii.gov/) or enhancements of existing systems, such as Alaska Ocean Observing System (AOOS) (http://www.aoos.org/) or the North Slope Science Initiative (http://www.northslope.org/).

Minimize Spill Probabilities Through Infrastructure Decisions

The USGS OCS Team is not well positioned to rigorously consider the state of knowledge or key information and technology gaps related to infrastructure engineering. However, it generally is accepted that effective Arctic technologies are the first step in overall oil-spill risk minimization. In addition to technologies, a sound understanding of bathymetry, ice scour, and shoreline erosion data and processes can improve infrastructure siting decisions. The BOEMRE has an active program to develop safety-related information in advance of future operations in the Arctic. As part of their Technology Assessment and Research Program, engineering properties and forces of moving ice on structures and pipelines are being studied (http://www.boemre.gov/tarprojectcategories/ice.htm, accessed March 30, 2011). The IMV Projects Atlantic (2008) assessed the current state of offshore technology in Arctic and sub-Arctic regions that might be applied in the Beaufort, Chukchi, and Bering Seas. They suggested the following to be valuable:

- development of a regional ice gouge database for the U.S. Beaufort and Chukchi Seas;
- identification of ice gouge recurrence rates;
- collection of multi-year ice thickness distribution, ridge dimensions and frequency within a floe, floe-size distribution, floe-speed distribution;
- definition of first-year ice thickness distribution, ridge dimensions;
- development of a regional geotechnical database;
- advancements in allowable/acceptable pipeline strain limits, repair techniques, leak detection systems;
- advancements in subsea protection systems, and trenching technologies;
- increased clarity on emergency well-control requirements; and
- advancements in determining maximum gouge depth based on ice strength and driving forces.

The IMV Projects Atlantic authors also examined open-water conditions with large fetches and waves because of the potential and now realized higher waves resulting from greater ice-free periods. The authors felt limited in their ability to consider this topic and supported the need for the compilation and collection of ice, meteorological, and oceanographic information to be used by all parties involved in infrastructure decisions. The generation of such data is an ongoing process within the BOEMRE annual studies process.

As noted above, information exchanges, such as the bi-national U.S. and Canada Northern Oil and Gas Forums, offer the best insight into topics that need to be addressed in the near term. Practitioners are investigating approaches to address ice forces on offshore platforms; offshore structure design challenges from ice load, scour, and thaw strain; predictive advances for critical sea-ice characteristics; extreme ice events; and impacts of increased open-water summer storms. These and other international forums support rapid and efficient transfer of state-of-the-art information on advancing technological challenges and successes.

Examples of the BOEMRE Technology Assessment and Research Program titles for Arctic safety and ice mechanics projects.

(http://www.boemre.gov/tarprojectcategories/ice.htm)

- Sea-ice scaling effects
- Engineering model for ice/soil/pipeline interaction
- Sea Ice Mechanics Workshop
- Safety/integrity of Arctic marine pipelines
- Scour and Arctic Marine Pipeline Workshop
- Risk assessment for ice damage to seabed facilities
- Ice Scour and Arctic Marine Pipeline Workshop
- 22nd International Offshore Mechanics and Arctic Engineering Conference
- Construction and maintenance of ice islands: Current practice and future research
- Measurement and control of underwater noise from oil drilling and production operations
- Design options for offshore pipelines in the U.S. Beaufort and Chukchi Seas
- Arctic offshore technology assessment of exploration and production options for cold regions of the U.S. Outer Continental Shelf
- Banff 1999, 2001, 2003 Pipeline Workshops
- Sea spray icing of drilling and production platforms
- Assessment of superstructure ice protection as applied to offshore oil operations safety
- Seabed scour and buried-pipeline deformation due to ice ridges
- Collection and archiving of environmental data relevant to design of Arctic structures
- Beaufort and Chukchi Seas ice design criteria
- Frictional sliding of sea ice
- Tracking ice islands and extreme ice features from Ellesmere Island to the Chukchi Sea
- 2009 freeze-up study of the Alaskan Beaufort Sea and Chukchi Sea
- ICESTRUCT JIP: Ice Effects on Arctic Offshore Structures
- Arctic Offshore Technology Assessment
- 2010 freeze-up study of the Alaskan Beaufort and Chukchi Seas

5.02. Finding: Significant coordinated international effort by industry and governments is taking place to develop safe and effective infrastructure and technologies to access energy resources in ice-covered Arctic waters. It appears that potential individual stress points are being well analyzed. Practitioners are investigating approaches to address offshore structure design challenges from forces, such as: ice load, scour, and thaw strain; and predictive advances for critical sea-ice characteristics, extreme ice events, and impacts of increased open-water summer storms. It was not evident to us how these efforts come together in a holistic analysis of full system risks to identify sensitive infrastructure components and the priority science and technology needed to enhance performance and safety. The types of physical threats to infrastructure related to ice (described above) generally are known but their distribution and the degree of the threat across the geography of potential leasing areas were not fully evident in our limited examination.

5.02. Recommendation: Efforts by the BOEMRE and industry to facilitate discussions of infrastructure needs and advances should receive continued support. For example, the recommendations of the BOEMRE-commissioned study by IMV Projects Atlantic (2008) to compile and collect ice, meteorological, and oceanographic information to be used by all parties involved in infrastructure decisions should continue to be considered and incorporated into the annual Federal and industry work planning process. However, many-faceted and different entities examine infrastructure needs and potential solutions and this is a highly technical discipline. Thus, communication of advances and discussion of remaining critical needs could be enhanced through a coordinated, transparent full-cycle risk model. While this would be valuable within the engineering and technical community, such an approach also could provide a more effective means for the non-engineering community to see, understand, and engage in discussions about development benefits and risks.

Assessing Risks and Potential Effects of Oil Spills

Background

Oil-spill risk analyses and their models and input data requirements used in Beaufort Sea and Chukchi Sea Planning Area decisions follow national protocols outlined in numerous documents (for example, Minerals Management Service, 2006 [appendix C], 2008a; Bureau of Ocean Energy Management, Regulation and Enforcement, 2010a). The major modeled components in these analyses include estimates of spill occurrence, spill trajectories, oil weathering patterns, and intersection probabilities with specific landscape units that are used to estimate fate and effect.

Two key probability analyses are considered—the hazard-based Conditional Probability and the risk-based Combined Probability. The former assumes a spill has occurred and then estimates the percent chance that a large spill would reach coastal habitats or other critical assets (for example, archeological sites, harbors). The latter expresses the percent chance of one or more oil spills ≥1,000 barrels (bbl) occurring and that such oil contacts a certain environmental resource area or land segment. The chance of one or more large spills occurring is derived from the spill rate (obtained from a fault-tree analysis discussed below) and the assumed resource volume. These analytically derived risk probabilities are subsequently combined with best available ecological information to qualitatively express potential impacts as illustrated in this excerpt from the Minerals Management Service (2007):

> " The Oil-Spill-Risk Analysis (OSRA) model estimates a 40% chance of one or more large spills ≥1,000 bbl occurring over the production life of Alternative I, but only 1% chance of one or more large spills occurring and contacting the U.S. Chukchi coastline within 3 days over the production life of Alternative I. If a large oil spill did contact this coastline, the oil probably would persist in a few of the tidal and subtidal sediments for a couple of decades, leading to a local but moderate effect on the few intertidal lower trophic-level organisms. The chance of one or more large spills contacting the U.S. Chukchi coastline increases to 6% within 30 days over the production life of Alternative I, demonstrating the advantages of requirements for rapid response capability."

Estimation of Spill Occurrence

Because there is limited Arctic OCS development, sufficient historical data on offshore Arctic oil spills do not exist to calculate spill probabilities directly. The BOEMRE has used Gulf of Mexico (GOM) and Pacific OCS data as analogs. However, since 2002, the BOEMRE has modified and supplemented these data to represent expected Arctic performance for large spills through a statistical fault-tree approach (for example, Bercha Group, Inc., 2006a, 2006b, 2008a, 2008b). Figure 5–1 shows a typical fault tree for both large pipeline and platform spills. Input rational is developed for Arctic modified effects, such as for process plant and storage tank release, structural failure, storms, and collision events (table 5–1). Arctic-unique effects are additive components whose quantifications are done in a "relatively cursory" way based on judgment (Minerals Management Service, 2006, appendix C). Updating the methodology and input data are a regular part of the BOEMRE Alaska OCS annual study planning process. For example, the 2011 proposed plan includes the updating of the fault-tree analyses with any new oil-spill occurrence reports, geohazard data, or GOM OCS historical data inputs; generation of fault-tree analyses for Arctic oil and gas lease sales based on the BOEMRE exploration and development scenarios; and generating life-of-field oil-spill occurrence rates and indicators (Prentki, 2010).

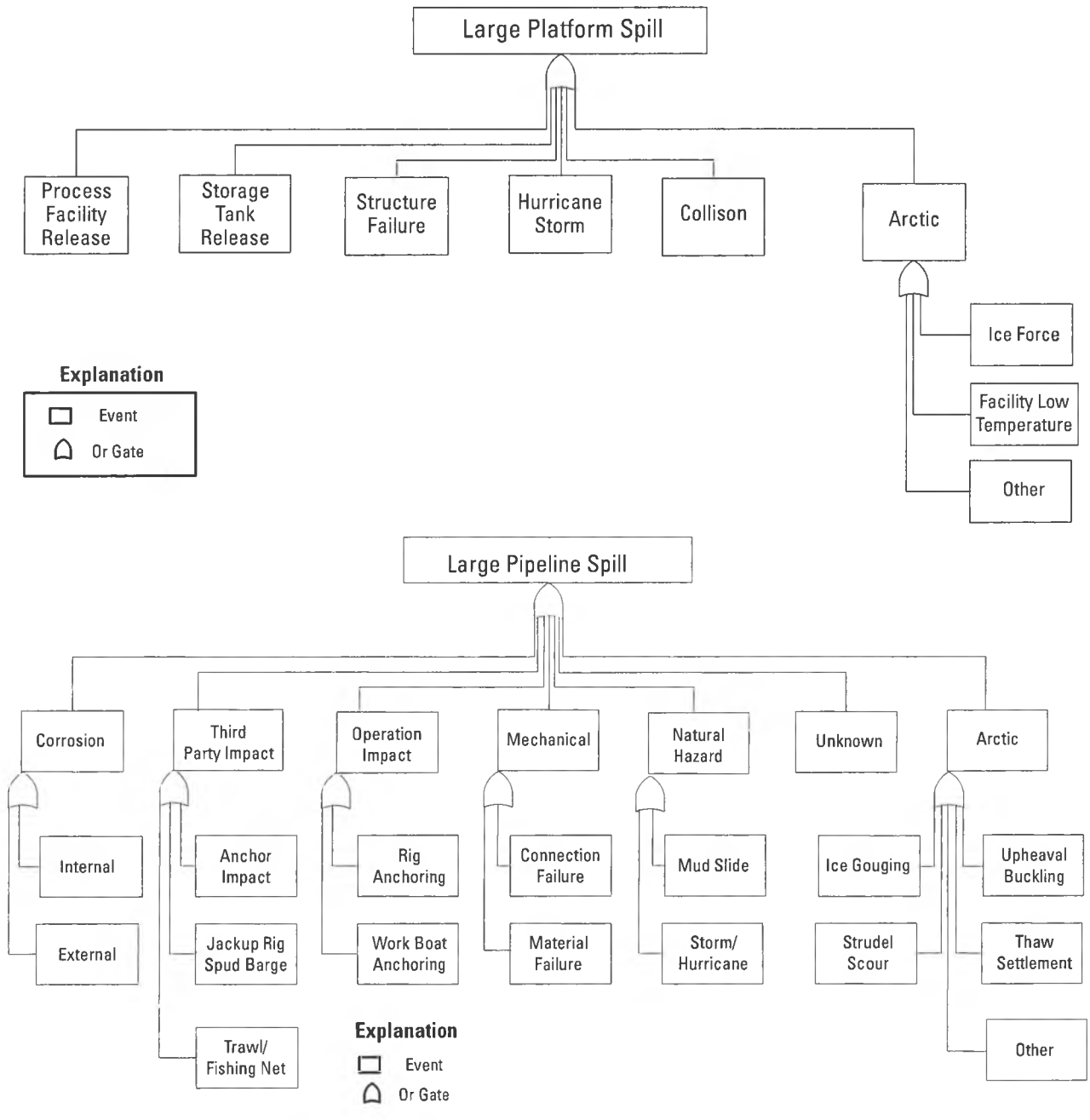

Figure 5–1. Typical fault tree for pipeline or large platform spill outlining key inputs including Arctic-specific factors, such as upheaval bucking, ice gouging, thaw settlement, scour and ice force, and facility temperature (Minerals Management Service, 2006, appendix C, figs. C–2 and C–3).

Table 5–1. Example of platform fault-tree input rational for Arctic modifications and unique considerations from Gulf of Mexico base data.

[Minerals Management Service, 2006, appendix C, table C–2. **Spill size:** All, all spill sizes combined; SM, small (≥50 and <100 bbl) and medium (≥100 and <1,000 bbl); HL, large (≥1,000 and <10,000 bbl) and huge (≥10,000 bbl)]

Event classification	Spill size	Percentage of frequency change			Reason
		Shallow	Medium	Deep	
Arctic modified					
Process facility release	All	(30)	(30)	(30)	State-of-the-art now, high quality control, high inspection and maintenance requirements
Storage tank release	All	(30)	(30)	(30)	State-of-the-art now, high quality control, high inspection and maintenance requirements
Structural failure	All	(20)	(20)	(20)	High safety factor, monitoring programs
Hurricane/storm	All	(50)	(40)	(30)	Less severe storms
Collision	All	(50)	(50)	(50)	Very low traffic density
—		**Frequency increment per 10^4 well-year**			—
		Median Expected	**Median Expected**	**Median Expected**	
Arctic unique					
Ice force	SM	0.1447	0.2170	0.3256	Assumed 10,000 year return period ice force causes spill 4 percent of occupancy 85 percent of the spills are SM
		0.0340	0.0510	0.0765	
	HL	0.0255	0.0383	0.0575	
		0.0060	0.0090	0.0135	
Facility low temperature	SM	0.1000	0.1000	0.1000	Assumed 10 percent of historical process facilities release frequency and corresponding spill size distribution
		0.1000	0.1000	0.1000	
	HL	0.0080	0.0080	0.0080	
		0.0080	0.0080	0.0080	
—	SM	0.0244	0.0316	0.0424	10 percent of above
		0.0134	0.0151	0.0177	
	HL	0.0033	0.0046	0.0065	
		0.0014	0.0017	0.0022	

5.03. Finding: The spill probability—fault-tree process—is a well documented, transparent, and best available approach to deal with estimations of spill likelihood in the Arctic OCS given that regional historical data on spills are not available. However, the approach depends on accurate adjustments of non-Arctic data to likely Arctic outcomes, which are admittedly done in a somewhat cursory manner. Climate change considerations also may alter the validity of spill frequency adjustments. For example, adjustment of GOM spill frequency probabilities downward because of an assumption that storms are less severe in the Arctic and that a reduced collision rate exists because of less traffic (table 5–1) as compared to GOM values may need to be reconsidered. For example, increases in storm severity and traffic patterns have already been observed and may increase in response to changing climate and ice conditions in the Arctic (see Chapter 4, Climate Change Considerations).

5.03. Recommendation: Continued updating of spill data, re-examination of statistical approaches used in the application of non-Arctic analogs (see Eschenbach and others, 2010), and rigorous development and incorporation of climate-influenced forecasts on factors such as storms, vessel traffic, or other fault-tree model adjustments would provide improved understanding of and confidence in spill risk estimates over the proposed project life.

Spilled-Oil Weathering and Persistence

The weathering characteristics of spilled oil influence the range of drift and spreading considered within spill trajectory assessments and dictate the effectiveness of chemical dispersants, *in-situ* burning, or mechanical responses (Daling and others, 1997; Prenki and others, 2004; fig. 5–2). The BOEMRE employs the Norwegian-developed and field tested (Daling and others, 1997; Daling and Strøm, 1999) SINTEF Oil Weathering Model (OWM) that incorporates oil density, viscosity, pour point, flash point, and water content and physical processes, such as spreading, evaporation, oil-in-water dispersion, and water uptake, as factors within its model-weathering calculations. The OWM is run over a 30-day time horizon, but has not been verified against field data for more than 4–5 days, nor does the SINTEF OWM incorporate the effects of currents, beaching, photo-oxidation, microbiological degradation, adsorption to particles, or encapsulation by ice that might affect degradation rates and toxicological characteristics. A summary of the model and uses within OCS analyses are presented by Prentki and others (2004).

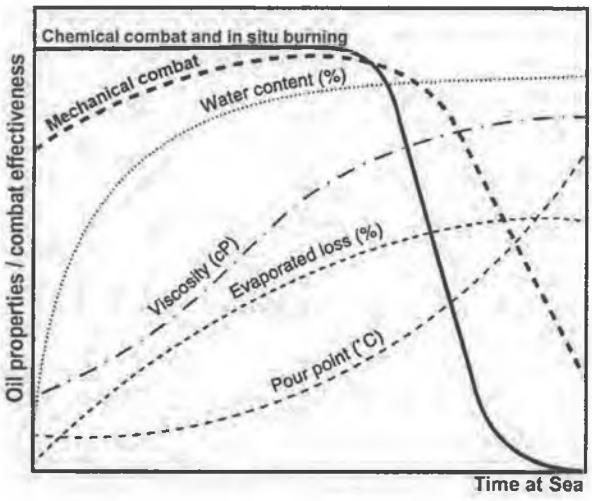

Figure 5–2. Schematic from Daling and others (1997, fig. 2) showing how oil properties change over time and influence spill response tool effectiveness.

Weathering is the combination of numerous physical, chemical, and biogeochemical processes acting to alter the phase and (or) composition of the oil. The processes affecting the weathering of oil spilled in open water, even in cold-water environments, generally are well understood (Fingas, 2008b). Many of the fundamental processes—such as evaporation, dissolution, spreading, and photodegradation—affecting oil weathering in the Arctic also occur elsewhere, but may occur at different rates given the specific meteorological conditions present in the Arctic. Yet, when compared with the current body of knowledge regarding oil weathering processes in open-water and temperate conditions, the body of knowledge regarding these processes in the context of Arctic oil spills is "very limited" (Brandvik and Faksness, 2009).

Laboratory testing provides a view into the nominal response of various oil types to weathering under different environmental conditions. Simulations of spills in various ice conditions have been done (for example, Prentki and others, 2004), but with limited field testing. The JIP on oil spill contingency for Arctic and ice-covered waters addresses some of these shortfalls by conducting a suite of studies from laboratory testing to full-scale field tests. Efforts, such as those by Brandvik and others (2010a) to conduct mesoscale weathering experiments in both the laboratory and at small-scale field scales, provide data to improve the capacity of oil weathering models to better predict oil weathering in cold and ice scenarios. Oil properties (for example, evaporation, emulsification, natural dispersion, flash point) have been experimentally assessed in the laboratory through time in different ice coverages (for example, 0, 30, 50, 70, 90 percent) and for different oils; these assessments directly inform spill response planning. Mesoscale field experiments conducted under the JIP, such as those conducted in Svalbard, Norway (Brandvik and others, 2010a) reduce the uncertainties of oil behavior characteristics that are critical to spill trajectory models and spill contingency plan strategies. For example, Brandvik and others (2010a) found that ice presence can slow weathering processes such as evaporation and emulsification, and can extend the operational window for the use of tools such as dispersants and *in-situ* burning.

Oil emulsification is an important weathering process to understand because emulsification can inhibit the effectiveness of oil-spill countermeasures, and preserve some of the constituents in oil that would otherwise tend to degrade—such as n-alkanes and some classes of polycyclic aromatic hydrocarbons (PAHs). This preservation also can prolong the potential for spilled oil to serve as a source of toxic contaminants, such as PAHs, to the environment. For example, Short and others (2007) noted that residual emulsified oil ("oil mousse") contained abundant levels of these compounds in subsurface sediments of Prince William Sound shorelines some 16 years after the *Exxon Valdez* oil spill, indicating that the "…remaining subsurface oil may persist for decades with little change."

There has been extensive study of water-in-oil emulsions (Fingas, 2008b) under different conditions ranging in scale from laboratory bench top to field tests. Three categories of emulsions—stable, unstable, and meso-stable—with distinct

physical properties generally are recognized. For example, viscosity can vary by several orders of magnitude across these categories, and thus have ramifications for the fate and transport of emulsified oil in the marine environment. The composition of the source oil is a key factor affecting the potential of forming and the resulting stability of emulsions. The addition of energy, such as through wave action, is needed to initiate emulsification, but the threshold energy level needed to initiate this process is not well understood. Recent attempts to derive empirical models describing the formation of oil-in-water emulsions have been hindered by our limited understanding of the chemical behavior of oil constituents in the environment (Fingas, 2008b).

Sea ice also can affect the formation of water-in-oil emulsions. Studies conducted on the fate of oil released in multi-year ice documented that ice morphology is a key parameter affecting oil weathering in the presence of ice (Payne and others, 1991). These researchers have observed that

> "[m]elting first-year ice produced substantial amounts of slush ice, and a stable water-in-oil emulsion of Prudhoe Bay crude oil containing up to 60 percent water was formed within 4 hours of the onset of wave agitation in this slush ice field. In contrast, rotting multi-year ice appeared to have a much lower tendency to produce a slush ice matrix during melting, and the formation of stable water-in-oil emulsions occurred over a relatively longer period of time."

A better understanding of these processes could help delineate the timeframe over which emulsions can form and the "time window" for effective operational response. Knowledge of the stability of emulsions over time underpins monitoring the fate and transport of spilled oil through trajectory modeling and the compilation of oil weathering budgets.

Full-scale field experiments provide invaluable ground-truthing and adaptive learning opportunities. Few such experiments have been conducted in the Arctic and none in U.S. waters. Sørstrøm (2009) and Brandvik and others (2010b) document the most recent large-scale effort conducted in the Barents Sea in spring 2009. Oil weathering experiments, oil distribution and bioavailability, and actual systems of spill contingency were assessed. Field data support findings from mesoscale laboratory efforts on the nature of physical and chemical change as oil weathers under ice conditions.

Persistence of oil was significantly underestimated after the *Exxon Valdez* oil spill. Short and others (2007) found that during early stages of the spill, less viscous oil readily percolated into finer grained beaches and, as the spill progressed along the Gulf of Alaska, more exposed and bouldered beaches allowed the increasingly viscous oil to percolate into "protected" interstitial areas. It remains unclear what "refugia" sea ice and eroding shoreline characteristics in the Arctic may offer oil and what might be the influences on the spatial or temporal degradation of oil. Oil spilled under the ice may be incorporated into the ice sheet where comparatively little weathering/degradation may occur; however, during the spring melt, the encapsulated oil may be released and undergo evaporation and other processes. For this reason, the effect of sea ice on oil weathering is a critical consideration to oil spill contingency planning and response in the Arctic. A substantial body of work was conducted during the 1970s and 1980s to characterize the fundamental processes affecting how oil may become incorporated within ice, and subsequently affect oil weathering (Payne and others, 1991). This incorporation may occur fairly rapidly, in as little as 18 to 72 hours, depending on the time of year (Dickins and Buist, 1981). Recent studies of oil-in-ice interactions addressed a knowledge gap pertaining to how these interactions may affect the efficacy and (or) timing of the potential deployment of spill countermeasures. Brandvik and Faksness (2009) reported that:

> "[o]perationally important weathering processes for oil spill operations like water uptake, emulsion stability and viscosity vary with oil type. Normally they increase relatively fast with increased weathering time in open water. In ice-infested water, several studies have indicated that this increase with time (for example, water content) can be drastically changed depending on ice type, ice coverage and energy conditions in the ice. Little knowledge concerning this is available today, and only for a limited number of oil types and ice regimes… ."

One example of the need to understand these processes in the context of oil-spill response operations is as follows:

> "after only a few hours of weathering on open waters, an oil spill may become too viscous for application of dispersants; yet that same spilled oil, if associated with dense ice, may be amenable to treatment with dispersants even after several days of weathering" (Brandvik and Faksness, 2009).

As a result, the presence of sea ice may serve to inhibit natural weathering processes, and could thus serve to expand the operational "time window" for deployment of spill countermeasures.

Seasonal variations in sea ice also merit consideration for oil-spill response. For example, if oil was spilled under ice in the spring (after May), the oil might not become encapsulated in the ice due to insufficient new ice growth before seasonal melting commenced (Buist and others, 2008a). Conversely, a spill occurring just prior to or during freeze-up (Lewis and others, 2008) may become rapidly incorporated in ice, such that response efforts could include a combination of oil recovery and ice tracking and monitoring operations. State-of-the-art models, such as the SINTEF model, require detailed

physical and chemical information to characterize the oil-ice interaction; such level of detail typically is not available (Brandvik and others, 2006). Further, Brandvik and others (2006) reported that the state of modeling of oil weathering in the presence of sea ice remained constrained by the ability to model sea-ice physics at the appropriate scale. The need to further refine and verify these models of physical processes on oil fate and transport is identified as an information need for oil-spill response in the Arctic (U.S. Arctic Research Commission, 2010).

One of the key processes of oil weathering is the extent and nature of interaction of oil with brine channels in ice. For example, in earlier studies, Payne and others (1991) noted that

> "[i]f oil is released into water under freezing conditions of active ice growth, lower molecular weight aromatic components can be advected with the sinking brine generated during frazil ice formation to the stable bottom boundary layer where, as conservative dissolved compounds, they can persist without evaporation for periods of up to several months."

To further investigate the fate of hydrocarbons from spilled oil in ice, Faksness and Brandvik (2008) conducted field experiments to evaluate the potential for dissolution of water-soluble components (WSCs) into and through first-year (annual) ice. The transport of WSCs from the oil through the ice was documented, and low but detectable concentrations of these components at the bottom of the ice core were measured. This transport mechanism may serve as a vector by which biota at the bottom of the ice sheet are exposed to these WSCs, with the potential for entrainment into the Arctic marine food web. The authors compared the field studies with laboratory experiments—using the Chemical Response to Oil Spills: Ecological Effect Research Forum procedure—and the similar distribution of WSCs in both sets of samples was interpreted to reflect that the brine channels in the ice sheet serve as a transport mechanism of WSCs from oil, through ice via the channels, and into the underlying water.

Natural biodegradation of oil in the marine environment is part of the process of oil weathering, and biostimulation and bioaugmentation have been considered as oil-spill countermeasures (Swannell and others, 1996). In general, however, oil biodegradation rates are difficult to predict, given the influence of oil type, variability of substrates, and other variable factors, such as temperature and nutrients (Zahed and others, 2010). In 1981, an experimental spill, known as the Baffin Island Oil Spill (BIOS) Project, was conducted on the northern tip of Baffin Island in Nunavut, Canada, as a means of studying natural biodegradation from an Arctic marine oil spill (Sergy and Blackall, 1987). Although much of the original oil has naturally degraded over time, follow-up studies have shown that some patches of the spilled oil remain essentially unaltered after decades of exposure (Prince and others, 2002). The interactions with sea ice may affect oil biodegradation processes, and can provide routes for components from spilled oil to enter the Arctic marine food web (Faksness and Brandvik, 2008).

A good understanding of ambient microbial communities and processes is needed for the water column, sediments, and ice to understand the potential for microbial degradation of oil in the Arctic, and the potential impact of this on oil fate and ecosystem uptake. There have been recent activities to increase our knowledge in these areas (Interagency Coordinating Committee on Oil Pollution Research, 2009). Braddock and others (2004) noted that despite large-scale development on the Alaska North Slope, there was limited understanding of microbial communities in this setting, and much of this derived from studies that were decades old. Garneau and others (2009) reiterated this point, noting that the microbial characteristics of the coastal Arctic Ocean have been little explored, but that studies conducted to date on the Mackenzie Shelf in the Beaufort Sea provide information on the existence of diverse and active microbial communities, with variation among communities across salinity gradients. A survey of microbial populations from offshore of Barrow and

5.04. Finding: The interaction of ice and oil has long been recognized as an important factor affecting oil fate and toxicity in the Arctic environment. Recent studies have focused on oil-water partitioning (water-soluble compounds, WSCs) associated with ice melt and brine channel flux in the ice column.

5.04. Recommendation: There is a need to better understand oil-in-ice weathering, particularly as it relates to the effectiveness of spill response countermeasures and the potential for ecosystem exposure. Oil-water partitioning is recognized as needing further study, especially the potential toxicity of the partitioned phases, as oil trapped in ice may remain relatively fresh (that is, toxic). This process also points to the potential for a longer term spill response that follows the initial event for potentially several months given seasonal changes to the ice column (melting).

Prudhoe Bay, Alaska, provides a more recent characterization of endemic populations and metabolic capability to degrade petroleum hydrocarbons (Braddock and others, 2004). Braddock and others (2004) reported that the total microscopic counts of bacteria and culturable heterotrophs in the sediment samples were comparable with estimates from studies conducted in the 1970s and 1980s in the same areas. Kirchman and others (2010) investigated potential seasonal and spatial variations of bacterial community structures in the Arctic Ocean to help improve the fundamental understanding of relationships between bacteria and phytoplankton in the Arctic Ocean, which appear to differ from those found in lower latitude oceans. This information helps inform our understanding of primary production during the rapid transition from spring to summer when ice coverage decreases in the Arctic Ocean. In water column samples collected from various locations in the Chukchi and Beaufort Seas, there generally was no significant seasonal variation in communities despite strong seasonal gradients in biogeochemical properties (Kirchman and others, 2010). These findings may have ramifications regarding the ecophysiological flexibility of bacterial communities in the areas sampled (Kirchman and others, 2010). This is an area for further research as it could have implications for the adaptability of indigenous microbial communities to changes in carbon source, such as in the event of an oil spill.

Recent studies following the *Deepwater Horizon* oil spill have shown the importance of characterizing not only the indigenous microbial communities in benthic sediments, but also those in the water column. In particular, Hazen and others (2010) reported natural biodegradation of the dispersed oil plume in deep water. Because the microbial communities appeared to rapidly adapt—as reflected in hydrocarbon-degrading genes—in response to the oil plume, the researchers concluded that there was potential for intrinsic bioremediation of oil contaminants in the deep sea. As such, these communities may have an important role in the fate of hydrocarbons in the GOM (Hazen and others, 2010). Analogous studies of indigenous microbial populations in the Arctic are warranted to gain a better understanding of the potential for these processes to naturally attenuate an Arctic oil spill.

Oil-Spill-Trajectory Models

The OSRA Model (Smith and others, 1982) as refined by Labelle and Anderson (1985), Ji and others (2004), and others simulates oil-spill transport and is dependent on realistic wind velocity and ocean surface current data, as well as accurate information of the ecological, economic, and (or) social resources located along coastlines that might be transected by oil. State-of-the-art trajectory models and quality input data for spill trajectory likelihoods are represented by analyses for the GOM. Johnson and others (2007) reaffirm the conclusions of Ji and others (2004) that oil-spill risk analyses are dependent on detailed information of ocean currents and wind fields. The ocean current inputs are computed from an ocean circulation model driven by analyzed meteorological forces through models such as the Princeton-Dynalysis Ocean Model, which have been extensively assessed with field observations in the GOM (Herring and others, 1999) including data from some 340 drifting buoys (Ji and others, 2004). Similar rigorous data are not presently available for the Arctic OCS, but a strong scientific framework is emerging for 3-D coupled ice-ocean models and 2-D ice-associated oil spill models (for example, Wang and others 2003, 2010) that will improve as knowledge about oceanographic characteristics of the Beaufort and Chukchi Seas increases. Efforts to understand and address data insufficiencies are the focus of numerous ongoing studies by BOEMRE, the Alaska Ocean Observing System, and others.

5.05. Finding: Natural biodegradation of oil in the marine environment is part of the process of oil weathering. The presence of microbial communities gives rise to the potential for intrinsic bioremediation of oil spills. Indigenous microbial populations in the Arctic may play an important role in the fate of hydrocarbons following an oil spill. However, the effect of these populations on such oil weathering in the Arctic is not well understood.

5.05. Recommendation: Recent studies underscore the need to better characterize Arctic-based indigenous microbial populations in the water column and benthic sediment, and define rates of microbial processes. This will ultimately allow for the full characterization of the role such communities have in the oil weathering process.

Well documented analyses of data and technology needs for meteorological and physical oceanography can be found in Beaufort Sea assessments by Hoefler Consulting (2006, 2007) and Weingartner and others (2010a). Present Arctic assets are listed within the interactive Alaska Ocean Observing System's Arctic Assets Application (fig. 5–3). Hoefler Consulting (2006) recommends the establishment of a redundant sensor system. The current lack of redundancy may result in a critical link remaining down for some time should it fail, due to weather and logistical limitations to access the site and the cost of site visits. Such a system also would serve as an enhanced Arctic coast-wide network to serve spill response goals and inform broader questions such as how climate change may affect system dynamics (fig. 5–4). Weingartner and others (2010a) outline a series of large-scale studies that would help define the critical oceanographic characteristics of the Beaufort Sea OCS to better inform pre- and post-spill modeling/response. These also would define environmentally sensitive marine areas by examining oceanographic exchanges, understanding shelf-basin exchange via wind and eddies, better defining characteristics of the coastal boundary and under-ice river plumes, and defining the sea-ice boundary through examination of thickness and under-ice topography. New analyses of mooring data by Weingartner and others (2009) provide a scientific foundation to understand likely movement of a spill in near-shore waters, such as oil spilled beneath landfast ice. Such work appears to be more mature for the Beaufort Sea dating back to efforts under the 1970s Outer Continental Shelf Environmental Assessment Program (OCSEAP, for example, Aagaard, 1981), but attention to Chukchi Sea conditions has increased (for example, Weingartner and others, 2005). Newly installed high-frequency land-based radar (fig. 5–5) holds promise to provide near-shore real-time current data of value for spill modeling, as well as for spill response (Potter and Weingartner, 2009; Weingartner and others, 2010b). The International Ocean Observing System (2009) presents partner perspectives on the present needs for this technology for all their regional networks. Should development in the Arctic OCS continue, it is likely that an increased number of such sites should be considered. Regardless of the development future, while the number of Arctic sites presently is not dramatically different from those in the GOM, the Arctic has fewer oceanographic assets (for example, buoys) in general and would benefit from increased access to this new technology. Analyses critical to such large-scale integrated efforts to better understand oceanographic circulation factors in Arctic oil-spill risk analyses are ongoing through BOEMRE (fig. 5–6).

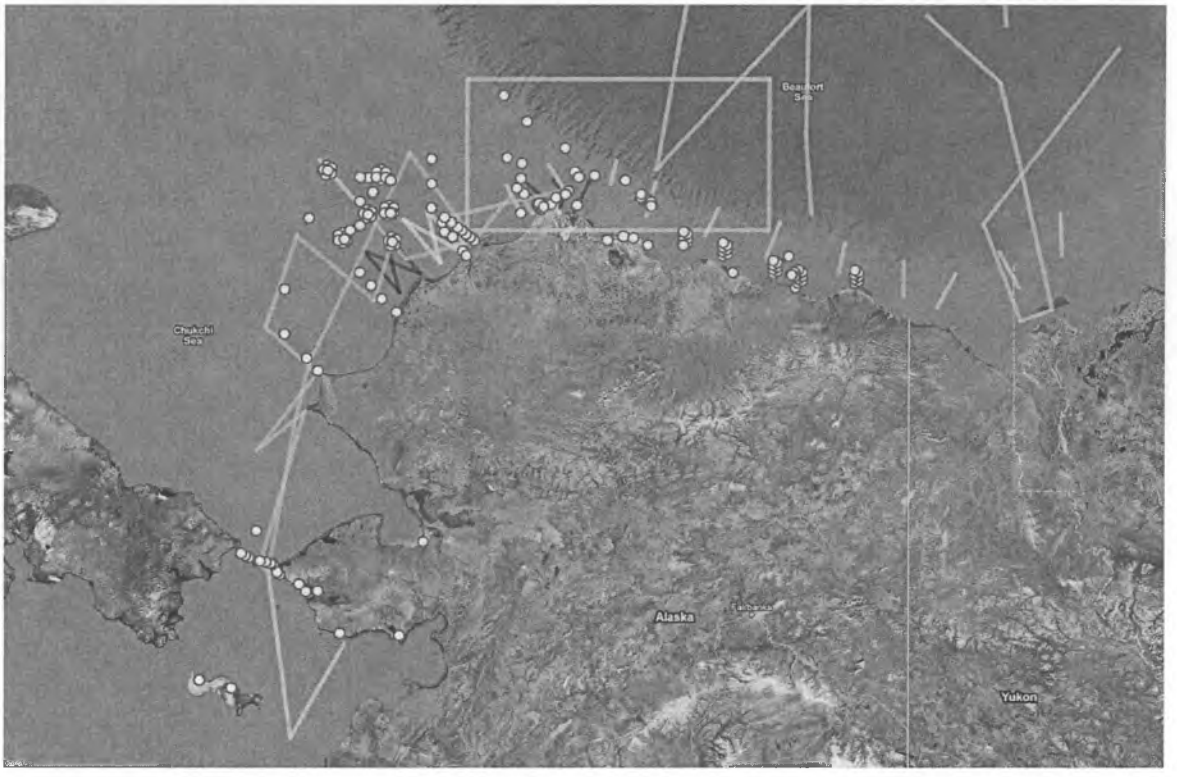

Figure 5–3. Examples of recent oceanographic cruises and sensor assets in the Beaufort and Chukchi Seas taken from the interactive Alaska Ocean Observing System's Arctic Assets Application. (Screen grab: http://data.aoos.org/maps/arctic_assets.php, last accessed February 1, 2011.)

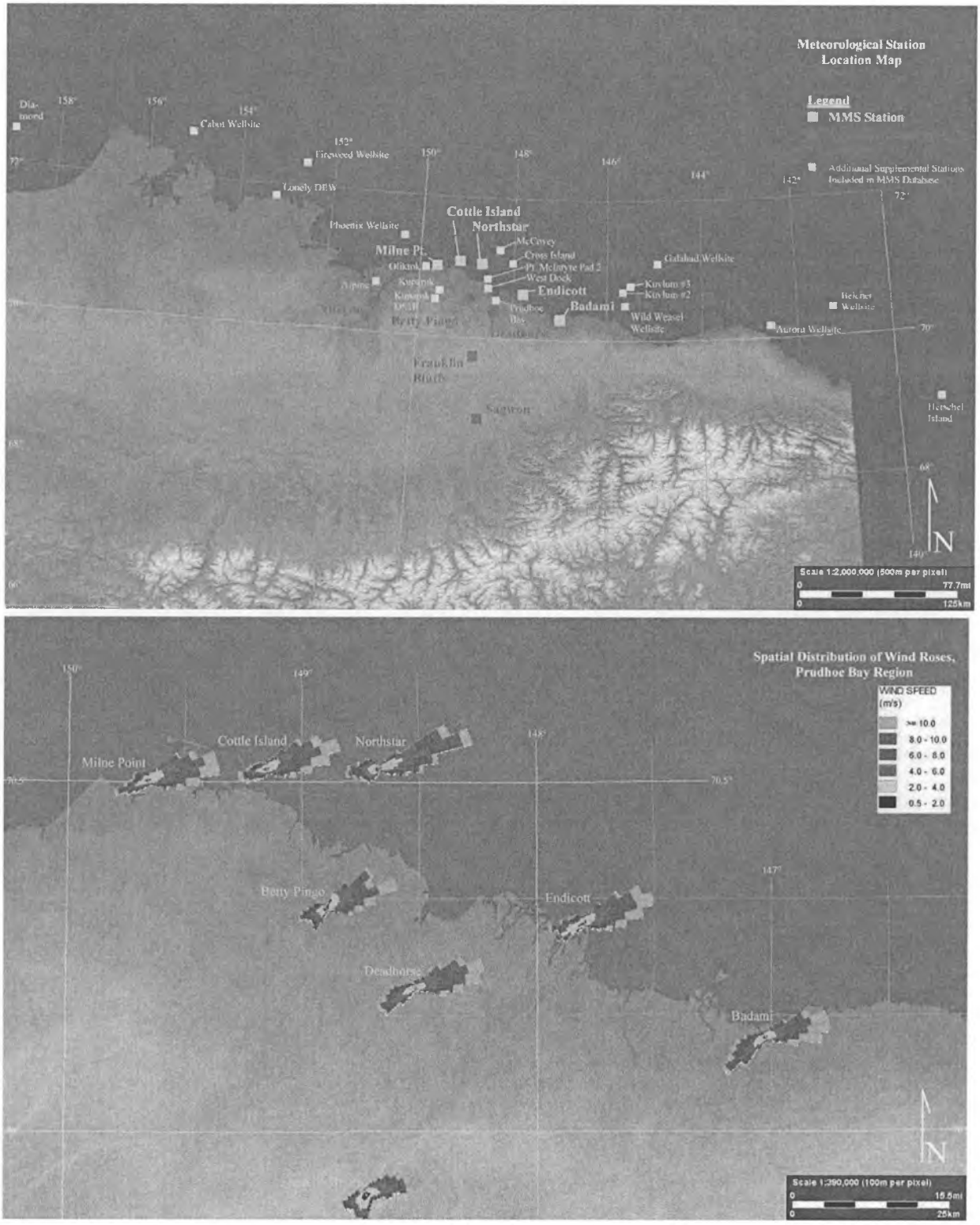

Figure 5–4. Examples of meteorological sites for the Beaufort Sea and spatial distribution wind roses generated by such stations, and other meteorological data useful for spill planning and response (from Hoefler Consulting, 2007, figs. 3–2, 4–21). (MMS, Minerals Management Service.)

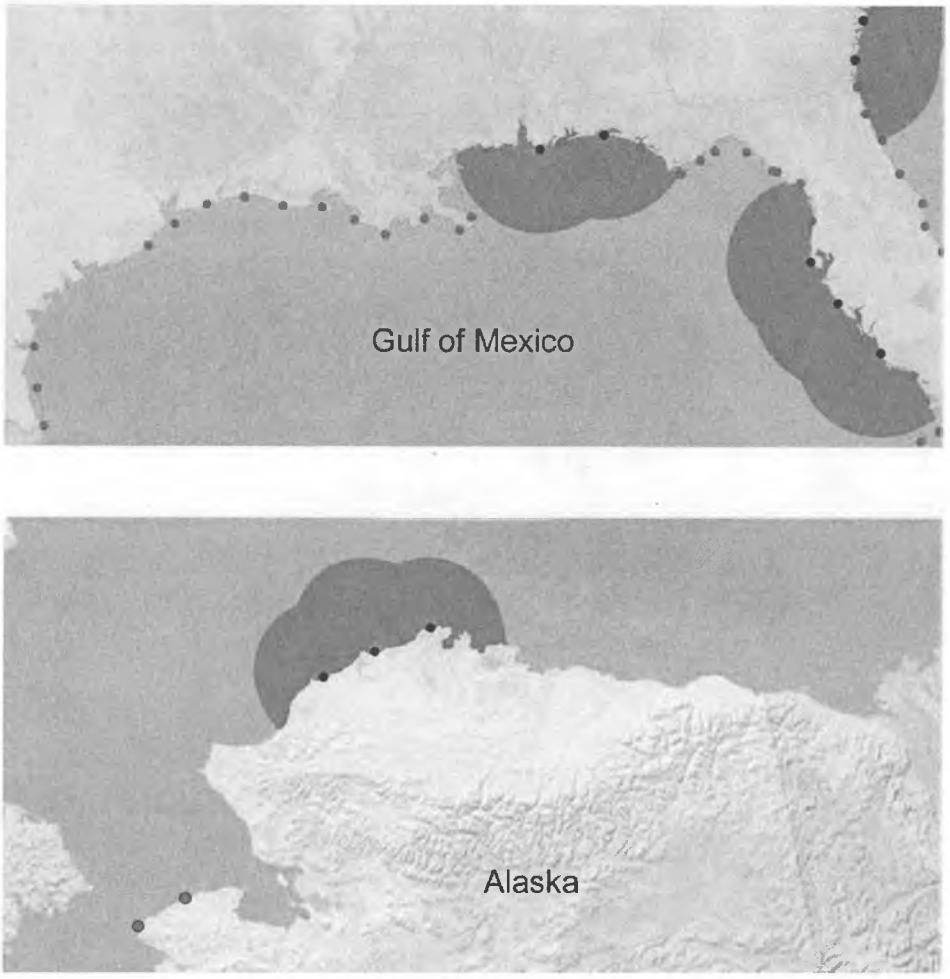

Figure 5–5. Existing High Frequency Radar (HFR) sites (black dots) and proposed sites (blue dots) modified from International Ocean Observing System (2009). The map of Alaska's North Slope and the Gulf of Mexico are to scale to demonstrate existing and proposed coverages (indicated by green areas) for these two major OCS regions.

5.06. Finding: The modeling framework used by the BOEMRE throughout its OCS program is well developed and has undergone rigorous analysis. However, physical oceanography and meteorology of the Arctic OCS are highly dynamic and not well understood because of the challenge of instrumenting a remote ice-influenced system such as the Arctic OCS. This is particularly true for the Chukchi Sea. Thus, the physical understanding of the Arctic OCS needed to inform models is not comparable with that of the GOM. This also is true for circulation or weather modeling that informs oil-spill-trajectory models. Outputs from such trajectory models influence ecological affect analyses, which are limited by the accuracy and precision of the physical data that inform them.

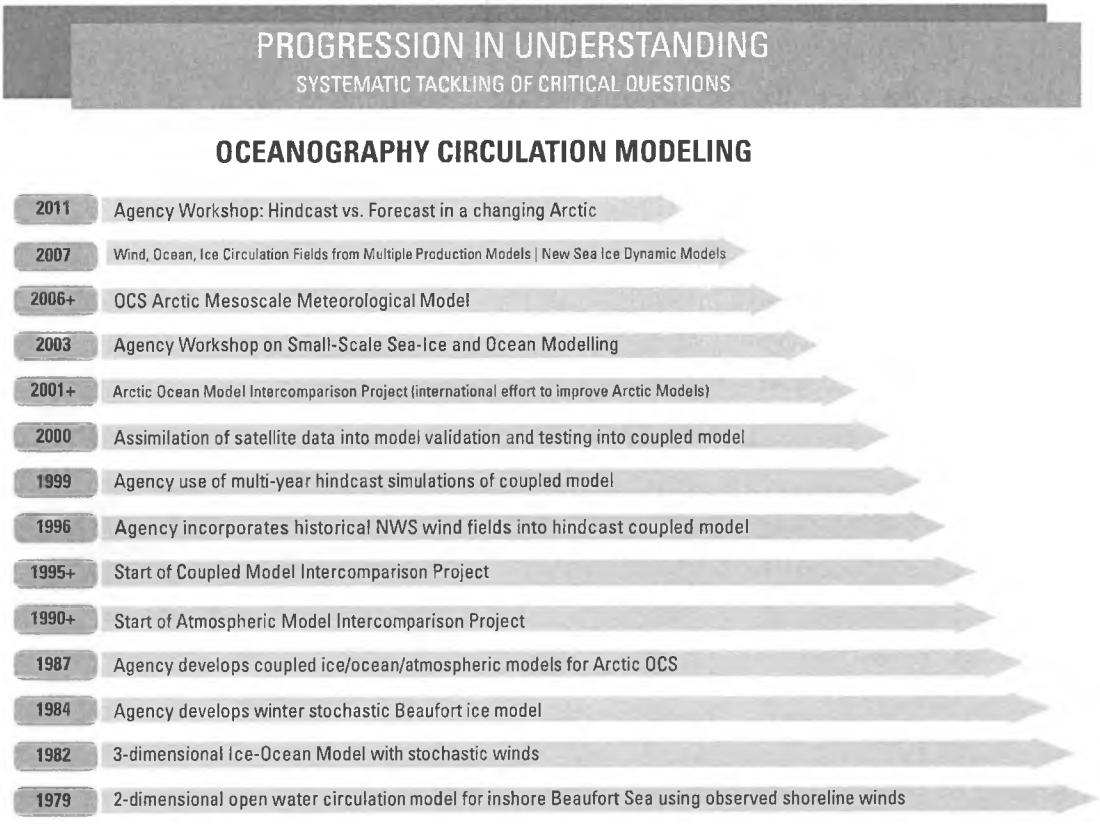

Figure 5–6. Schematic illustrating the progression of science developed under the BOEMRE OCS Environmental Studies Program to better inform an understanding of ocean circulation critical to topics such as oil-spill-trajectory models [Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), written commun., 2011].

5.06. Recommendation: Existing recommendations for the Beaufort Sea from Weingartner and others (2010a) and Hoefler Consulting (2006, 2007), if implemented, could significantly improve the weather and oceanographic data required by trajectory models. These recommendations include establishment of a redundant meteorological sensor system to enhance Arctic coast-wide spill response goals and a series of large-scale studies of oceanographic exchanges, shelf-basin exchanges via wind and eddies, coastal boundary, under-ice river plumes, and sea-ice boundary to better inform pre- and post-spill modeling and response. We did not find similar synthesized recommendations for the Chukchi Sea. If they do not exist, then producing such analyses would be quite valuable to improve model confidence. Physical oceanographic and meteorological data help inform a wide variety of issues in the Arctic. The international Arctic resource community might benefit from a broader discussion on core data needs and the efficient development of multi-purpose, multi-agency monitoring networks to inform energy development needs as well as climate forecasting, aviation, and shipping safety. The visualization and serving of data through a fully operational Arctic node similar to that of the Alaska Ocean Observing System would help ensure efficient access to information and improved asset planning that is critical in the Arctic where scientific instrumentation costs are high.

Ecological and Social Resource Intersection Analyses

Ultimately, oil-spill-trajectory models and their supporting oceanographic inputs are used to inform analyses of potential effects of spills on areas of environmental, social, and (or) economic interest. The processes described in the section "Oil-Spill-Trajectory Models" define where oil might transect an area (for example, shoreline, reef, migration route) in a very quantitative analytical approach that can be tested for sensitivity and become a foundation for documented improvement when new data or insights are developed (for example, Wang and others, 2010). The value of the area (for example, for subsistence, cultural needs, community infrastructure, or wildlife habitat) is based on best available information. Analysts designate segments important to various resources, and the time periods that those resources occupy that spatial location. This process is often done collaboratively through "expert" discussions and reviews of available literature and is well presented, for example, in the Draft Environmental Impact Statement for the Beaufort and Chukchi Seas multiple lease sales 209, 212, 217, 221 (Minerals Management Service, 2008a). An example of an Environmental Resource Area (ERA) designation and supporting scientific literature (fig. 5–7, table 5–2) helps illustrate the scientific foundation behind the resource designations. There is a significant range in the data that support ERAs from quite limited or dated [for example the Outer Kotzebue Sound (ERA 57)] to those with some 10 supporting sources covering some 40 years (for example the Chukchi Spring Lead System, ERA 19, table 5–2). The USGS OCS Team believes that the literature presented represents a current picture of available scientific information. However, unlike the earlier components of the Risk Assessment Process, the ecological considerations in the assessment are qualitative in nature with no measures of data quality or data uncertainty. It is difficult to judge the value of existing information in the decision-making process, or where and what new ecological data would result in substantially improved decision making. In other words, one cannot run a sensitivity analysis under the present process to examine how important the limitations of the literature or variation in expert opinion might be to the decision-making process.

The challenge to quantitatively include ecological resources is not unique to the Arctic OCS process, but exists throughout the discipline of environmental assessment. Emerging information products and tools, such as those developed by the Alaska Ocean Observing System and Smith's (2010) Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas, represent emergent approaches about data quality and sufficiency that can be built upon. These products and tools represent great advances for the Arctic, where much remains unknown; many different entities conduct work; the landscapes are remote and enormous; and each piece of information is expensive to collect. Even with such tools, insights into what ecological resources might be at risk and the data gaps that are most critical to fill will rely on a mix of expert knowledge and existing data for some time. Structured Decision Making and its supporting tools, from the simplest influence diagrams to the more complex mixed analytical and expert Bayesian Network models, provide discipline to technical or value-based deliberations (for example, Varis 1997; Faber and others, 2002) and can provide inputs to and complement existing regulatory processes. These tools are particularly helpful when there is disagreement about whether a decision needs more information and what information might improve that decision.

5.07. Finding: Oil-spill risk assessment processes have a strong, transparent, and quantitative model framework through the spill-trajectory model phase. The social and (or) ecological value of an area and the potential impact should oil transect it is based on "expert" discussions and review of available literature. They are more qualitative in nature, with limited measures of data quality or data uncertainty expressed.

5.07. Recommendation: The application of the maturing science of Structured Decision Making and supporting tools (from the simplest influence diagrams to the more complex mixed analytical and expert Bayesian Network models) could provide a transparent and quantitative discipline to technical or value-based deliberations. Such collaborative processes could help better define what uncertainty is unacceptable to vested parties and what new information could address that uncertainty in a structured and testable manner.

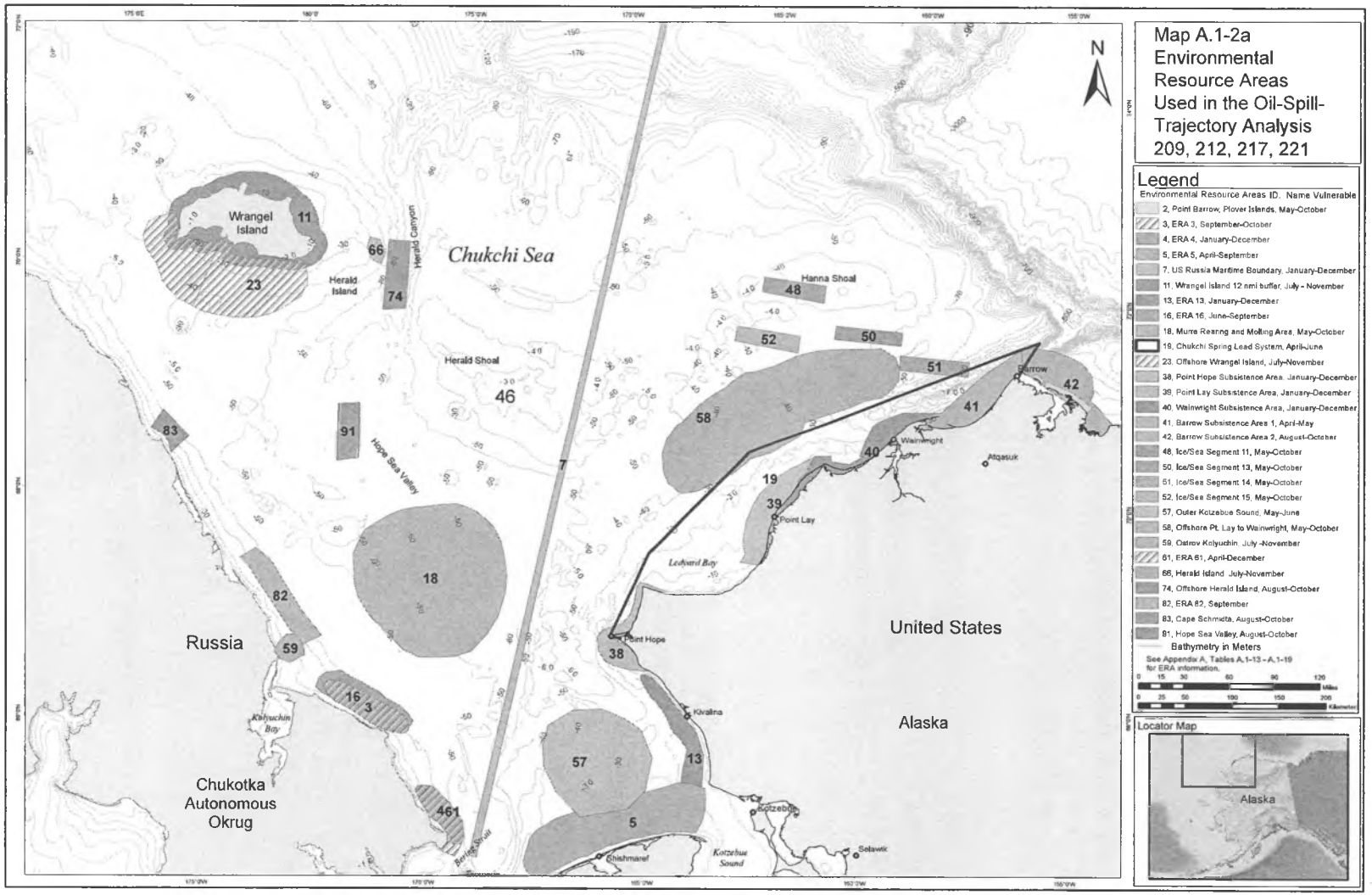

Figure 5–7. Example of Environmental Resource Areas (ERAs) used in the oil-spill-trajectory model (Minerals Management Service, 2008a, appendix A).

Table 5–2. Example of resource definition and supporting literature for Environmental Resource Areas (ERA) presented in figure 5–7.

[Modified from Mineral Management Services, 2008a. ERA IDs found in figure 5–7. References are found in Minerals Management Service, 2008a]

ERA ID	Vulnerable	General resource	Specific resource	Reference
2	May–October	Birds, barrier island	Spectacled eiders, Long tailed ducks	Lehnhausen and Quinlan, 1981; Johnson, 1993; Johnson, Wiggins, and Wainwright, 1993; Laing and Platte, 1994; Dau and Larned, 2004
3	September–October	Subsistence	Bowhead whales, Grey whales, walrus	Mel'nikov and Bobkov, 1993.
4	January–December	Subsistence	Bowhead whales, Grey whales, walrus	Mel'nikov and Bobkov, 1993.
5	April–September	Subsistence	Polar Bears, walrus, weals	Sobelman, 1985; Wisniewski, 2005.
7	January–December	Lower tropic	International Russian waters	U.S. Dept. of State, 1990.
11	July–November	Marine mammals	Polar bears, walrus	Kochnev, 2002; Kochnev and others, 2003; Kochnev, In prep.; Fay, 1982.
13	January–December	Whales	Beluga whales	Suydam and others, 2001; Suydam, Lowry and Frost, 2005.
13	January–December	Subsistence	Polar bears, walrus, weals, Bowhead whales, Beluga whales	Burch, 1985.
16	June–September	Whales	Bowhead whales, Gray whales	Mel'nikov and Bobkov, 1993; Bogoslovskaya,Votrogov and Krupnik, 1982.
18	May–October	Birds	Murre foraging, rearing, and molting area	Springer and others, 1984; Piatt and Springer, 2003
19	April–June	Birds, marine mammals	Seabird foraging; spring migration area for Long tailed ducks, eiders, loons	Swartz, 1967; Connors, Myers, and Pitelka,1979; Sowls and others, 1978; Gill, Handel and Connors, 1985; Johnson and Herter, 1989; Piatt and others, 1991; Piatt and Springer, 2003; Oppel, 2007.
23	July–November	Marine mammals	Walrus	Fay, 1982; Jay, 2007. pers. commun.
38	January–December	Subsistence	Beluga whales, Bowhead whales, walrus, seals	Braund and Burnham, 1984.
39	January–December	Subsistence	Fish, seals, waterfowl, Beluga whales	Braund and Burnham, 1984; Impact Assessment, 1989; Huntington and Mymrin, 1996; USDOI, BLM and MMS, 2003.
40	January–December	Subsistence	Bowhead whales, Beluga whales	Braund and Burnham, 1984; Braund & Associates, 1993a, Kassam and Wainwright Traditional Council, 2001; USDOI, BLM, and MMS, 2003.
41	April–May	Subsistence	Bowhead whales, Beluga whales, walrus, Waterfowl, seals, ocean fish	Braund and Burnham, 1984; S.R. Braund & Associates, 1993b; North Slope Borough, 2001; USDOI, BLM and MMS, 2003.
42	August–October	Subsistence	Bowhead whales, Beluga whales, walrus, waterfowl, seals, ocean rish	Braund and Burnham, 1984; Braund and Associates, 1993b; North Slope Borough, 2001; USDOI, BLM, and MMS, 2003.
48	May–October	Whales	Bowhead whales,gray whales, walrus	Moore and DeMaster, 1997.
50	May–October	Marine mammals	Walrus	Fay, 1982; Jay, 2007. pers. commun.
51	May–October	Marine mammals	Walrus	Fay, 1982; Jay, 2007. pers. commun.
52	May–October	Marine mammals	Walrus	Fay, 1982; Jay, 2007. pers. commun.
57	May–June	Marine mammals	Walrus	Fay, 1982; Jay, 2007. pers. commun.
58	May–October	Marine mammals	Walrus	Fay, 1982, Jay, 2007. pers. commun.
59	July–November	Marine mammals	Polar bears, walrus	Kochnev and others, 2003; Kochnev, In prep.; Fay, 1982.
61	April–December	Whales	Bowhead, fin, and humpback whales	Melnikov, 2000; Melnikov and Bobkov, 1993; Melnikov, and others 2004; USDOC, NMFS, 2006; Rice, 1974, Bogoslovskaya, Votrogov and Krupnik, 1982, Marqueette and others 1982; Mizroch, In Prep.; Mizroch, Rice and Breiwick,1984; Angliss and Outlaw 2005; 2007.
66	July–November	Marine mammals	Polar bears, walrus	Ovsyanikov,1998; Stishov, 1991, Fay, 1982; Jay, 2007 pers. com.
74	August–October	Whales, Polar Bears, Walrus	Bowhead whales	Bogoslovskaya and others 1982.
82	September	Whales	Bowhead whales	Mel'nikov and Bobkov, 1993; Bogoslovskaya,Votrogov and Krupnik, 1982.
83	August–October	Whales	Bowhead whales	Bogoslovskaya, Votrogov and Krupnik, 1982
91	August–October	Whales	Bowhead whales	Bogoslovskaya, Votrogov and Krupnik, 1982

Science and Oil-Spill Contingency Planning

Contingency plans, as defined under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (http://www.epa.gov/oem/content/lawsregs/ncpover.htm), require information, much of which is not within the purview of science (for example, response resources, command and control structures, communications, and relationship to other plans). Here, we discuss points where scientific insights and data help inform the planning process. For example, the 2008 International Oil Spill Conference (2008) outlined factors that may be desired in plans (table 5–3). The areas of potential spill coverage must be defined based on scenarios identified in a risk analysis. Presently, for the Arctic such scenarios are limited (Alaska Regional Response Team, 2010). Whether part of the formal NCP process or not, assessment of risk and development of plans include spill scenarios, surface trajectories, subsurface trajectories, stochastic modeling, real-time forecasting, oil characterization, oil fate and effects modeling, and oil weathering. Much of the foundational science for these elements is similar to that required in oil-spill risk assessments detailed previously and will not be described again.

During our expert consultations, participants raised a number of issues relevant to this topic. Potential spill volume is an early input to and an overriding influence on the spill scenario and requires an understanding of the source reservoir volume and pressure. Several entities we met with felt there was insufficient information to reasonably constrain estimates of likely spill volume. In particular, Coast Guard leaders responsible for spill response in the Arctic felt this was an essential input to the series of downstream decisions that they must make within spill contingency plans.

Table 5–3. Spill Response Planning and Assessment Categories as suggested in the 2008 International Oil Spill Conference proposed guide on response planning and readiness assessments.

[Modified from International Oil Spill Conference, 2008, table 1]

Setting the Stage	**Operational Response**
1. Legislation and regulation	16. Source control, salvage, and firefighting
2. Multi-national agreements	17. Response technologies
Developing a Plan	18. Waste management
3. Resources at risk	19. Wildlife recovery
4. Spill risk analysis	**Response Support**
5. Risk minimization	20. Spill monitoring, tracking, and sampling
6. Evaluation of response technologies	21. Cleanup assessment
7. Net environmental benefit analysis	22. Data management and success
8. Expert information sources	23. Logistics
9. Contingency planning	24. Finance, administration, and procurement
Organization and Communications	25. Demobilization
10. Response management systems	**Developing and Sustaining Response Capability and Readiness**
11. Notification systems	26. Exercises
12. Communications	27. Training
13. Safety for responders and public	28. Sustainability and improvement
14. Security	
15. Public information development and distribution	

5.08. Finding: Because of the frontier nature of oil and gas exploration in the U.S. Arctic, few empirical data are available to constrain the estimates of oil reservoir volume and pressure patterns throughout the Arctic OCS, which results in uncertainty within spill risk assessments and oil-spill contingency planning.

5.08. Recommendation: A national investment in foundational geologic and geophysical data can provide an improved understanding of how oil and gas resources are formed and emplaced in reservoirs in the Arctic. However, substantial improvements in estimates will require data from exploration wells that are made publicly available.

In our consultations, various parties expressed the need to develop and test approaches to address "Organization and Communication" capacities for spill response. For example, the National Oceanic and Atmospheric Administration (NOAA) and key partners are actively expanding the successful Emergency Response Management Application (ERMA®) system, most recently used during the *Deepwater Horizon* oil spill in the GOM, to Arctic planning and response. This geospatial decision-support tool combines product output from NOAA sources as well as datasets agreed upon by stakeholders (Coastal Response Research Center, 2011) to provide onsite coordinators critical background and real-time data.

We are not aware of any large-scale field testing of the types of assets and communications that must come together rapidly and successfully for a spill event in the Beaufort or Chukchi Seas. However, the 2009 "Sound Predictions" effort by the Alaska Ocean Observing System (AOOS; 2009) and others in Prince William Sound (Gulf of Alaska) is an example of operational testing that can better improve the science/data component of oil-spill response. Through such field experimentation, the accuracy of ocean current and weather model forecasts, data access, and the utility of an ocean observing system for oil-spill response can be assessed and improved. Underpinning any of these efforts is the need to have data easily accessible and current. The Alaska Data Integration Working Group (2011) is a broad effort to facilitate improved data transparency and access across organizations that will feed well into the needs of Arctic ERMA® and AOOS.

5.09. Finding: Management, spill response, and science communities are actively engaged in developing essential decision support and ocean observing systems. However, these systems are not yet fully funded, operational, or fully tested for Arctic waters.

5.09. Recommendation: Significant improvements in spill preparedness could be accomplished through the completion of decision support and data systems, such as the Arctic Emergency Response Management Application, the Alaska Ocean Observing System, and the State-Federal Alaska Data Integration Working Group. Field testing of assets and data systems as was done in the 2009 "Sound Predictions" experiment in Prince William Sound, Alaska, could significantly improve preparedness by highlighting significant data and operational needs.

Oil-Spill Response

All spill response requires effective planning, tracking, surveillance, and understanding of environmental considerations. For the Arctic, the unique challenge is to understand how oil will move if spilled; how it will respond to environmental conditions; what natural and cultural resources and historical properties are at risk; and how effective response tools will be in cold and ice-covered conditions. Many of the topics we have discussed in our oil-spill risk assessment sections inform actions during oil-spill response. The need for a multi-faceted science and technology effort as the foundation to an efficient and effective oil-spill response capacity is widely understood particularly because of unique Arctic challenges and is evident in the focus on this topic applied under the BOEMRE OCS research program (fig. 5–8).

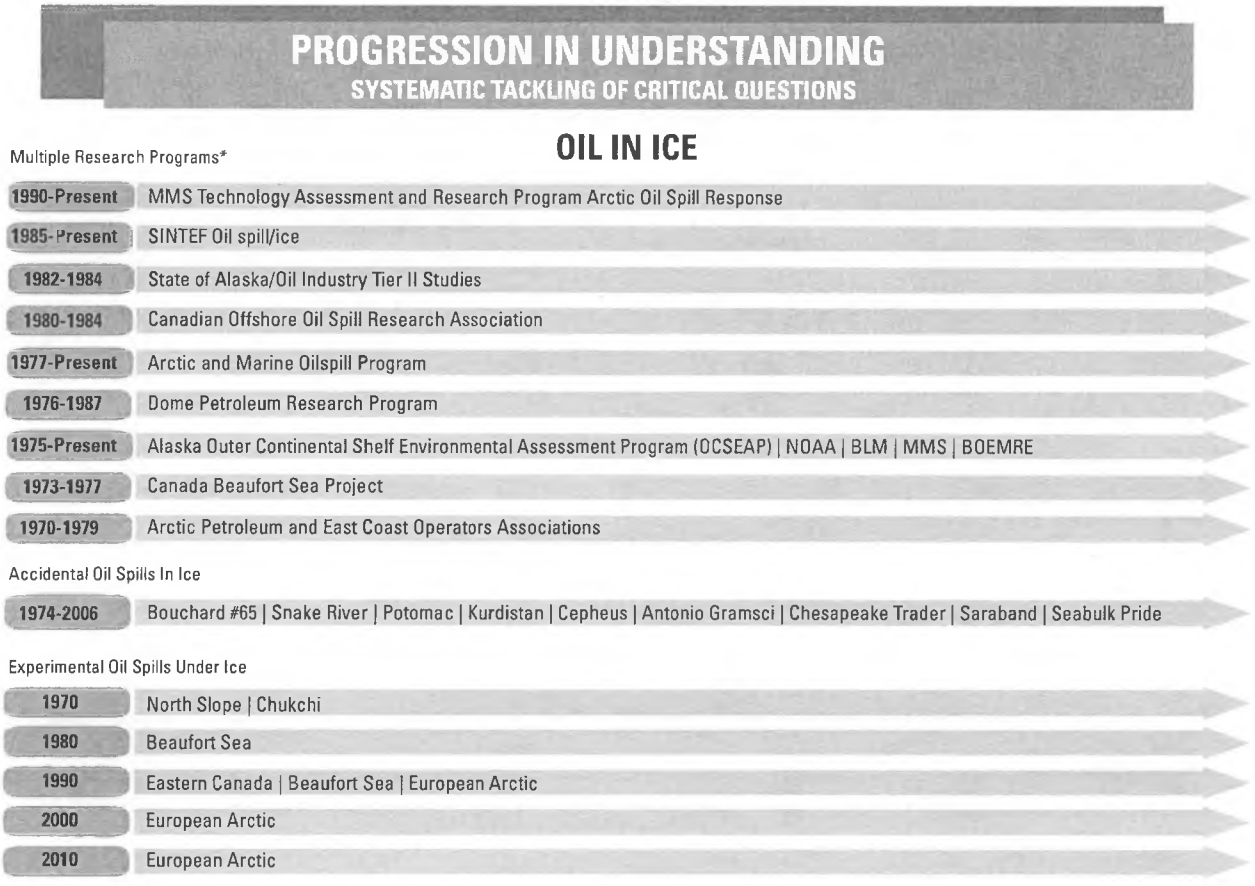

Figure 5–8. Schematic illustrating progression of science developed under the BOEMRE OCS Environmental Studies Program to better understand the behavior of oil in ice [Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), written commun., 2011]. BLM, Bureau of Land Management; MMS, Minerals Management Service (now BOEMRE); NOAA, National Oceanic and Atmospheric Administration; OCSEAP, Outer Continental Shelf Environmental Assessment Program.

Response Gap

In later sections, we focus on the various spill response methods and technologies as they relate to Arctic and ice-covered waters. Those included are containment and mechanical recovery, burning, bioremediation, and enhanced dispersion. The materials we discuss in those sections highlight the scientific issues, progress, and information gaps that have been expressed for each of the various tools. However, here we discuss the broader issue of oil-spill countermeasures and the topic of "response gap." Lessons learned from the 1989 *Exxon Valdez* oil spill in the sub-Arctic waters of Prince William Sound Alaska (see appendix D) and the most recent 2010 *Deepwater Horizon* oil spill in the GOM (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011) reiterate that there is no single response technique suitable for all circumstances. The National Research Council (NRC; 2003) stated that reliance on only one recovery system is "unlikely to be successful" to respond to an oil spill offshore of the Alaska North Slope. Most recently, Lee (2010) emphasized the need for the availability of multiple tools, and the challenges in the Arctic of ice dynamics, cold temperatures, and limited light in the winter. Many individual tools will not be available to responders at specific times because of wind, sea, ice, or light conditions (table 5–4; also see Nuka Research and Planning Group, LCC, 2007b; Nuka Research and Planning Group, LCC and Pearson Consulting, LCC, 2010). Understanding what combination of countermeasures will likely be available under the temporal and spatial variability of the Arctic is essential to assess environmental risks from any potential spilled oil. Beyond that, as discussed previously in Chapter 4. Climate Change Considerations, environmental conditions in the Arctic that affect countermeasure effectiveness are changing. And they are changing in complex ways not yet understood.

5.10. Finding: While efforts are ongoing to develop countermeasures to address the potential of an oil spill in Arctic and ice-covered waters, it remains unclear when and where any one of these countermeasures, or countermeasures in combination, will be available under current and future weather, sea state, ice, and light conditions of the Arctic—or whether they will work even if available.

5.10. Recommendation: Spill planning and response would benefit from a collaboratively derived Response Gap analysis of countermeasures, a rigorous analysis of the likelihood of the availability of a multi-countermeasure suite in different Arctic locations and seasons, and the forecasting of climate change influences on the Response Gap. While industry is responsible for stockpiling response equipment, continuation of the Federal and Joint Industry Program approach could inform efforts to develop suites of new technologies and approaches to improve effective response in the Arctic. An independent analysis of the Response Gap could help better articulate what overall risks exist from potential failures in spill response.

Mechanical Containment and Recovery

A number of recent advances have been made in mechanical containment and recovery devices as oil-spill mitigation countermeasures (Brandvik and others, 2006; Minerals Management Service, 2008b). However, the effectiveness of mechanical countermeasures, particularly in ice-infested waters, poses an ongoing challenge (World Wildlife Fund, 2009). In a recent review of technologies to improve oil-spill response effectiveness in the Arctic, Nuka Research and Planning Group, LCC (2007a) documented a number of promising mechanical recovery technologies that could be utilized in open water, but some of these lacked sufficient field testing in ice conditions to evaluate their effectiveness. Mechanical containment and recovery countermeasures, such as booming, sorbents, and skimmers, are affected by the presence of sea ice. Their recovery rate of spilled oil diminishes rapidly with increasing amounts of sea ice. For example, ice can induce tears in booming, or can clog skimmer systems and prevent them from encountering spilled oil. One additional challenge with mechanical recovery systems is the need for a platform from which to operate or deploy, requiring the availability of ice-class vessels, tugs, or barges to support response activities (World Wildlife Fund, 2009). With sea ice coverage greater than about 60 percent, the ice itself can potentially serve as a natural containment barrier (Dickins and Buist, 1999). There also is a need for mechanical recovery systems capable of removing oil that is under the ice (Brandvik and others, 2006).

There are a number of types of booms available depending on whether the purpose of the booming is to contain the spill for recovery purposes (containment or diversion booming) or to protect sensitive areas from the spilled oil (exclusion or deflection booming) (DeCola and others, 2006). Recent advances in technology have been made to extend the capability of ice booms, adapting technology that had been in use for several decades to protect water intakes upstream of hydroelectric power plants into a countermeasure for oil-spill response. Ice booms also have the capability to assist other mechanical recovery systems by providing an ice-free environment, and in separating oil from ice

Table 5–4. One example of physical and timing limitations on oil-spill response tools for the U.S. Arctic.

[From Nuka Research and Planning Group, LCC and Pearson Consulting, LCC (2010, tables 6–1, 6–2). Color code: Green, conditions generally considered to be favorable; yellow, conditions may impede response operations; red, response would not be possible. **Visibility:** Moderate, light fog or less than 1 mile visibility; Low, heavy fog, less than one-quarter mile visibility, or darkness. n/a, not applicable; mph, miles per hour; ft, feet]

Limiting factor	Ice coverage					Wind			Wave height			Visibility		
Conditions	<10%	11% to 30%	31% to 70%	>70%	Solid ice	0–20 mph	21–35 mph	>35 mph	<3 ft	3–6 ft	>6 ft	High	Moderate	Low
Mechanical recovery with no ice management														
Mechanical recovery with ice management					n/a									
In-situ burning														

Environmental factors and response gaps (Estimated percentage of time when operating limits are impaired or exceeded in U.S. Arctic)			
Winter (January–March)	**Spring (April–June)**	**Summer (July–September)**	**Fall (October–December)**
Ice Condition: solid (100%)	Ice condition: solid (80%), Broken Ice (20%)	Ice condition: broken ice (60%) Open Water (40%)	Ice condition: open water (20%), Broken ice (60%), solid (20%)
Approximate daylight hours: 4.5	Approximate daylight hours: 19	Approximate daylight hours: 21	Approximate daylight hours: 5.5
Average number days peak gust >30: 20 (22%)	Average number of days peak gust >30: 12 (1%)	Average number of days peak gust >30: 19 (21%)	Average number of days peak gust >30: 30 (34%)
Average number of days of fog: 51 (57%)	Average number of days of fog: 53 (58%)	Average number of days of fog: 44 (49%)	Average number of days of fog: 51 (57%)
Average external minimum temperature: -49°F	Average external minimum temperature: -9°F	Average external minimum temperature: 20°F	Average external minimum temperature: -32°F

(Abdelnour and Comfort, 2001; Abdelnour and others, 2001). Fire-resistant booms also have been developed for *in-situ* burning, as a means of containing and concentrating the oil into a layer atop the water surface that is sufficiently thick to sustain ignition and burning (Tebeau, 2003; Potter and Buist, 2008). There are a couple notable partnerships that culminated in the development of mechanical oil recovery systems for deployment in ice-infested waters—the Mechanical Oil Recovery in Ice-Infested Waters (MORICE) project (Jensen and Mullin, 2003) and the Lamor Oil Ice Separator (LOIS) (Minerals Management Service, 2008b). The concept for MORICE emerged from a review of the status of mechanical recovery devices and culminated in the development of a full-scale system that was tested at the National Oil Spill Response Research and Renewable Energy Test Facility in 2002, under a variety of ice conditions and under relatively mild weather conditions (Jensen and Mullin, 2003). The LOIS is a commercially available mechanical recovery system consisting of an oscillating ice grid that washes oil from ice chunks as they move along a grid; the oil is subsequently concentrated for recovery by a skimmer (Minerals Management Service, 2008b).

Skimming systems are designed to recover oil from the water surface. Recent overviews of the state-of-the-art of these technologies are given in Brandvik and others (2006), Nuka Research and Planning Group, LLC (2007a), Hänninen and Sassi (2010), S.L. Ross Environmental Research, Ltd., and others (2010), and Fingas (2011a). There have been recent efforts to develop standardized testing protocols for determining the recovery capacity of skimmer systems (Schmidt and others, 2009). Oleophilic skimmers are the most common type of mechanical oil-spill response equipment (Broje and Keller, 2006). Efforts to develop better skimmer systems for cold and ice conditions (Broje and Keller, 2006; Keller and Clark, 2008) have found they still have limited oil encounter and recovery rates. Thus, S.L. Ross Environmental Research, Ltd., and others (2010) recommended that deployment of skimmers in the Beaufort Sea may be best suited for responding to oil spills covering a small area and with relatively small ice pieces, given the current limitations of the oil encounter and recovery rates.

The National Research Council review (2003) cited results from a Robertson and DeCola (2001) study involving a field trial using a barge-based recovery system in a simulated spill response on the North Slope under varying seasonal ice conditions. The authors found that realistic maximum operation limits for mechanical recovery of a simulated spill ranged from about 0 to 1 percent in fall ice conditions; about 10 percent in spring ice conditions without ice management; and about 30 percent in spring ice conditions with extensive ice management. The National Research Council (2003) noted that given these estimates, reliance only on mechanical recovery systems to respond to an oil spill offshore of the Alaska North Slope is "unlikely to be successful." They called into question the viability of mechanical recovery technologies to clean up spills, particularly large oil spills, in broken ice, citing statements by the Alaska Department of Environmental Conservation that the mechanical recovery technologies available then were not likely to be successful in the Beaufort and Chukchi Seas. The NRC also noted that the results of research on the effectiveness and environmental liabilities and advantages of alternative countermeasures, such as dispersants and *in-situ* burning, especially in broken-ice conditions, would be useful in facilitating needed contingency planning. The potential scale of the response needed to an offshore oil spill in ice-infested waters is a major challenge to the mechanical recovery systems, as many of these technologies appear best suited for batch recovery of spilled oil in pits or ice leads (Nuka Research and Planning Group, LLC, 2007a). In a recent review commissioned by the Canadian Environmental Studies Research Funds, S.L. Ross Environmental Research, Ltd., and others (2010) noted that

> "[t]here has been little research done with regard to the problem of removing oil from larger ice floes with diameters ranging from 10s to 1,000s of meters that typify breakup and pack ice conditions during winter in the Beaufort Sea."

5.11. Finding: There are a number of recent technological advances in mechanical containment and recovery devices as oil-spill mitigation countermeasures. The effectiveness of mechanical countermeasures, particularly in ice-infested waters, poses an ongoing challenge. Scaling up test results from laboratory- and mesoscale testing into practical field recovery rates is a recognized information need. Further, an understanding of the types and (or) amounts of platforms needed to deploy these devices is needed. This lack of information currently is a limiting factor in translating the technological advances from these devices into an operational context, particularly at the scale at which these devices might be deployed in response to a large spill event in the presence of sea ice.

5.11. Recommendation: An evaluation of the presence or lack of standardized testing approaches (especially wave tanks), the cross-comparability of results, and collaborative development of protocols would be beneficial. This information would inform the practical recovery limits that can be achieved during response operations, and refine our understanding of the appropriate setting and scale at which these devices could be effectively deployed. Finally, there remains a need to further develop mechanical recovery systems to recover oil accumulated under ice.

In a recent review of countermeasure technologies for spill response in Beaufort Sea spring breakup or fall-freeze-up seasons, Solsberg (2008) reported that there have been advances made in mechanical recovery systems. However, many of these may face severe limitations during deployment due to ice-processing challenges, extreme weather (freezing) conditions, and changing conditions in the ice itself. Nuka Research and Planning Group, LLC (2007b) points out that the range of ice conditions that may be encountered in the Beaufort Sea is an important factor when determining what types of technologies are "appropriate and reliable" for oil-spill response and recovery. For example,

> "[a]vailable estimates from mechanical response in broken ice vary from 1 to 20 percent depending on the degree of ice coverage and if responding during freeze-up or spring break-up. This compares with estimates of 5 to 30 percent for open ocean response without broken ice. Recent barge trials on the Beaufort Sea demonstrated that even trace amounts of ice (less than 1/10 ice coverage) can cause significantly reduced efficiencies in mechanical recovery" (Minerals Management Service, 2008b).

One of the challenges to oil recovery in ice-infested waters is the availability of ice coverage information on the time scales (shorter) and conditions (dynamic) of a spill response operation. Solsberg (2008) noted that

> "[a] common way of presenting the potential use of countermeasures in Arctic conditions is a chart or table that assigns the standard approaches of mechanical operations, *in-situ* burning and dispersant application to a specific range of ice cover. The problem with this approach, however, is that conditions in Beaufort Sea ice are so dynamic during the transition seasons that any response would likely prove to be limited to a small (time) window of opportunity—leave alone the obvious safety concerns."

For any countermeasure, and mechanical recovery systems in particular, it is important to have a better understanding of ice drift and oil movement so as to inform response operations and deployment of appropriate countermeasures (Solsberg, 2008). The ability to predict ice movements to inform the use of mechanical recovery systems dovetails with other information needs for an improved understanding of the Arctic Ocean and sea ice. Uniting monitoring and process studies and facilitating modeling at different scales will lead to better understanding of sea ice response to various forcing factors (U.S. Arctic Research Commission, 2010).

5.12. Finding: One of the challenges to mechanical oil recovery in ice-infested waters is the availability of ice coverage information, on the short time scales and in the dynamic conditions of a spill response operation.

5.12. Recommendation: There is a need to develop a system with the ability to make short-term ice dynamics forecasts to inform windows for mechanical recovery operations and to improve recovery technologies in the "ice gap" (about 30 to 70 percent ice coverage). From an operational perspective, there also is a need for information to inform response planning in the event of shifting ice coverage.

In-Situ Burning

In-situ burning (ISB) has been studied for several decades as a response tool for oil spills in ice. Some of the earliest activities were laboratory, tank, and field studies conducted in the 1970s associated with drilling in the Canadian Beaufort Sea (Potter and Buist, 2008). Later oil exploration efforts in Svalbard (1980–94) also considered ISB as a primary countermeasure for use in Arctic oil spills (Brandvik and others, 2006).

One of the key challenges to the effectiveness of ISB is maintaining sufficient thickness of oil to sustain a burn. The minimum ignitable thickness of a fresh crude oil slick on water is about 1 mm, whereas for aged, unemulsified crude oil the minimum thickness is on the order of 2–5 mm (Potter and Buist, 2008). Emulsification is an important process affecting the effectiveness or the response window of opportunity for use of ISB, because the oil in the emulsion is not able to reach a temperature to burn until the water is first boiled off (Potter and Buist, 2008). Emissions from ISB include the release to the atmosphere as well as burn residue. The residue from an ISB may float on water or sink, depending on the oil type and the extent of the burn.

There is a large body of scientific work based on laboratory, mesoscale, and to some extent field trials that demonstrate ISB to be effective in removing oil from the water surface under Arctic conditions, but it remains to be determined whether these results translate into real-world conditions. The effectiveness of ISB can be affected by weather and sea-state conditions, but ice is a particular challenge. At ice coverage exceeding 70 percent, ISB can be conducted without any mechanical containment systems, as the ice provides a natural barrier to restrict the movement of oil across the water surface. At ice concentrations less than

30 percent, open-water ISB may be feasible (Brandvik and others, 2006; Potter and Buist, 2008), including the use of oil containment with a fire-resistant boom. Ice concentrations of 30–70 percent are considered to be the "most difficult from an *in-situ* burning perspective" (Juurmaa, 2006). The particular challenge for ISB in ice concentrations in this range is that these ice concentrations are high enough to impede the effectiveness of mechanical containment systems, yet too low to serve as a natural containment barrier for the oil (Brandvik and others, 2006; Potter and Buist, 2008).

In addition to the abundance of sea ice, the type of sea ice present can impact the effectiveness of ISB. S.L. Ross Environmental Research, Ltd., and others (1998) reported that for freeze-up scenarios at low and medium ice concentration, ISB offered little advantage over containment and recovery techniques. However, there was potential to contain and burn oil in their 70-percent ice scenario as suggested above. For break-up scenarios, burning on water provided effectiveness similar to containment and recovery. And, burning oil on floes or concentrated in melt pools was as effective as on-water burning or containment and recovery approaches. Conducting ISB in pack ice during break-up may be more effective at removing spilled oil than when there is a similar amount of ice coverage during the fall freeze-up, because the fall freeze-up generates significant amounts of slush ice that can impede containment of slicks (Potter and Buist, 2008). In a recent review of countermeasures in the Beaufort Sea, Solsberg (2008) noted that

> "...the relative behaviour of spilled oil and ice require further investigation to determine how feasible it is, in fact, to burn oil during the transition seasons .... While small and meso-scale testing is needed, field work is the ultimate means of measuring the feasibility of burning."

Brandvik and others (2010a) report ISB efficiencies ranging from 50 to 90 percent from a field test (during about 70–90 percent ice coverage) and mesoscale laboratory experiments in a wave tank under varying ice coverage conditions (at 0, 50, and 90 percent). In field and the mesoscale trials at 90-percent ice coverage, ISB had a longer window of opportunity (about 120 and about 140 hours, respectively). Mesoscale experiments at 0-percent ice coverage had less than a 5-hour window of opportunity and slightly better at 50-percent ice coverage (about 10 hours). The authors concluded that the favorable comparisons among results from the field test and mesoscale basin experiments at high percentage ice coverage were an indication that the mesoscale trials could be considered to reflect realistic conditions (Brandvik and others, 2010a). In the course of the field experiment, the authors noted that strong winds caused the dense ice field being tested to move at a rate of approximately 40 km/d (Brandvik and others, 2010b), underscoring the need for information on weather and coupled ice-transport conditions to inform potential oil-spill responses operations.

As we discussed in section, "Spilled-Oil Weathering and Persistence," in the event spilled oil becomes entrained in ice, the rate of oil weathering may be slowed to the extent that the response window for using ISB is expanded. For example, oil in brine channels could potentially be released during spring ice melt in melt pools. Oil that is released from ice during the melting and collects in pools atop the pack ice may be treatable by ISB (Brandvik and others, 2010a). However, this approach could provide an additional exposure route to wildlife given that melt pools can form thaw holes, which in turn may serve as breathing holes for wildlife and provide an important ecosystem for other marine life (World Wildlife Fund, 2009). Features such as leads, polynyas, and ice edges tend to be focal points of biological activity, as well as targets for pooled spilled oil (World Wildlife Fund, 2009).

5.13. Finding: There is a large body of scientific work demonstrating that *in-situ* burning (ISB) of oil is effective in removing spilled oil from the water surface under certain experimentally controlled Arctic conditions. However, there are insufficient data to assess the effectiveness of ISB under the full suite of real-world conditions that might be experienced during a response to an oil spill.

5.13. Recommendation: Many of the mesoscale and field tests show a considerable range in the *in-situ* burning (ISB) effectiveness. However, because ISB is one of the few response options that exist for the Arctic, it is important to conduct additional research to improve its effectiveness. Thus, further focused study is essential to better define the applicability of ISB under various conditions.

There are a number of studies on the emissions from ISB, including air emissions (soot and gases) and ISB residues, which could float to the water surface or sink to the ocean floor. Recent syntheses of the state-of-knowledge on atmospheric emissions from ISB are given in Potter and Buist (2008), S.L. Ross Environmental Research, Ltd., and others (2010), and Fingas (2011b). Recent studies of atmospheric emissions from ISB point to the need for an expanded characterization of the composition of air emissions. For example, Aurell and Gullett (2010) studied atmospheric ISB emissions in the GOM during the *Deepwater Horizon* oil-spill response and found examples of halogenated organic compounds (toxic environmental pollutants) above background levels. These results contrast with previous conclusions drawn from limited mesoscale laboratory studies of ISB. These compounds have potential health effects, such as immunotoxicity, carcinogenicity, and teratogenicity. S.L. Ross Environmental Research, Ltd., and others (2010) provide an overview of the environmental issues with ISB and the evolution of ISB procedures confirming that most research has focused on characterizing the atmospheric emissions from ISB with fewer studies characterizing and testing for potential toxicity arising from ISB residues. Nuka Research and Planning Group, LCC and Pearson Consulting, LCC (2010) point out that earlier studies have shown that there is greater potential for ISB to form residues in the presence of sea ice than when ISB is conducted in open water—citing Fingas (2004) and Buist and others (2003). Previous studies have acknowledged that ISB residues may contain toxic materials, and should be removed from the marine environment where possible (Nuka Research and Planning Group, LCC and Pearson Consulting, LCC, 2010). Nuka Research and Planning Group, LCC, and Pearson Consulting, LCC (2010) cite previous studies, such as the American Petroleum Institute (2004) that investigated the proclivity for ISB residues to sink and identified the need for technologies to recover sunken ISB residues. Potter and Buist (2008) stated that residues from efficient burns of crude oil generally are environmentally inert, but that potential environmental effects are derived from physical properties, including whether residues float or sink, and what chemical constituents are retained. In that regard, the potential for residues that will sink can be predicted based on the properties of the initial oil to some extent.

Several field and mesoscale efforts are informative on the topic of concentrations of toxics (for example, polycyclic aromatic hydrocarbons or PAHs) resulting from ISB. One foundational study is the Newfoundland Offshore Burn Experiment (NOBE; Fingas and others, 1995). In addition to extensive characterization of the atmospheric emissions, including soot and gases, from the NOBE, Fingas and others (1995) also analyzed the residue from the experiment. They reported that the residues resembled highly weathered oil with lower amounts of PAHs than the starting oil. However, Brenner and others (1990) found that PAH concentrations in ISB residues and Alberta sweet crude oil samples were comparable and that there was a lower total amount of PAHs emitted via smoke at thinner slick layers (2-mm versus 10-mm layer). In a synthesis of data from 45 mesoscale burns, Fingas and others (2001) found that PAHs in the soot and residue were about 2–8 percent of that in the starting oil. Wang and others (1999) conducted detailed chemical analyses on ISB residues from several mesoscale burns in Mobile Bay, AL. They concluded that high-molecular weight PAHs were derived largely from the combustion process itself. Garrett and others (2000) also support this finding. Therefore, there is a need for thorough chemical analysis in conjunction with measurement of ISB effectiveness under mesoscale and larger test conditions. The potential for less effective burns resulting from ice and weather conditions may yield higher amounts of high-molecular weight PAHs. This is consistent with Buist and others (1999) who found that the chemical composition of residue depends on the parent oil, the degree of weathering, and the efficiency of the burn. Levels of PAHs in residue could be as much as 40 percent more than in the parent, but considering the volume reduction accomplished by burning, the total amount of PAHs could be a fraction of what was in the slick before ignition.

There has been limited research on the toxicological effects of burnt oil relative to other oil-spill remediation techniques and some results appear contradictory (Cohen and Nugegoda, 2000). DeCola and others (2006) echoed this idea and stated that few published data exist on sublethal effects of burn residues, and no information on impacts of burn residues to benthic-feeding whales. Some insights on the comparative toxicity of ISB residues can be gleaned from Cohen and Nugegoda (2000). They tested the water accommodated fraction (WAF) from crude oil, chemically dispersed crude, and burnt crude oil. They found that of the three elements, dispersed crude oil WAF was the most toxic and burnt crude oil WAF was the least toxic to their marine fish test species. But, they also noted that sublethal toxicities of crude oil WAF and burnt crude oil WAF were observed at dilutions seven to eight times less than in the dispersed crude oil WAF. These results leave the relative toxicity ISB residue on marine organisms unclear.

Despite the relatively few studies characterizing ISB residues and potential toxicological or other effects, there appears to be a general operational consensus that

ISB residues should be collected and removed from the environment (for example, Buist and others 1999). This concept is included in the ARRT's *In-Situ* Burning Guidelines for Alaska, Revision 1 (Alaska Department of Environmental Conservation and others, 2008), which states that

> "[t]he toxicological properties and effects of the residue demonstrate the need and importance of a residue recovery plan which is an operational requirement."

They further note that the longer term effects of ISB residues on marine organisms have not been investigated.

Recently, in the *Deepwater Horizon* oil-spill response, the National Marine Fisheries Service and others (2010) issued a temporary emergency rule closing a specific portion of the GOM to red shrimp fishing due to the presence of ISB residues. Such actions underscore the continuing need for additional information on the composition, characteristics, bioavailability/bioaccessibility of ISB residues, as well as emissions from ISB, to inform response decisions and natural resource damage assessments and restoration activities.

5.14. Finding: There are relatively few studies characterizing emissions and residues from *in-situ* burning (ISB), including their potential toxicology. However, the studies that do exist suggest there is a potential for health effects from compounds released from ISB. Robust characterization of likely ISB air plumes and toxicological testing, especially on potential effects to benthic organisms, of ISB residue are lacking.

5.14. Recommendation: Our review underscores the importance of three points:

1. There is a need for thorough chemical analysis and measurement of *in-situ* burning (ISB) effectiveness under mesoscale and larger test conditions.
2. Better characterization of ISB residues is needed, especially toxicity, physical properties, and bioavailability of contaminants contained within the residue matrix; this is especially true in relation to potential effects to benthic communities.
3. Improving pre- and post-spill plume modeling would help inform whether or not an ISB should be conducted and would facilitate On-Scene Coordinator decisions on measures to protect local populations. The potential effect of "fall out" from a smoke plume that goes over land-based (plant) subsistence resources is of particular concern.

Dispersants

Dispersants are chemical mixtures consisting of three main items: surfactants, solvents, and additives. The surfactant molecules contain components that tend to bond with water (hydrophilic) and others that tend to bond with oil (oleophilic). Thus, the aim of dispersants as a spill mitigation countermeasure is not to reduce the volume of spilled oil in the environment—in contrast with other countermeasures such as mechanical recovery and ISB—but rather to facilitate the mixing and dispersion of spilled oil within the water column by promoting the formation of tiny oil droplets and preventing the recoalescence of those droplets into larger accumulations, such as slicks. The National Research Council recently (2005) conducted an extensive review of the effectiveness and impacts from the application of dispersants to oil spills, which we will summarize briefly here. Based on our expert consultations, the findings in the NRC report remain valid and applicable to the issue of data gaps for the Arctic. They noted that the

> "...objective of dispersant use is to enhance the amount of oil that physically mixes into the water column, reducing the potential that a surface slick will contaminate shoreline habitats... [but] increase[s] the potential exposure of water-column and benthic biota to spilled oil. Dispersant application thus represents a conscious decision to increase the hydrocarbon load... on one component of the ecosystem...reducing the load on another... This trade-off reflects the complex interplay of many variables, including the type of oil spilled, the volume of the spill, sea state and weather, water depth, degree of turbulence (thus mixing and dilution of the oil), and relative abundance and life stages of resident organisms" (National Research Council, 2005).

Some of the key questions regarding dispersant applications, and recommendations for research priorities most applicable to our assignment from National Research Council (2005) are:

- Is the spilled oil or refined product known to be dispersible?

  Example: The need for research into the mechanisms and rates of weathering processes—including parameters such as the rheology of chemistry of both oil and dispersants and energy dissipation—affecting the chemical effectiveness of dispersants, including both bench-scale and well-coordinated wave-tank studies.

- Are the environmental conditions conducive to the successful application of dispersants and their effectiveness?

  Example: The need for research in support of modeling and forecasting of the effectiveness of a dispersant application, including the need for data from wave-tank studies and the updating of protocols for Specialized Monitoring of Advanced Response Technologies.

- Will the effective use of dispersants reduce the impacts of the spill to shoreline and water surface resources without significantly increasing impacts to water-column and benthic resources?

  Example: The need for research into improving oil trajectory and fate models for both planning and real-time decision-making needs, with appropriately designed experiments to verify and validate these models. Such experiments could include research into quantifying weathering rates and fate of chemically dispersed oil droplets relative to undispersed oil.

Subsequent research activities have targeted these knowledge gaps, some of which are highlighted in the Biennial Report of the Interagency Coordinating Committee on Oil Pollution Research (2009) and the synthesis of the Arctic Oil Spill Response Research and Development Program (Minerals Management Service, 2008b). Fingas (2008a) also conducted a review of scientific literature related to oil-spill dispersants, spanning the years 1997–2008 and noted that a Canadian Research Council workshop on dispersant research priorities established priorities similar to those of the NRC.

5.15. Finding: Although significant research and technological studies have examined chemical dispersants over the past decade, including focus on cold-water and Arctic applications, the scientific understanding is yet incomplete.

5.15. Recommendation: Our examination suggests that substantial scientific and technical work as outlined by various expert groups still must be done before dispersants can be considered a practical response tool for the Arctic.

There has been recent work to develop new formulations of dispersants (Nedwed and others, 2008) that can be applied to an oil slick as a gel, and thus potentially be more effective on oils with higher viscosities. Such advances may hold promise for extending the response window for dispersant application by facilitating use on higher viscosity oil slicks stemming from either weathering oil or due to the cold temperatures.

Li and others (2008) note that two of the most important factors in the effectiveness of a chemical dispersant are the energy dissipation rate which affects the penetration of oil into the bulk aqueous phase and the particle size distribution of the dispersed oil. Waves can provide a significant source of mixing energy to the dispersion process. Thus the effectiveness of dispersants is derived from a physical-chemical process that includes the chemical properties of the oil and dispersant, and the physical action of the waves (National Research Council, 2005; Li and others, 2008). Vörösmarty and others (2010) note that sea-ice cover is especially important to address in studies of Arctic Ocean circulation given the unique momentum and buoyancy forcing that arise from overlying sea-ice cover. Furthermore, dispersants can be effective in broken ice provided there is some mixing energy available, and wave reflection among broken and brash ice may serve as highly localized sources of mixing energy (Minerals Management Service, 2008b). Given this potential source of mixing energy, there also is a need to characterize specific energy distributions on a more localized scale, that is, at the point of dispersant application, such as energy added from the ship's propellers or via high-pressure water systems to enhance mixing (Sørstrøm and others, 2010). A recent study by Nedwed and others (2007) tested the potential for an azimuthal stern drive (ASD) from an icebreaker as a means to provide the mixing energy necessary to disperse chemically treated oil slicks in broken ice. The authors found that this approach holds promise for mixing and dispersion of oil spilled on top of and under continuous ice and within leads, and could significantly supplement the dispersion that would take place with wave energy alone.

The issue of energy dissipation may help to describe some of the disparity observed across studies. For example, Belore and others (2009) in a study of dispersant application at the National Oil Spill Response Research and Renewable Energy Test Facility achieved dispersant effectiveness results that generally were higher than results from similar testing at a different facility, and the authors postulate this difference could have been due to higher wave energies achieved during their tank studies. Likewise, Venosa and others (2008) in a series of wave tank experiments found that the energy of the system had a strong influence on the ability to transfer oil from the surface into the water column even with the aid of dispersants. Further, Venosa and others (2008) noted a difference in the effectiveness of the two dispersants they tested and postulated that some dispersants may be more suitable for low- to moderate-energy settings, whereas others may be better suited for application in moderate to higher energy conditions.

As discussed previously, the weathering of oil entrained in sea ice may be inhibited. When it is subsequently released as the ice melts, the timeframe may be significantly extended for dispersant use as a countermeasure (Dickins and others, 2008; Brandvik and others, 2010a). This process would significantly alter the paradigm under which the "response window" for application of dispersants to spilled oil is viewed (Lewis and Daling, 2007). Further characterization of the effectiveness of dispersants under these conditions is needed to inform the "response window." This underscores the recommendation raised in National Research Council (2005) that

> "[r]elevant state and federal agencies and industry should develop and implement a focused series of studies that will enable the technical support staff advising decisionmakers to better predict the effectiveness of dispersant application for different oil types and environmental conditions over time."

Brandvik and others (2006) report that dispersants can be a suitable mitigation countermeasure in Arctic waters, both open water and up to 50-percent ice covered. In a recent review of dispersant effectiveness under Arctic conditions, Lewis and Daling (2007) identify that factors such as salinity of sea ice and colder temperatures affect the viscosity of spilled oil and may reduce the effectiveness of dispersant applications. These conditions also inhibit oil weathering factors, such as the formation of emulsions (Fingas, 2008b). Thus, the window of opportunity during which dispersants may be effective may be extended. Laboratory studies by Moles and others (2002) found that at the conditions typical of Alaskan estuaries and marine waters, dispersant effectiveness was at study detection limits (less than 10 percent). Some dispersants are more sensitive to salinity and temperature, and measured effectiveness can vary by roughly a factor of 10 or more (Lewis and Daling, 2007). However, recent results from tests conducted at the National Oil Spill Response Research and Renewable Energy Test Facility using four Alaskan North Slope crude oils and two dispersants found that the dispersants were more than 90 percent effective at dispersing fresh and weathered forms of the oils under cold weather conditions (Mullin and others, 2008; Belore and others, 2009).

5.16. Finding: How environmental conditions might actually affect dispersant effectiveness during oil-spill response is not yet well understood. As noted in our review, it has not yet been established whether wave-tank experimental conditions are typical or representative of wave conditions that could be encountered at sea with ice present. Factors, such as salinity and temperature, also can vary dispersant effectiveness by a factor of 10 or more.

5.16. Recommendation: We concur with the National Research Council (2005) recommendation that a focused series of studies should be developed and implemented that will enable practitioners to better predict the effectiveness of dispersant use for different oil and environmental conditions. For example, further study of oceanographic characteristics such as salinity, temperature, and circulation and wave patterns, and the influence of sea ice cover on these, in the Arctic Ocean would facilitate our understanding of the magnitude of the effectiveness of dispersants as a countermeasure against an oil spill in the Beaufort and Chukchi Seas. This information, aided by increased monitoring and prediction of winds, currents, temperature, and salinity, would be particularly useful in understanding the regional aspects of dispersant applications.

In addition to understanding the window of opportunity during which dispersants can be successfully used, there is a need to improve our understanding of the long-term viability of the dispersed oil. Fingas (2008a) reported that many researchers recognize that oil-spill dispersants are not stable and will destabilize and rise to the surface: half-lives of dispersions may be between 4 and 24 hours. However, in a recent study (Nedwed and others, 2007) using an ASD icebreaker to enhance mixing energy in a Canadian basin test, the researchers postulated that the dispersed oil would be "... unlikely to resurface even in very low energy conditions" based on their study results.

There is uncertainty regarding the effects of dispersants on marine organisms in the Arctic (World Wildlife Fund, 2009). One of the uncertainties is the potential effect of dispersants on the natural processes of microbial degradation of oil and how this may affect the toxicity of the residual oil. One of the key compound classes within crude oil, in terms of toxicity and other long-term deleterious effects on ecosystems, are PAHs, yet there are few studies to date that quantify the fate and potential for biodegradation of these compounds (National Research Council, 2005). Recent reviews (National Research Council, 2005; Fingas, 2008a) indicate that a scientific consensus regarding the effect of dispersants on toxicity of dispersed oil and effects on biodegradation of oil is lacking. The National Research Council (2005) concluded that there was no compelling evidence that the toxicity of chemically dispersed oil is enhanced relative to that of physically dispersed oil or that there were any reproducible effects of chemical dispersion on the rate of biodegradation of crude oil. However, Fingas (2008a) reported that

> "[i]t is clear, on the basis of current literature that the surfactants in some of the current dispersant formulations can inhibit biodegradation."

Lindstrom and Braddock (2002) reported that "the effect of dispersant on biodegradation of a specific hydrocarbon was not predictable by class [of hydrocarbon]" and either an increase or a decrease in the toxicity of the residual oil could result. Adding to this discussion, Zahed and others, 2010) found that the dispersant Corexit 9500 appeared to enhance biodegradation of crude oil, including at higher initial concentrations of crude oil, based on laboratory-scale bioremediation trials.

In contrast, there are a number of earlier studies indicating that chemically dispersed oil is more toxic to marine organisms than untreated oil (Pew Environment Group, 2010). The National Research Council (2005) found that

> "[i]n order to better understand the fate and effects of dispersed oil, studies should be conducted to estimate the relative contribution to toxicity of dissolved-, colloidal-, and particulate phase oil in representative species."

Fingas (2008a) states that

> "[l]ong-term effects of chemically-dispersed oil are poorly-studied and relatively unknown at this point in time. Again little has changed from the first review in 2002, but it is very clear now that the toxicity of dispersed oil is greater than that of physically dispersed oil, primarily because of the large increase (5 to 50 times) in the amount of aromatics and PAHs in the water column."

Subsea dispersants were used for the first time during the *Deepwater Horizon* oil spill and in larger quantities, both surface and subsurface, than during any previous spill (Pew Environment Group, 2010). Given this large-scale application of dispersants, there is a critical need to understand the potential toxicity of dispersants and other effects on marine organisms (Judson and others, 2010). Samples collected following the application of dispersants to the *Deepwater Horizon* oil spill have documented the presence of one of the dispersant surfactants in deepwater hydrocarbon plumes at 1,000–1,200 m water depth (Kujawinski and others, 2011). The researchers concluded that the surfactant itself underwent no biodegradation. Researchers also noted that they could not yet determine if the dispersant application successfully reduced the size of the oil droplets or facilitated the entrainment of these droplets within the deepwater plume (Kujawinski and others, 2011). Finally, because of the emphasis now placed on subsea dispersant use by the National Response Team, it will be important to address research needs regarding such use. However, the USGS OCS Team had insufficient time to consider this new emerging issue. We note here that further consideration of the potential applicability of the technique to Arctic scenarios and any unique Arctic consequences of such use should be assessed.

5.17. Finding: The interplay of factors such as weather and sea ice on the "window of opportunity" for use of dispersants and how sea-ice conditions may affect the stability of dispersed oil is yet not well understood. The understanding of the potential toxicological effects of dispersants on Arctic ecosystems is lacking.

5.17. Recommendation: Surface dispersants are used in response to oil spills internationally, but improving the understanding of the "window of opportunity" for potential deployment of all dispersants in the Arctic is needed. A more extensive understanding of the toxic and sublethal effects and ramifications for microbial communities (and the natural biodegradation of oil) also is needed.

Chemical Herders

Chemical herders—also referred to as oil collecting agents—are chemicals applied to the water surrounding an oil spill in order to thicken the spill, without the need for mechanical containment, to a point that it can sustain a burn (Buist and others, 2008a; Minerals Management Service, 2008b). Chemical herders constitute an oil-spill countermeasure that can be used in conjunction with ISB (Sørstrøm and others, 2010). This is because one of the critically limiting factors with ISB is the need to have a slick that is sufficiently thick to sustain a burn. Recent studies are also investigating the potential for application of chemical herders to enhance mechanical recovery of oil when used in conjunction with deployment of skimmers, and the potential for herding agents to contract the slick area, and thus improve the efficacy of dispersant applications (S.L. Ross Environmental Research, Ltd., 2010).

Chemical herders have been available for several decades (Buist and others, 2008b), but not used extensively offshore to date because they are effective under largely calm conditions (S.L. Ross Environmental Research, Ltd., 2010). There are currently no commercially available chemical herders approved for use in Arctic waters (World Wildlife Fund, 2009).

Reviews on the state-of-the-art of oil-spill countermeasures, as by D.F. Dickins Associates, Ltd. (2004), have identified chemical herder behavior in ice environments as a knowledge gap. Subsequent research activities (Interagency Coordinating Committee on Oil Pollution Research, 2009; Minerals Management Service, 2008b; and Buist and others, 2008a) have sought to address this gap. Recent studies have focused on the potential utility of herders in responding to oil spills in cold waters, and particularly in ice-covered waters. For example, Minerals Management Service (2008b) suggested that

> "[i]n loose broken ice.... conditions, even with no possibility of booming, if these slicks could be thickened to the 2- to 5-mm range, effective burns could be conducted."

In this context, herding agents may be helpful in the "ice response gap" window of 30- to 70-percent coverage (World Wildlife Fund, 2009).

These recent studies (as with ISB and dispersants) involved public-private sector collaborations, such as BOEMRE and ExxonMobil (Minerals Management Service, 2008b), and the JIP on oil-spill contingency for Arctic and ice-covered waters. International cooperation, at a variety of scales, also has facilitated research from laboratory testing to mid-scale testing at the U.S. Army Cold Regions Research and Engineering Laboratory, the National Oil Spill Response Research and Renewable Energy Test Facility, and the Fire Training Grounds in Prudhoe Bay, Alaska. Recently, two full-scale burn experiments involving the use of chemical herders were conducted in the offshore of Svalbard, Norway (Minerals Management Service, 2008b; Pew Environment Group, 2010). One large-scale experiment with chemical herders was carried out on a free-floating crude oil slick in low (10 percent) ice coverage as part of the JIP Oil-in-Ice effort in 2008 (Sørstrøm and others, 2010). One of the formulations used in recent studies of chemical herders in cold-water conditions is the U.S. Navy cold-water herder formulation (Buist and others, 2008b; Buist, 2010). This herding agent was successful in producing slicks in excess of 3 mm and in significantly contracting oil slicks in the presence of ice (Buist, 2010). One of the recommendations from this work is to conduct a large-scale field trial to test the effectiveness of chemical herding (as a precursor to ISB) in pack ice, and to investigate the influence of wind and sea conditions on this potential spill mitigation countermeasure. One of the key objectives would be to determine how long a herded slick can maintain its thickness with regular re-application of the surfactant under a realistic scale (Buist, 2010). New formulations of chemical herders are under development and testing (Buist and others, 2010).

While an important measure in support of ISB, the application of chemical herders may affect other recovery and mitigation countermeasures. S.L. Ross Environmental Research, Ltd. (2010) notes that

> "...the active ingredient in herding agents (the surfactant) renders sorbent pads less hydrophobic and their water retention increases considerably. This could be a significant detriment to oleophilic skimmers such as drums, discs and rope mops whose recovery surfaces contact herding agent (SIC). This should not be an issue with other skimmers types such as weirs and vacuums."

The question of potential toxicity of chemical herding agents to marine species is noted in the literature (Buist and others, 2008a; World Wildlife Fund, 2009). Although direct toxicity data appear to be lacking, it has been postulated that the risk posed to the marine environment may be modest (Buist and others, 2008b). Buist and others (2008a) note that toxicity data on the U.S. National Contingency Plan (NCP) website indicate that one herder, for example, is only about one-half as toxic as approved chemical dispersants. Toxicity information, from Material Safety Data Sheets, for the components of the U.S. Navy chemical herder is given in Buist (2010). However, information on toxicity that is currently required in Subpart J of the NCP does not necessarily relate to species of concern to Alaska. Research on the potential toxicity of chemical herders to Arctic and subsistence marine organisms would help determine if short- and (or) long-term effects might occur.

5.18. Finding: Although chemical herders are important to improved effectiveness of *in-situ* burn countermeasures, they affect oil recovery efficiencies from various mechanical recovery systems. The resulting trade-offs in countermeasure efficiencies are not fully understood under Arctic field conditions. The toxicity of chemical herders to organisms may not be significant, but this belief has not been validated for Arctic species of concern.

5.18. Recommendation: A better understanding of the comparative value and impact of chemical herders may be warranted to inform oil-spill response scenarios and the timing for deployment of various countermeasures, particularly given the potential for a second-stage recovery effort during ice melt to target oil that had previously been entrained in sea ice. Developing toxicological data for Arctic species of interest would better define the relative value and impact of chemical herders within the countermeasure suite of available tools.

Oil-Mineral Aggregates

The association of oil and fine mineral particulates, typically referred to as oil-mineral aggregates (OMAs) or oil-suspended particulate matter aggregates and oil and fine particle interaction, has long been recognized as a process by which hydrocarbons are transported in marine systems (Owens, 1999). Several case studies, spills of opportunity, and field studies—such as the Baffin Island Oil Spill (BIOS) project—have demonstrated that this oil-clay flocculation process merits consideration in conjunction with other oil-degradation processes (physical weathering, photodegradation, and biodegradation) in understanding the natural attenuation and removal of oil from shorelines (Owens and others, 1994). This process garnered considerable attention in studies of coastal processes following the *Exxon Valdez* oil spill, as researchers noted the association between oil and mineral fines as a mechanism for the natural removal and attenuation of hydrocarbons on the shoreline (Bragg and Yang, 1995). Once formed, OMAs are relatively stable structures, the particle-size distribution and density (or buoyancy) of which are dependent on the mineral-to-oil ratio (MOR) in the structure. Both the composition of the oil and the type of mineral fines can affect this ratio (Zhang and others, 2010). Some basic OMA properties are in need of further study, such as the size distribution of the OMAs, particularly in the presence of dispersants, and how this may affect the settling velocity of OMAs in the water column. There is relatively little known about the specific effect of salinity and clay mineral type on OMA formation (Li and others, 2007). The Arctic Ocean in general is fresher than other marine environments studied. Thus, understanding how regional salinity may affect OMA formation is important. Further, the potential timing of a spill event could influence these processes. For example, should a spill coincide with the spring melt (Yunker and others, 2002), associated discharge pulse from the Mackenzie River system salinity levels would be greatly reduced at some regional scale. The discharge from this fluvial system could significantly affect the salinity and (or) suspended particulate matter (SPM) concentrations, particularly in the nearshore environment. The fate and transport of OMAs are important considerations for oil-spill-trajectory modeling in nearshore waters (Sterling and others, 2004).

Given the natural propensity for oil and SPM to form OMAs, there exists the potential that OMAs also could be used as an oil-spill countermeasure. The Canadian Coast Guard has recently conducted studies looking into the potential utility of this process as a countermeasure to combat oil spills in ice-covered waters (Cloutier and Doyon, 2008). The Centre for Offshore Oil, Gas and Energy Research also is conducting research into this potential use of OMAs, such as the application of mineral fines as a powder or an aerosol mixture to oil slicks at the surface (Lee and others, 2009). In the event additional mixing energy is needed, one potential mechanism under consideration is adding mixing energy to accelerate the OMA formation process (Lee and others, 2009). Utilization of the OMA formation process may be a helpful tool to address the 'ice response gap' in which conventional mechanical technologies may not be effective (Lee and others, 2009).

If OMAs are considered for use in the Arctic, a thorough understanding of how OMAs are incorporated into the sea ice, such as slush, is needed. This understanding is important to oil fate and transport analyses, as OMAs could be transported with the slush ice away from the site of the spill. Payne and others (1991) studied the process by which oil-contaminated sediments could be incorporated into sea ice and thus it is likely that sea ice also could have scavenging potential for OMAs and facilitate greater dispersal of oil (as OMA) over a much larger area.

There is a need to understand how the potential process of OMA formation may be affected by other countermeasures used in response to an oil spill. For example,

> "[t]he synergistic effect of dispersants and mineral fines enhances the transfer of oil from the surface downward into the water column; and a large number of small particles is produced as a result of interaction of dispersants and mineral fines with crude oil" (Li and others, 2008).

Li and others (2007) utilized wave-tank studies to examine these processes, and found that OMA formation can occur with both physically- and chemically-dispersed oil. These studies were conducted under breaking waves. Absent this energy, it is unclear of the effect. Li and others (2007) note that additional factors, such as oil type and weathering state, the type of mineral fines, and the MOR are areas for future study as well as testing under a variety of sea-energy conditions.

Detection, Monitoring, and Tracking

There are numerous technologies available for use in detecting and tracking oil spills on open water, and on top of, within, or under sea ice. These can include: GPS tracking buoys (Dickins and Buist, 1999); tethered balloons (Dome Petroleum Limited and others, 1982); satellite imagery; airborne reconnaissance; trained visual observers; ground, airborne, and space remote sensing technologies; vessel surveillance; optical methods (still and video cameras); unmanned aerial systems (Lehr, 2008); and on-ice surveys. Recent technological advances in the development of lightweight sensors with improved sensitivity (Brown and Fingas, 2009) can augment the utility of these platforms through deployment of multi-sensor systems. For example, there are now efforts investigating the use of a tethered balloon to carry a visible and infrared surveillance system as a means of augmenting real-time spill monitoring capabilities (Prince William Sound Oil Spill Recovery Institute, 2009). In oil-spill response, a suite of these techniques is needed to accommodate the spatial and temporal (especially real-time) needs, as many factors, such as percent ice coverage and thickness, oil slick thickness, oil type and state of weathering, and weather conditions, affect the utility of these technologies. Several recent syntheses, including Dickins (2010), S.L. Ross Environmental Research, Ltd., and others (2010), Interagency Coordinating Committee on Oil Polution Research (2009), Brown and Fingas (2009), Jha and others (2008), Minerals Management Service (2008b), and Tebeau (2003), have documented advances in these technologies over the past decade.

In a review of these technologies and their general effectiveness in response, DeCola and others (2006) noted that

> "estimates vary regarding the impacts of sea ice on spill surveillance and tracking. Response experts often use 50 percent ice coverage as a rule-of-thumb for defining the extent to which open water detection and mapping may be applied. When ice coverage exceeds 50 percent, methods such as visual observation become much less reliable because of problems in detecting the presence of oil in ice leads; however, remote sensing technologies may still apply."

Some technologies require further testing under Arctic conditions. For example, a critical gap identified in spill response is the lack of capability to accurately measure and map the thickness of oil on water and to rapidly send this information to response personnel in the command post (Mineral Management Service, 2008b). World Wildlife Fund (2009) noted that the combination of multi-spectral aerial imagery and infrared detection shows promise for mapping oil slick thickness, but that these tools need further refinement under Arctic conditions and with specific Arctic oil types in order to better demonstrate their feasibility as an operational tool in Arctic oil-spill response. Similarly, DeCola and others (2006) stated that the

> "latest generation of high resolution radar satellites could be used to map large spills in an open pack condition, but radar signatures of new ice, oil, and calm water can be very confusing."

Several recent BOEMRE efforts focus on mapping the thickness of oil, including Bureau of Ocean Energy Management, Regulation and Enforcement (2011b).

In a study of ground penetrating radar (GPR), D.F. Dickins Associates (2005) found that, at frequencies above 800 MHz, GPR yielded clear, well defined frequency, phase, and amplitude anomalies where oil was known to be present at the ice/water interface and trapped within ice tested under lab conditions. The agreement of experimental results with initial modeling indicates the potential to accurately predict GPR response to a variety of Arctic spill scenarios and radar parameters.

Overall, the results clearly demonstrate the potential for detecting oil under sea ice with GPR. Measurements with GPR and airborne radar were conducted over an intentional oil spill in Svea, Svalbard, Norway, in April 2006 and in April 2008 (Dickins and others, 2008). The overall results from two field tests are very promising in that they indicate that GPR using currently available systems is capable of detecting and mapping oil in ice over a broad operational time window from early to late winter, typically November to April in the Beaufort Sea area. This timeframe covers approximately 70 percent of the nearshore fast ice season in most years. The current generation GPR is capable of mapping oil under or trapped within growing winter ice from 30 to 210 cm. Minimum oil thickness detection limit appears to be roughly 2 cm.

Airborne radar also was tested and found to detect oil on frozen ground under snow and oil encapsulated in or under fresh ice. The test also showed that radar can detect oil in and under first year ice with relatively even top and bottom surfaces. Detecting oil through multi-year ice or rafter/ridged first year ice is expected to be difficult because of the voids and jumbled blocks of rough ice which may scatter the radar signal in many different directions.

The time of year also may be important to the detection of oil on or under ice. The overall results from a Dickins and Bradford (2008) study of airborne radar system capabilities in selected Arctic spill scenarios indicate that currently available systems are capable of detecting and mapping oil in ice over a broad operational time window in the Beaufort Sea area. The most reliable months for detection are January and February with results in November, December, and March depending on the internal brine volume of the ice (combination of salinity and temperature). There are still challenges in detecting oil early in the winter with thin, high salinity ice sheets (October) and in the spring (May/June) with warm thick ice having a high volume of liquid brine. During these periods, higher powered radar systems and (or) a corresponding improvement in signal to noise ratios would need to be developed to cover the beginning and end phases of the ice cycle. Detection of trapped oil is not as critical during May and June, however, as the oil will naturally surface through the porous ice and provide a clear visual indication of the presence of residual trapped oil.

Based on previous work, there are limited prospects for developing operational radar based systems to detect oil in sea ice that is floating, but not bottom fast ice. The optimum direction for future radar research and development needs to focus on systems that can evolve into practical operational devices, readily deployed and maintained in Arctic conditions. Future tests need to combine both laboratory and field trials with oil spilled under ice. A sole reliance on laboratory or tank tests will not provide an adequate basis for developing operational systems for future use.

Satellite imagery also is an important component and can inform oil-spill response and other operations in the Arctic, although radar systems are the most practical because of their ability to be used during both the day and the night, and during most cloud cover conditions. For example, as part of the JIP Oil-in-Ice project to assess the overall capabilities of Synthetic Aperture Radar satellites to detect oil spills in ice and monitor ice conditions, Babiker and others (2010) commented that high quality ice information and all-weather satellite coverage is viewed as essential by most companies with operators in the Arctic. Regular satellite surveillance minimizes the need for floating rigs to disconnect riser and drill string in response to advancing ice features and reduces spill risk. In addition, seismic surveys may be completed more efficiently by taking into account ice conditions.

The most effective solution may not be a single sensor, but rather could require the integration of several different technologies (Brown and Fingas, 2009). In a recent review of the state-of-knowledge regarding airborne remote sensing, Dickins and Andersen (2010) noted that multi-spectral remote sensing, when supplemented by visual observation from trained observers, is presently the most effective method for detecting and mapping the presence and spatial distribution of oil on water. There have been many recent studies to test a variety of sensors under different conditions. In their review, Jha and others (2008) stated that laser fluorosensors were the best available sensor for oil-spill surveillance, given the ability to detect oil against many backgrounds, including ice and the shoreline. However, the authors cautioned that no single sensor is capable of providing all requisite information needed to support an effective oil-spill surveillance operation. Advances in technology also may be needed to produce smaller, less energy-intensive systems that could be installed on smaller airframes that are more widely available and (or) affordable to oil-spill responders and government regulators (Brown and Fingas, 2009).

5.19. Finding: There are numerous technologies available for use in detecting and tracking oil spills on open water and in or under sea ice, with varying levels of detection and spatial resolution. Improvements have been made to individual sensors over the past decade; these improvements are documented in a number of available syntheses. Of these, the laser fluorosensor is among the most highly regarded in terms of ability to detect oil in certain snow and ice conditions (Brown and Fingas, 2009). However, there is consensus in the scientific and response communities that no single sensor or approach is sufficient to address all the needs for effective Arctic oil-spill response, particularly given other challenges, such as long hours of darkness and the presence of sea ice. In this regard, high quality ice information and all-weather satellite coverage are viewed as essential by most Arctic operators (Arctic Council, 2009). Given the limitations for each individual type of sensor, packages of multi-sensor systems appear to hold the most promise for versatile and comprehensive remote sensing. Hence, there is growing emphasis on the development of multi-sensor systems that can be deployed from a variety of platforms.

5.19. Recommendation:

1. For spilled oil detection in and (or) under ice, two avenues stand out as the likely focus of future development: acoustics (including the potential use of ultrasound), and electromagnetic (primarily the wave domain systems commonly referred to as impulse radars or ground-penetrating radars). Further testing could be pursued in both these areas. Continued development of practical operational systems for detecting oil in or under ice will be extremely challenging. It is recommended that the latest evolution of the acoustic system first tried in the 1980s be tested over a realistic mix of first year sea ice under field conditions. At the same time, it would be valuable to test the capabilities of the latest generation of ground-penetrating radars in areas of bottom-fast ice where the interface is ice to frozen sediment rather than ice to water.
2. Of the sensors currently available, the laser fluorosensor appears to hold the most promise, given its potential to detect oil in the presence of ice and snow. However, to facilitate broader use of this sensor and its incorporation into multi-sensory packages that can be deployed from a variety of platforms, a reduction in the size and energy consumption—requiring advances in solid-state laser technology—of these systems is critical (Brown and Fingas, 2009).
3. More work is needed on testing of multi-sensor systems to inform remote-sensing operations for spill response. In particular, expanded testing of unmanned aircraft systems is needed to augment observations from trained observers.
4. Research is needed to enhance satellite remote sensing and surface validation capabilities, including development and (or) refinement of satellite-based oil detection algorithms for ice-covered areas.
5. Assessing system performance under real-world conditions during a future offshore controlled spill exercise is seen as a critical need. Such an exercise would provide information essential to refining these capabilities from an operational standpoint.

Field Trials and International Coordination

The National Research Council (1994) recommended

> "the design and completion of one or more experimental oil spills in the general area of the Chukchi and Beaufort Seas. We believe that experimental spills are essential because they can contribute to the scientific understanding of processes, and fill data gaps, about the interaction of ice and oil. These tests also can contribute to accurate assessments of the abilities and limits of countermeasures, and remediation and restoration procedures. The data from recent tests should be evaluated. Carefully controlled field tests would be an invaluable extension of such work into a realistic environmental setting."

This finding appears to remain valid today. The lack of any consistent regulatory framework to facilitate field trials with oil represents a critical science and technology obstacle to achieving real progress in the field of at-sea spill response. Most significant technical advances in Arctic spill response can be attributed to a series of highly successful field trials with oil carried out in U.S., Canadian, and Norwegian waters. Many of these trials have involved moderate-size releases at an affordable cost and have been carried out safely and in an environmentally responsible manner with a high degree of confidence, through a rigorous process of program design and execution. A major point regarding the near-term possibilities for new field trials with oil revolves around the likelihood of obtaining appropriate permits for such experimentation (D.F. Dickins and Associates, 2004). Permits, obtainable in Canada and Norway, are considered unlikely in the United States given that all permit applications have been declined during the last 10 years and no spills in U.S. waters for experimental purposes have been allowed for nearly two decades.

Certainly the previously discussed JIP efforts represent a strong international science and technical collaboration. In addition, at a government level, the Emergency Prevention Preparedness and Response (EPPR) Working Group establishes a framework for future cooperation in responding to the threat of environmental emergencies in the Arctic. The EPPR works within the Arctic Environmental Protection Strategy (AEPS), which was adopted by Canada, Denmark/Greenland, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States through the Ministerial Declaration at Rovaniemi, Finland in 1991. The other working groups within AEPS are the Arctic Monitoring and Assessment Program, Protection of the Arctic Marine Environment, Conservation of Arctic Flora and Fauna, and Sustainable Development and Utilization. The EPPR Working Group provides a forum in which member governments and indigenous peoples work to better prevent, prepare for, and respond to environmental threats from discharges of pollution from activities which take place in the Arctic. The EPPR operates through a system of National Contacts and meets at least annually to assess progress and to develop EPPR Work Plans. EPPR efforts include risk analyses; response exercises for emergencies such as radiological accidents and major oil spills; assessing environmental agreements; evaluating warning systems and communication networks; and sharing experience and technical information, including research and development data.

While not in Arctic waters, CANUSDIX, an effort between Canada and the United States, is a unique annual exercise held near Dixon Entrance, at the southern tip of the Alaskan panhandle and is an example of an innovative combination of spill scenarios, training workshops, equipment deployment, and coordinated multi-year planning (for example, see Canadian Coast Guard, 2010). Like the Arctic, coordinated planning and exercising by partner agencies are a necessity for Dixon Entrance, an environment that also is remote, environmentally sensitive, and characterized by severe weather and limited infrastructure (Gardner and others, 2008).

5.20. Finding: Exercises such as CANUSDIX, an annual emergency response exercise between Canada and the United States near Dixon Entrance at the southern tip of the Alaskan panhandle, and the previously discussed Alaska Ocean Observing System's and others "Sound Predictions" effort in Prince William Sound, Gulf of Alaska, provide practical means to not only identify operational weaknesses but are the only existing practical tools to routinely determine if and what model, real-time data, and data management uncertainties and weaknesses significantly affect desired operational outcomes.

5.20. Recommendation: Efforts to conduct exercises such as CANUSDIX and "Sound Predictions" in the Arctic could significantly advance understanding of the tactical science and information issues that must be addressed. Even if there is not a broader acceptance of conducting actual oil-spill field trials, having scientific protocols in place to take advantage of "spills of opportunities" are essential.

Natural Damage Assessment, Recovery, and Restoration Phase

Background

Discussed in this section are those research needs required to defensibly assess resource injuries, recovery progress, and restoration approaches should oil be released. Our intent is not to suggest that a spill is likely, but to think through such a scenario in a very broad sense and identify approaches and types of scientific information that might reduce societal uncertainties about government capacity to deal with the consequences of oil spills in the Beaufort Sea or Chukchi Sea Planning Areas.

The primary legal framework to determine resource damage is vested within the Natural Resource Damage Assessment (NRDA) process. The NRDA generally is implemented in three phases, which require the natural resource trustees, which in the case of a spill in the Beaufort or Chukchi Seas include the State of Alaska, NOAA, and the Department of the Interior (DOI), to:

1. Determine whether injury to public trust resources has occurred (Preliminary Assessment);
2. Quantify injuries and identify possible restoration projects (Injury Assessment/Restoration Planning); and
3. Implement restoration strategies and monitor effectiveness of such actions.

These are straightforward in language but as stated by the National Oceanic and Atmospheric Administration (2011):

> "Although the concept of assessing injuries may sound simple, understanding complex ecosystems, the services these ecosystems provide, and the injuries caused by oil and hazardous substances takes time—often years. The season the resource was injured, the type of oil or hazardous substance, and the amount and duration of the release are among the factors that affect how quickly resources are assessed and restoration and recovery occurs. The rigorous scientific studies that are necessary to prove injury to resources and services—and withstand scrutiny in a court of law—also may take years to implement and complete."

It is unlikely that even with foreknowledge of where and when an oil spill might occur the suite of baseline information useful to NRDA would be fully available (for example, population, physiological, or toxicological). This is particularly true for the Arctic OCS because of the suite of physical and ecological uncertainties discussed throughout this report, as well as the practical challenges inherent in Arctic research in general. Here, because of the nature of our assignment, we have not attempted to review the scientific literature that would inform the likely exponential suite of possible scenarios and associated potential injured resources that would inform the NRDA-related activities. Instead, we examine strategic science and approach capacities in the Arctic and potential gaps in those capacities that might be informative. We also take advantage of insights gained from the 1989 *Exxon Valdez* oil spill (appendix D) in Prince William Sound, Alaska (http://www.evostc.state.ak.us/ website, accessed May 11, 2011), and the more recent *Deepwater Horizon* oil spill in the GOM to inform our assignment.

Scenarios and Science Planning

Both the *Exxon Valdez* oil spill and the 2010 *Deepwater Horizon* oil spill demonstrate the logistical, technical, and scientific challenges of responding to rare, but significant events. The success of the NRDA process, particularly in the "Preliminary Assessment" stage is dependent on the rigorous collection of time critical and (or) ephemeral information. Previous large oil spills have demonstrated that access to immediate post-spill survival, physiological, behavioral, toxicological, and habitat information could have improved the ultimate level of confidence in NRDA findings. Despite previous lessons learned from the *Exxon Valdez* oil spill, coordinated science plans for the integrated collection of critical data needed for NRDA-related activities have not been prepared in the areas of proposed development. A coordinated joint State–Federal Gulf Coast Ecosystem Restoration Council to inform strategic and efficient restoration efforts into the future has been proposed (Recommendation E6: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011) as was the case after the *Exxon Valdez* oil spill; however, the opportunity to collect much of the time critical data will be past before such establishment. In the case of the *Deepwater Horizon* oil spill, the region had fairly easy and robust access to scientific capacities (multiple Federal and State laboratories, academic specialists), extensive citizen volunteers to help capture early resource mortality data, and community infrastructure (for example, boats), all of which improved the likelihood that critical early post-spill data were captured. The Arctic OCS and coastal environment is not similarly positioned.

Although the *Exxon Valdez* oil spill is scientifically informative for many aspects of our later discussions, it was a spill that occurred from tanker grounding rather than from drilling activities. Thus, contemporary environmental studies of the nature produced through the BOEMRE Environmental Studies Program for the Arctic OCS described previously were not available. The spill also occurred after a period of ocean climate regime shift (for example, Anderson and Piatt, 1999), whose consequence to effective injury and recovery assessment was not well understood for some time into restoration efforts. In that regard, our existing scientific foundation and progress towards expanded understanding of the distribution of species, potential fate and effect of oil, and the nature of environmental change (including changing climate scenarios) could be argued to be more robust than was available for Prince William Sound in 1989. There is the current effort invested in environmental studies under the BOEMRE, project efforts by industry (for example, Funk and others, 2010), the agency mission-specific monitoring ongoing at both Federal and State levels, and the broad collation and synthesis efforts by many parties (for example, Smith, 2010).

The existing Oil Spill Risk Assessment (OSRA) framework described earlier, while at some level limited because of the qualitative manner in which ecological information is presently incorporated, does provide information on likely landscapes and resources affected under simulated spills. This foundation is valuable and provides information useful to better understand and narrow the range *a priori* of likely NRDA injured resources under the various oil-spill scenarios.

In the report prepared by Integral Consulting Inc. (2006) for the *Exxon Valdez* Oil Spill Trustees Council, scientists who gained experience from the *Exxon Valdez* oil spill provided a strong foundation for understanding the types of scientific information needed to assess recovery status, lingering oil impacts, and restoration progress to inform what types of "pre-spill" data should be readily available (fig. 5–9). Information on population characteristics (for example, abundance and productivity, physiological metrics, and habitat) and exposure metrics (for example, bioaccessibility, exposure pathways, and biomarkers) all must come together in a weight-of-evidence to inform NRDA activities (Integral Consulting Inc., 2006, fig. B–4).

5.21. Finding: The remoteness of the Arctic OCS, the small resident population, and limited community infrastructure likely would limit the probability of early science responses that were seen during the *Deepwater Horizon* or *Exxon Valdez* oil spills, resulting in the loss of time-critical data informative to Natural Resource Damage Assessment.

5.21. Recommendation: The development and pre-positioning of a multi-agency coordinated Oil Spill Science Contingency Plan could potentially mitigate some of the challenges inherent in spill response in the Arctic. The planning process itself would be valuable by identifying what skills and protocols exist or need to be developed. The *Deepwater Horizon* oil-spill response demonstrated the need for local citizen engagement in sample collections. This is likely more true in the Arctic, due to access limitations. Local community members could be the first available on scene. Consideration of a "Citizen Scientist" program as a component of Science Contingency Plans might be fruitful.

5.22. Finding: The Oil Spill Risk Assessment (OSRA) process employed by the BOEMRE provides information to help define where natural resources might be exposed to oil under various spill scenarios.

5.22. Recommendation: A strategic follow-on analysis to the present Environment Resource Area OSRA that would examine the state of knowledge of specific NRDA metrics (for example, see fig. 5–9) could help identify specific population, physiological, habitat, and exposure data for future NRDA activities. This would help establish priorities for needed science under BOEMRE-focused planning as well as ongoing efforts by science and resource agencies.

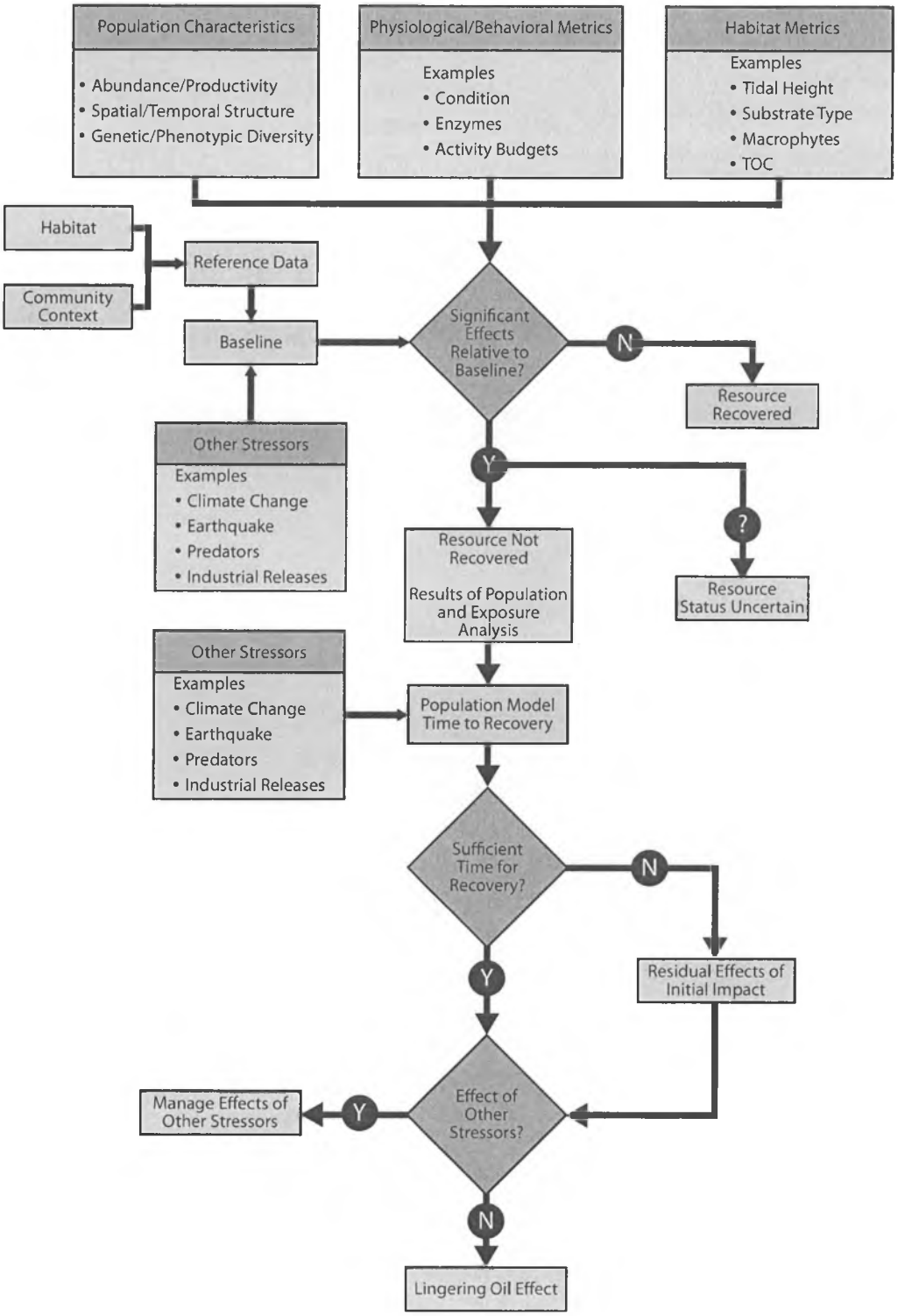

Figure 5–9. Factors incorporated into population level evaluations of recovery status (modified from Integral Consulting Inc., 2006, figs. B3 and B5). TOC, total organic carbon; N, No; Y, Yes.

Integrated Monitoring and Process Understanding

As discussed elsewhere in our report, there are high accumulated uncertainties associated with any development activity in the Arctic and what science is "essential" to informing decisions. In addition to project uncertainty, climate changes may affect the relevancy of historical data to future decisions, and there is a huge spatial extent under consideration. Thus, having the "right" science, at the "right" time, and at the "right" scale is problematic. In such an environment, there may be great value to a more aggressive science strategy to integrate sampling approaches to ultimately improve inferences from sampling available at one scale to another, or one time or location to another. As discussed above, the same could be said for the ability to develop a full pre-understanding of all the essential NRDA metrics for each potential injured resource (or resource being examined in pre-decisional leasing documents). Here, we discuss several elements of this challenge and potential approaches to provide some level of mitigation.

Several existing study programs for the Beaufort and (or) Chukchi Seas serve as examples of approaches that may provide the framework for improving our ability to scale understanding from one level to another. The BOEMRE has undertaken a wide variety of integrated monitoring efforts over the last decade. These include:

1. ANIMIDA, the "Arctic Nearshore Impact Monitoring in the Development Area" study designed to assess potential environmental contaminant inputs from Beaufort Sea oil and gas development and its continuation cANIMIDA (for example, Boehm, 2001; Neff and Associates, LLC, 2010), and
2. COMIDA, the "Chukchi Sea Offshore Monitoring in Drilling Area" effort which conducts an extensive multi-study examination of the environment.

Both these efforts provide a mid-scale view of environmental background conditions associated with prospects. When coupled with the more detailed prospect-specific industry efforts such as those in the Chukchi Sea Lease Area, significant process and scaleable information could be generated informative to both permitting and future NRDA needs (fig. 5–10).

Another approach that is likely valuable in the effort to better generate and understand factors critical to NRDA, particularly in a changing climate, is formal integrated multidisciplinary monitoring and process studies. The *Exxon Valdez* oil spill can be used as an example to gain perspective—more than 30 biological resource types were considered to be injured by the *Exxon Valdez* Oil Spill Trustee Council during the *Exxon Valdez* Oil Spill NRDA process (*Exxon Valdez* Oil Spill Trustee Council, 2001) with the majority recovered or recovering and four viewed as not recovered or recovery unknown by 2010 (*Exxon Valdez* Oil Spill Trustee Council, 2010). The challenge faced by the Trustee Council to judge recovery was largely due to:

1. Variability in population estimates as a result of highly mobile fish, birds, and marine mammals causing wide confidence limits for population size estimation;
2. Lack of pre-spill data;
3. Interaction of the spill and other natural factors (for example, climate) that constrained the ability to judge the role of oil in population status; and
4. Geographic scale of studies conducted both before and after the spill which ranged from scales to assess populations to others keyed to localized effects and oil exposure.

To compensate for incomplete information, injury often was inferred from comparisons of oiled and unoiled areas, with recovery defined as a return to conditions comparable to those of unoiled areas. Confidence in such designs is limited because of natural variability among sites oiled and unoiled prior to a spill. Ultimately, efforts turned towards the development of ecosystem-based integrated studies to attempt to better establish population status relative to recovery and factors still constraining recovery through a weight-of-evidence approach across suites of species whose status remained uncertain (*Exxon Valdez* Oil Spill Trustee Council, 1994). Efforts like those described in Peterson and Holland-Bartels (2002) for a suite of species whose recovery status was still uncertain or deemed non-recovered after extensive study and some 5 years after the oil spill highlight that coordinated multi-species sampling and coupled hypothesis-driven studies can mitigate many weaknesses in incomplete pre-spill data. Efforts such as those proposed by Grebmeier and others (2010) for a Distributed Biological Observatory (DBO) or underway in the Bering Sea and Aleutian Island Integrated Ecosystem Research Program (BSIERP, http://bsierp.nprb.org/) of the North Pacific Research Board and National Science Foundation offer examples of approaches that could well serve the full suite of interested parties and their decision-making requirements that cascade out of DOI OCS decisions.

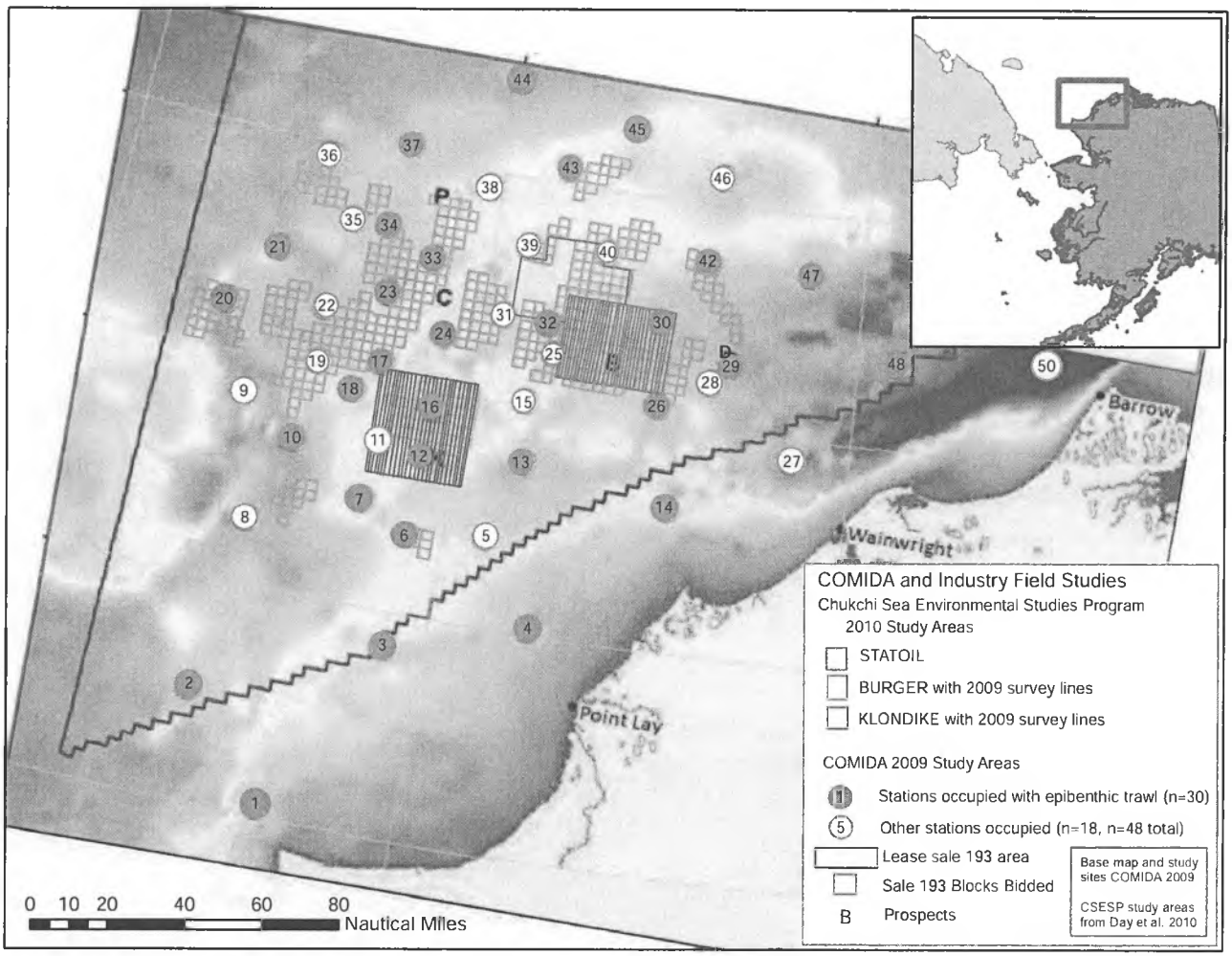

Figure 5–10. Example of the BOEMRE-sponsored COMIDA sampling and the more spatially detailed industry-sponsored sampling (modified from Dunton, 2010; Day, 2010).

5.23. Finding: Significant advances have taken place with the COMIDA ("Chukchi Sea Offshore Monitoring in Drilling Area") and cANIMIDA ("continuation of the Arctic Nearshore Impact Monitoring in the Development Area")-like efforts funded by the BOEMRE and the more spatially detailed efforts by industry. Such efforts individually provide critical information on ecosystems, potential anthropogenic effects from development, and climate factors.

5.23. Recommendation: The benefits from these individual efforts to improve scientifically defensible inference of findings to different geographic and temporal scales could be significantly enhanced through additional focused coordination and joint study planning. Discussions in a workshop format to outline specific experimental designs presently employed and to discuss fruitful efforts to link study efforts might be beneficial as one approach.

The DBO (fig. 5–11), as envisioned by Grebmeier and others (2010), would provide a monitoring and experimental framework:

> "...to detect, measure, and track the combined effects of changing oceanographic conditions on the ecosystem....[with] holistic, integrating measurements of basic oceanographic variables [and] with data on species- and trophic level interactions, from primary producers to marine mammals... The DBO is envisioned as an array to identify and consistently monitor biophysical responses in four pivotal geographic areas that exhibit high productivity, biodiversity, and rates of change. ...The DBO would support a suite of *in-situ* time-series measurements to evaluate ecosystem status, supplemented by satellite observations. Sea ice observations include ice and snow thickness and biological sampling to evaluate changes to productivity in sea ice systems and habitat sustainability for predators."

A DBO approach, which would bring value to resource missions beyond that required by the BOEMRE, would require a concerted multi-agency and international planning effort. However, once established, a DBO might provide a critical and essential complement to mission-specific sampling by the BOEMRE and species studies by NOAA, U.S. Fish and Wildlife Service, and (or) the State of Alaska. This is particularly true as climate is hypothesized to force significant ecosystem-level changes that will require rigorous understanding if they are to be defensibly incorporated into OCS-specific or the broad array of other agencies mission considerations.

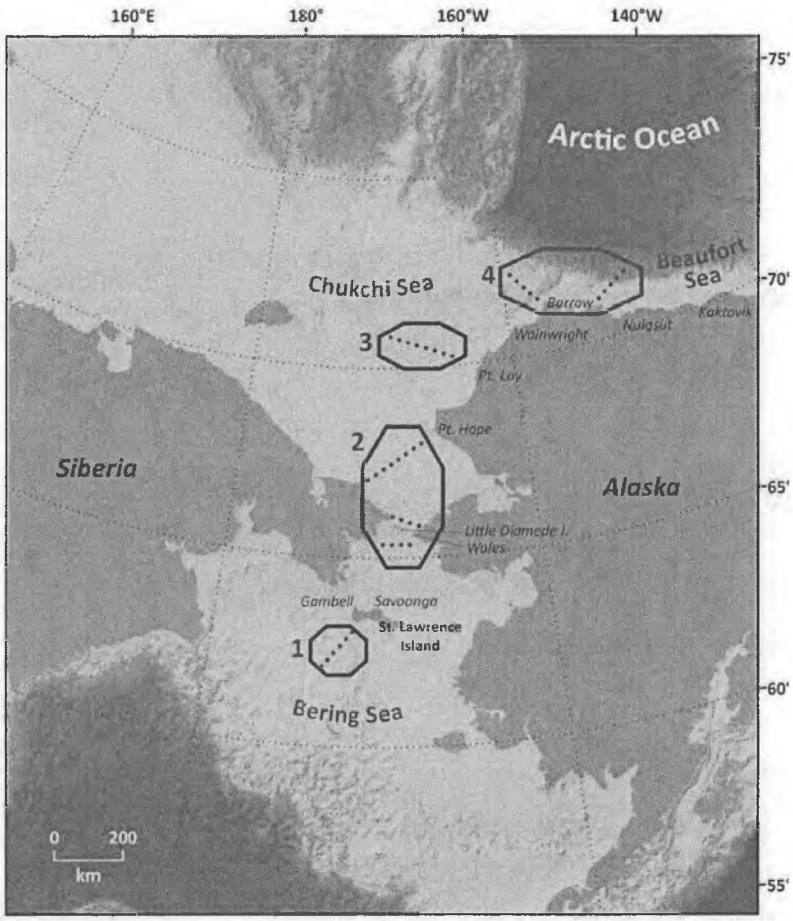

Figure 5–11. Schematic of the location of the proposed Distributed Biological Observatory for standard hydrological and biological measurements in the Bering, Chukchi, and Beaufort Seas (Grebmeier and others, 2010).

5.24. Finding: The Arctic environment is highly variable both physically and biologically. Here, it is difficult to conduct and maintain the suite of individual surveys and sampling efforts of ecosystem components at sufficient levels to understand potential future impacts from development. As was demonstrated in the *Exxon Valdez* Trustee Council recovery science efforts, this is particularly true for information needed to establish population status.

5.24. Recommendation: The Distributed Biological Observatory concept is one that holds significant scientific promise to mitigate some of the major constraints to a defensible science framework for critical Arctic decision making.

5.25. Finding: Similar to findings 5.23 and 5.24, the nature of resource variability and uncertainty in the Arctic challenges the development of the full suite of scientific information needed by decision makers and vested parties relative to resource management in the Arctic.

5.25. Recommendation: The BSIERP (North Pacific Research Board-National Science Foundation Bering Sea and Aleutian Island Integrated Ecosystem Research Project) and the DBO (Distributed Biological Observatory) concepts and enhanced industry-COMIDA ("Chukchi Sea Offshore Monitoring in Drilling Area")-like efforts offer the potential to create a transparent and scientifically rigorous study framework to support and enhance existing BOEMRE and other organizational interests in the Arctic.

Finally, the conceptual approach used by the North Pacific Research Board in its BSIERP, which considers commercial fishery research within the context of an ecosystem framework, offers another successful approach to understanding anthropogenic factors in the context of complex ecosystems and changing environments (North Pacific Research Board, 2006). The BSIERP was envisioned to address scientific challenges to effective fishery management associated with expected changes in the ecosystem such as:

- "Physical phenomena (for example, weather patterns, sea ice characteristics, transport, mixed layer dynamics, temperature, nutrient fluxes);
- Composition, abundance, distribution, and demographic parameters of biological components from plankton to seabirds and marine mammals;
- Strength of existing predator-prey linkages and development of new linkages;
- Human strategies for resource extraction, transportation, and community adaptation."

This effort considered hypotheses that included how the distributions and abundances of species might be changing; characteristics of physical and chemical attribute change; changes in lower trophic level production; processes controlling energy pathways; the role of climate change in these processes; and the economic and sociological impacts of a changing ecosystem on the coastal communities and resource users of the Bering Sea. The concepts and the efficient approaches forwarded under the BSIERP (fig. 5–12) are appealing when considering the functionally similar challenges of resource decision making for the Arctic.

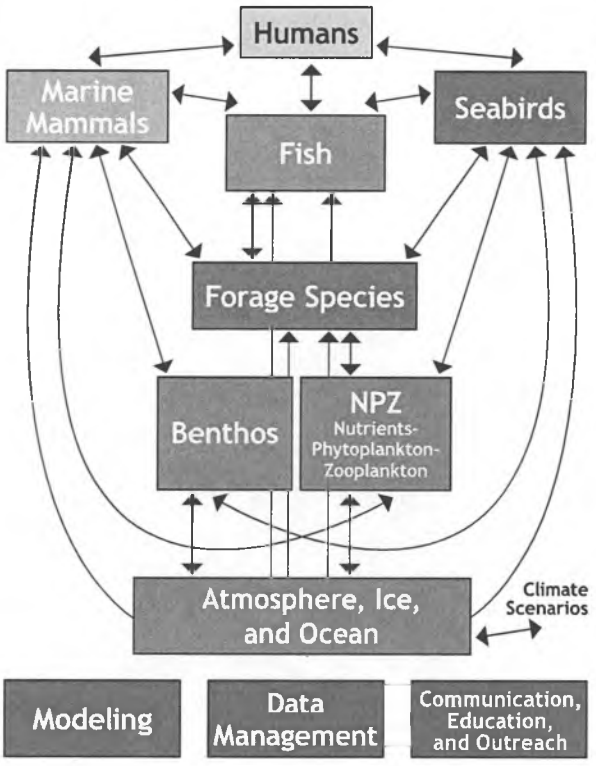

Figure 5–12. Conceptual design of the North Pacific Research Board Bering Sea and Aleutian Island Integrated Ecosystem Program. Graphic available at: http://doc.nprb.org/web/BSIERP/zzWebsite/proj_mgmt/01.10_bsag_web.pdf, accessed March 8, 2011.

As a final consideration, any of these larger integrated approaches, as well as the existing BOEMRE program, requires input from many other resource programs. Should these efforts be lost or reduced, the science-based decision making about oil and gas development in the Arctic may be compromised. For example, Grabmeier and others (2010) discuss that the DBO would require collaboration and joint data collection with vessel cruises through the Pacific Arctic Group network of governments and scientists working in the Pacific Arctic, inclusion within international Sustaining Arctic Observing Networks, and (or) Arctic Council (website: http://www.arctic-council.org/, accessed May 10, 2011) efforts. The BSIERP, as mentioned previously, is a close partnership with the National Science Foundation with strong in-kind funding leverage from mission work from many State and Federal agencies. Thus, not only is the support for new collaborations key to developing enhanced insights for oil and gas development in the Arctic, but also the maintenance of core agency mission work. One only has to turn to the

environmental documents of the BOEMRE (for example, Minerals Management Service, 2006) or to the data sources that were the basis of "The Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas" document (Smith, 2010) to capture the critical nature of core mission work of other Federal and State agencies. The amount of such existing work is encouraging, but the general quality as defined by spatial and temporal coverage should be increased (appendix E, table E–1).

5.26. Finding: The information that presently supports science-based decision making on oil and gas development in the Arctic comes from both the topic-focused work of agencies such as BOEMRE, and the efforts of broader agency-specific mission work of many Federal, State, community, and nongovernmental entities.

5.26. Recommendation: The ability to develop oil and gas resources in as safe and environmentally sound a way as feasible relies on many data sources outside the formal annual planning process of the BOEMRE. Understanding the potential jeopardy these data collections might be in across organizations because of different planning processes and national and regional priorities, and development of a strategic collaboration to maintain and enhance such scientific efforts could prove valuable. Such information could be identified as part of an overall science plan.

Oil-Spill Risk, Response, and Impact Under Future Climate Considerations

In Chapter 4, Climate Change Considerations, the authors discuss how physical characteristics important to oil-spill risk, response, and impact may change under climate forecasts in the next 50 years. A number of significant changes are expected to occur in the physical environment of the Beaufort and Chukchi Seas. Some of these changes will stress the biological systems that are so highly adapted to the extreme conditions of this region. These changes are also expected to affect the environment in which Arctic OCS exploration and development activities occur. Some climate changes will mitigate the environmental risks of energy development in the region, while others will compound them. The interactions between future climate change over the next 50 years and potential energy development within the Arctic OCS are described briefly in the following paragraphs.

- *Temperature:* Extremely cold temperatures are cited as a factor contributing to the risk of accidents and spills. The large warming projected to occur within the Arctic OCS during autumn and winter is expected to reduce the risk of accidents and spills during those seasons, as is the more modest warming during spring.
- *Sea Ice:* The Chukchi and Beaufort shelves are expected to be ice-free for a greater period of time each year. This will reduce the portion of the year when the presence of sea ice may contribute to the risk of accidents resulting in spills, and will increase the time when spill sites will be accessible to vessels without icebreaking capabilities. Mechanical devices for recovering oil (booms, skimmers, pumps) may function more effectively for a greater part of the year. However, sea ice will still be present throughout winter and spring. With its projected reduced thickness, the ice pack will be more dynamic, increasing the risk of spill-producing accidents during these seasons. Oil-spill response may be more difficult in the more dynamic sea-ice environment.
- *Clouds:* The increasing prevalence of low-level clouds and fog during the open-water season will increase the occurrence of poor-visibility conditions during summer and autumn. In addition, these poor-visibility conditions are expected to occur over a greater fraction of the year, extending into late autumn. Poor visibility is a factor that increases the risk of accidents resulting in oil spills, makes vessel and aircraft operations extremely dangerous, increases the response time of vessels and aircraft trying to respond to an accident or spill, hampers onsite spill response operations once the needed equipment and personnel arrive, and makes it difficult to monitor the location and condition of a spill by using aircraft. The projected increase in high-level clouds (all seasons) compounds the problem by limiting satellite-based surveillance. In contrast to summer and autumn, the occurrence of low-level clouds and fog is not projected to change substantially during winter or spring.
- *Icing Conditions:* Icing conditions present a significant hazard in the Arctic, both to personnel and equipment. These conditions are expected to occur more frequently during autumn. Icing conditions increase the risk of accidents resulting in oil spills, make aircraft operations extremely dangerous, increase the response time of aircraft trying to respond to an accident or spill, and hamper onsite spill response operations once the needed equipment and personnel arrive. This is primarily an autumn phenomena, and is not expected to increase risks during winter, spring, or summer.

- *Precipitation:* The increasing frequency and intensity of precipitation (all seasons), as well as the number of wet days, may elevate the risk of accidents resulting in oil spills. Such conditions also may make it more difficult to respond to spills when they occur. Increased precipitation during winter and spring may contribute to the severity of 'white-out' conditions which greatly reduce visibility. The projected increase in precipitation is expected to reduce the salinity of the surface waters in the Beaufort and Chukchi Seas, potentially reducing the effectiveness of chemical dispersants applied to oil spills.

- *Storms:* A number of physical arguments suggest Arctic cyclones, including Polar Lows, will become more frequent and (or) more intense during autumn and winter. Although this projected change has not yet been rigorously tested (and so is uncertain), we note that there are no physical arguments to suggest storms will become less frequent and (or) less intense during these seasons. An increase in storminess during autumn and winter, if it occurs, will increase the risk of accidents resulting in oil spills if oil and gas operations are conducted during those seasons. Such storms would increase the frequency of strong winds (autumn, winter) and rough seas (autumn). High winds can prevent or hamper aircraft and vessel access to spill sites, adversely affecting spill response times. Mechanical recovery systems and ISB are hampered by high winds. Accurate application of chemical dispersants is more difficult during high winds. However, rough seas may enhance the effectiveness of chemical dispersants once applied to a spill. Rough seas, drifting pack ice, and storm surges may cause significant damage to offshore equipment, artificial islands, and onshore coastal infrastructure. At this time, there are no convincing arguments that storms will become either more or less frequent during spring or summer.

- *Sea-Level Rise:* Artificial islands and causeways built for offshore energy development will be increasingly vulnerable to inundation from sea-level rise and damage from storm surges. This risk can be substantially reduced through proper engineering that takes sea-level rise into account.

- *Coastal Zone:* Land-based infrastructure (for example, pipelines, storage tanks) designed to support offshore energy development will be much more vulnerable to damage due to sea-level rise, storm surges, permafrost degradation, and accelerated coastal erosion. Proper engineering and site selection may mitigate this risk to a large extent.

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Chapter 6

Marine Mammals and Anthropogenic Noise

By Deborah R. Hutchinson and Richard C. Ferrero

Introduction

In the ocean realm, where vision often is limited by turbidity and darkness, marine mammals rely upon hearing as their primary sense. The scientific consensus is that audition is used in a wide range of activities, for example, to communicate, to forage, to hunt, to sense the environment, to navigate, to socialize, to seek mates, to find open water amidst ice, and to flee predators. Cetacean and pinniped auditory systems are adapted to exploit the ease with which sound travels in water—roughly five times faster than in air, and for far greater distances. For marine mammals, the oceans are relatively opaque to light, but transparent to sound.

The oceans also are noisy places. Among the natural contributors to ocean ambient noise are wind, rain, waves, ice cracking, surf, earthquakes, volcanoes, lightning strikes, and biological sources including the wide array of sounds made by marine mammals. Superimposed on these sounds are manmade ("anthropogenic") sounds from shipping, industrial activities, naval operations, marine research, aquaculture, and aircraft, among others. For the same reasons that marine mammals use sound for survival and reproduction, humans use sound as the most cost-effective and efficient tool for remote sensing and mapping of the seafloor and sub-seafloor to understand, among other issues, habitats and mineral and energy resources. The characteristics of all these sources of sound can be intermittent or sustained, loud or barely audible, and cover a wide range of frequencies (for example, Wenz, 1962). The Arctic Outer Continental Shelf (OCS) is one of the few relatively pristine regions on Earth where shipping and coastal community development is minimal. With the possible exception of the Prudhoe Bay region, the introduction of anthropogenic sound also has been minimal, because of the harsh ice-covered, cold, and remote location. Hence the Arctic offers the potential opportunity to understand the impacts of anthropogenic sound before animals have become widely sensitized, habituated, or disturbed by chronic manmade sounds.

It has been recognized for some time that human-generated noise has the potential to have deleterious effects on marine mammals (for example, Payne and Webb, 1971; Greene and Richardson, 1988; Richardson and others, 1995; Gordon and others, 2004; Southall and others, 2007; Tyack, 2008, 2009). Elevated background noise from manmade sources may prevent animals from hearing sounds they use for their survival or reproduction (masking). Manmade sound may trigger behavior changes, such as avoidance or displacement, which interrupts normal activities. Loud sounds may cause temporary or permanent changes in hearing. Some sounds also may initiate physiological stress responses or even physical injury that could affect survival or reproduction. The great challenge in understanding these impacts is that studying wild populations of Arctic marine mammals is expensive, difficult, and sometimes dangerous. Furthermore, extrapolating limited observations from individual animals to understand longer term characteristics of a population is often more speculative than substantive.

The past two decades have witnessed a growth in concern about and research into human-generated sound in the oceans and its potential impacts on the health and sustainability of marine mammals. A synthesis book was published in 1995 (Richardson and others, 1995). Four National Research Council (NRC) reports have directly explored the association between anthropogenic noise and marine mammals (National Research Council, 1994, 2000, 2003a, 2005). The Marine Mammal Commission also has published synthesis documents (Vos and Reeves, 2005; Marine Mammal Commission, 2007; Simpkins and others, 2007; Bradley and Stern, 2008). Additional syntheses have explored the effects of anthropogenic sound on marine mammals, including seismic studies (for example, Ketten, 1997; Popper and others, 1997; National Resources Defense Council, 1999; Au and others, 2000; Wartzok and others, 2004; Southall and others, 2007; Tyack, 2008; Marine Ecology Progress Series, 2009). Special studies have investigated the effects of oil and gas activities, particularly seismic experiments, on marine mammals (for example, National Research Council, 2003b; Tolstoy and others, 2009); and a Joint Industry Project (JIP) on sound produced from exploration and production (E&P) developed a report identifying knowledge gaps and recommended research for anthropogenic sound and marine life (Thorson and others, 2005). Phase 2 of this JIP lasted from 2006 to 2009 with additional publications (International Association of Oil & Gas Producers, 2011) and a third phase began in January 2010. The U.S. interagency task force on Anthropogenic Sound and the Marine Environment issued an integrated research plan in 2009 (Southall and others, 2009). Since 2006, the Acoustic Ecology Institute has released annual summaries of science, policy, and legal developments related to ocean noise (Acoustic Ecology Institute, 2007).

Marine mammals known to occur in the U.S. Arctic OCS include both year-round or seasonal inhabitants as well as a broader collection of occasional visitors. Cetaceans most notably associated with the Beaufort and Chukchi Seas include bowhead, beluga, and gray whales with less frequent sightings of harbor porpoise, and fin, humpback, and killer whales. Five pinniped species are found in these waters, including ringed, bearded, ribbon, and spotted seals, as well as Pacific walrus. Likewise, polar bears are found throughout this area.

In this chapter, which focuses on the impacts of sound in the Arctic, we emphasize species that could potentially be affected at the population level (owing to more frequent occurrence than the occasional visit)—bowhead, beluga, and gray whales; ringed, ribbon, bearded, and spotted seals; Pacific walrus; and polar bears (table 6–1). In addition, several of these species warrant close attention given their legal status. Bowhead and fin whales have long been listed as endangered under the Endangered Species Act (ESA). The polar bear was listed as threatened in 2008 (U.S. Fish and Wildlife Service, 2008) and in November 2010, the U.S. Fish and Wildlife Service (USFWS) further designated critical habitat for the polar bear (U.S. Fish and Wildlife Service, 2010). The gray whale was considered endangered until 1994, when it was delisted (National Marine Fisheries Service, 1994). Among the pinnipeds, National Marine Fisheries Service (NMFS) initiated an ESA consultation for the four Arctic seal species—the ribbon seal (National Marine Fisheries Service, 2008a) and the spotted seal (National Marine Fisheries Service, 2009a) did not warrant listing action for U.S. waters; however, in December 2010, NMFS proposed that the U.S. Arctic populations of the bearded (National Marine Fisheries Service, 2010a) and ringed (National Marine Fisheries Service, 2010b) seals warranted threatened listings. USFWS recently published a finding for Pacific walrus of warranted but precluded under ESA (U.S. Fish and Wildlife Service, 2011).

Aside from these species or population specific considerations, this collection of marine mammals derives unique stewardship consideration through multiple layers of legislative mandate. The Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), and the National Environmental Policy Act (NEPA) are important drivers in management decisions and the need for science to support them. Of these and with particular relevance to this report, NEPA particularly affects the Department of the Interior because of the regulatory responsibilities of the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) for offshore oil and gas development. The National Oceanic and Atmospheric Administration (NOAA)/NMFS and USFWS share responsibility for implementing MMPA and ESA, with a particular concern for authorizing activities that produce anthropogenic sound in the oceans.

Table 6–1. Marine mammals of concern in the Arctic Outer Continental Shelf.

[From Allen and Angliss (2010) unless otherwise noted. **Locale:** B, Beaufort abundance; C, Chukchi abundance; P, Pacific abundance; T, total abundance. **Population status:** +, increasing; ?, unknown. **MMPA** (Marine Mammal Protection Act) **ESA** (Endangered Species Act) **status:** From http://www.nmfs.noaa.gov/pr/species/: Cd, candidate; E, endangered; D, depleted; DL, delisted; Th, threatened]

Common name	Latin name	Locale	Stock abundance	Population status	MMPA ESA status
Bowhead whale	*Balaena mysticetus*	T	9,400	+	E,D
Beluga whale	*Delphinapterus leucas*	B	32,500	?	
		C	3,700	?	
Gray whale	*Eschrichtius robustus*	P	17,500	+	DL
Ringed seal	*Pusa hispida*	T	?	?	Cd
Ribbon seal	*Histriophoca fasciata*	T	?	?	
Bearded seal	*Erignathus barbatus*	T	?	?	Cd
Spotted seal	*Phoca largha*	T	?	?	
Pacific walrus	*Odobenus rosmarus divergens*	T	129,000	?	Cd[1]
Polar bear	*Ursus maritimus*	C	2,000	?	Th
		B	1,800	?	

[1]U.S. Fish and Wildlife Service (2011).

Despite the research and interest in the impacts of noise on marine mammals, considerable controversy surrounds how MMPA, NEPA, and ESA are applied to regulate offshore activities and protect marine mammals. A recent court case in the Arctic OCS is the July 2010 decision halting activities under Lease Sale 193 in the Chukchi Sea citing the need for further environmental review. Tension exists between the advocates for more precautionary approaches to decision making and regulation (National Resources Defense Council, 1999) and the regulatory agencies implementing MMPA and ESA (that is, NMFS and USFWS). Both behavioral and auditory effects associated with anthropogenic sound are considered "takes" under MMPA and ESA, especially if the effects are considered "biologically significant," a finding that also is controversial in how "biologically significant" is determined and applied (National Research Council, 2003a, 2005).

6.01. Finding: For all the many studies conducted on ocean noise and marine mammals, large uncertainty still exists in extrapolating how impacts of noise on individual animals may affect survivorship or reproductive rates of populations. The National Research Council (2005) addressed how to determine "when noise causes biologically significant effects" (subtitle of the report) but the proposed model involves five core components for which transition inputs and outputs are not always specified or quantified (for example, Clark and others, 2009). More work is needed that is designed to determine how to most effectively determine the impacts of noise at both individual and population levels.

6.01. Recommendation: Investment in efforts such as those of BP and the North Slope Borough with the University of California, Santa Barbara—Cumulative Effects of Anthropogenic Underwater Sound on Marine Mammals—which is to summarize and synthesize the literature on effects of anthropogenic sound on marine mammals, develop suggested approaches for routinely assess such effects, and to define fruitful avenues of future research (http://www.eri.ucsb.edu/adminstrative/research_awards_icess, accessed April 1, 2011)—and the conduct of resulting high priority research would improve the science foundation for a myriad of planning and permitting actions related to Arctic OCS.

Finally, marine mammals are integral to the culture and identity of the Iñupiat Native community of the North Slope of Alaska. The bowhead whale is a vital dietary component, source of bone and baleen for traditional crafts, and an essential symbol of the subsistence culture of the Iñupiat community. The MMPA protections for marine mammals include making them available for subsistence hunting. Annual hunting quotas for the bowhead whale are determined by the International Whaling Commission. The U.S. quotas are allotted to the 11 North Slope communities by the Alaska Eskimo Whaling Commission. For 2010, NOAA issued a quota of 75 strikes to the Alaska Eskimo Whaling Commission. Walruses, polar bears, and seals also are hunted and used by the Native community. A significant recurring concern of the Native community is that oil and gas related activities may displace marine mammals from hunting grounds, thereby threatening the livelihood and existence of the Native community. Moreover, they seek to ensure that local traditional knowledge is used to augment understanding of seasonal movements, distributions, and abundance of marine mammals (for example, Noongwook and others, 2007).

In response to concerns about noise associated with oil and gas activities in the Arctic, NOAA/NMFS initiated an Environmental Impact Statement (EIS) on the effects of Arctic OCS oil and gas activities (seismic and exploratory drilling), and held scoping meetings in February and March 2010, in seven North Slope villages and Anchorage (National Marine Fisheries Service, 2010d). The EIS, still in preparation, examines the effects of oil and gas activities, including noise, on marine mammal species and stocks, as well as their effects on communities and subsistence.

Characterization of Sound in the Oceans

Sound is not intuitive to measure or describe. Technically, sound travels in water as a mechanical vibration, or pressure wave (also called a p-wave) comprising mechanical particle motion oscillations associated with alternating compressions and rarefactions. The physics of sound measurement and transmission are covered in many places and are only briefly summarized here, for example, American National Standards Institute (1986, 1994), Richardson and others (1995), National Research Council (2003), and Erbe (2011). Sound is composed of waves of varying frequencies (measured in cycles/second, Hz) that are of sufficient strength to be detected. In basic terms, sound can be loud or soft, high frequency or low frequency, continuous or pulsed, and its measured loudness and pitch will depend on how distant or close one is to the source. The description of sound necessarily involves relative measures of its character (for example, compared to a reference), and will depend on whether the measurement is done at the source or at some distance from the source. Complicating the characterization is that sound in water attenuates and weakens as it travels ("propagates") away from the source, depending on factors such as salinity and temperature of the water, presence or absence of ice, reflection off the sea or ice surface, the depth of the water, and hardness of the seafloor (in coastal waters). Because higher sound frequencies attenuate more rapidly, low-frequency sounds also travel farther than higher frequency sounds. Hence the sound characteristics at the source (where the sound is created) may have very different characteristics by the time they travel to the marine mammal (where the sound is received).

The methods used to measure sound magnitude include pressure, energy, and intensity. For any acoustic wave, the measure of the pressure on the sound wave can be from zero-to-peak (zero to maximum pressure), peak-to-peak (maximum negative to maximum positive pressure), or a root-mean-squared (rms) value (average of the squared pressure over the duration of a pulse) (fig. 6–1). Sound Pressure Level (SPL) gives the sound pressure relative to a reference pressure, which for water is 1 micropascal (μPa). Because of the large dynamic range of sound pressures, the decibel unit (dB) quantifies pressures (relative to the reference pressure) on a logarithmic scale, so that the SPL of a sound in water using the rms value is given as 20log10(P/Pref), where Pref is 1 μPa and the units are dB re 1 μPa (rms). Sounds at the source typically are standardized to 1 m distance from the source and are given in units of dB re 1 μPa (rms) at 1 m. Sound Pressure Level using the rms approach is the current metric used in MMPA for establishing zones of safety for marine mammals.

Sound also can be characterized by energy, which integrates the pressure through a time window and is proportional to the time integral of pressure squared. Typically, 1 second is the standard for the time, and is referred to as a Sound Exposure Level (SEL), in units of dB re 1 μPa2s. Intensity measures the energy that passes through a unit area per unit time and also generally is derived from pressure squared. Sound Exposure Level is sometimes used to understand sound propagation for seismic arrays (Tolstoy and others, 2009).

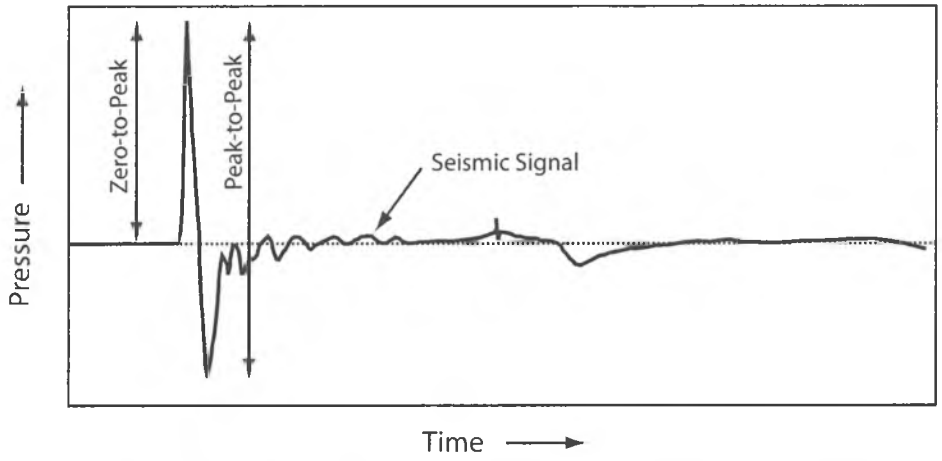

Figure 6–1. Example of a seismic sound signal showing how zero-to-peak and peak-to-peak pressure would be measured.

The use of the logarithmic scale can be confusing. For example, a doubling of pressure will add 6 dB to the SPL, whereas a doubling of intensity adds only 3 dB. For a sound pulse such as an airgun, where the pulse duration is less than 1 second, the SEL value will always be less than the SPL (rms) value. Further, the SPL (rms) will be less than SPL (zero-to-peak) and both will be less than SPL (peak-to-peak). Hence it is important to be rigorous in describing and measuring sound levels to specify SPL versus SEL and to identify whether SPL is for peak-to-peak, zero-to-peak, or rms. The media frequently quote dB estimates for measurements that do not specify the type of SPL or SEL measurement. Further, dB measurements in water use a reference of 1 μPa whereas for air the reference is 20 μPa, rendering comparisons between the two inappropriate. Imprecision in describing sound adds confusion and sometimes alarm to reasoned public discourse. Because sound also contains different frequency contents, the SPL of different sound sources in not necessarily additive (and, if additive, must be added using logarithmic, rather than linear, rules).

Airgun size is classified by its chamber volume. The way this volume is related to level of sound also is not linear. Excellent summaries describe how changes in source strength, operating pressure, and number of airguns in an array affect SPL measurements (Dragoset, 1990, 2000).

Although the current regulatory framework uses the SPL (rms) pressure measurement, some researchers have suggested that the energy metric, SEL, is more useful because total energy enables sounds of differing durations to be more readily compared (for example, Southall and others, 2007; Tolstoy and others, 2009). It perhaps may be most useful to use both. Extremely high but nearly instantaneous sound waves have low energy levels (because the energy is averaged over a much longer time frame than the duration of the pulse), but may still cause damage to auditory or other tissues. Additionally, cumulative energy contained in low-amplitude sounds may interfere with hearing after long exposures. As an example, one can imagine how a gunshot or firecracker going off near one's ear would affect hearing, and also imagine how working with constant background noise for a long period of time also might affect hearing.

Different animal species have different frequency sensitivities. Five functional hearing groups of marine mammals exist based on their presumed hearing frequency range (for example, Southall and others, 2007), which are summarized in table 6–2. Only four of these apply to the Arctic marine mammals of interest (the high-frequency cetaceans, such as harbor porpoise, which are only seasonally present in the Arctic in low abundance, are not among the subjects of this chapter). It is important to note that sound frequencies particularly greater than 1,000 Hz (1 kHz) attenuate rapidly in water.

A useful diagram summarizing the magnitude and frequency of different kinds of sounds found in the oceans is that created by Wenz (1962), which is still widely used (fig. 6–2).

Table 6–2. Arctic Outer Continental Shelf Marine Mammal Hearing Groups.

[Modified from Southall and others (2007) for the marine mammals of interest in this report. Hz, hertz; kHz, kilohertz]

Functional hearing group	Genera	Estimated auditory bandwidth
Low-frequency cetaceans	*Balaena, Eschrichtius*	7 Hz – 22 kHz
Mid-frequency cetaceans	*Delphinus*	150 Hz – 160 kHz
High-frequency cetaceans	(none)	200 Hz – 180 kHz
Pinnipeds in water	*Erignathus, Histriophoca, Pusa*	75 Hz – 75 kHz
Pinnipeds in air	(same as species in water)	75 Hz – 30 kHz

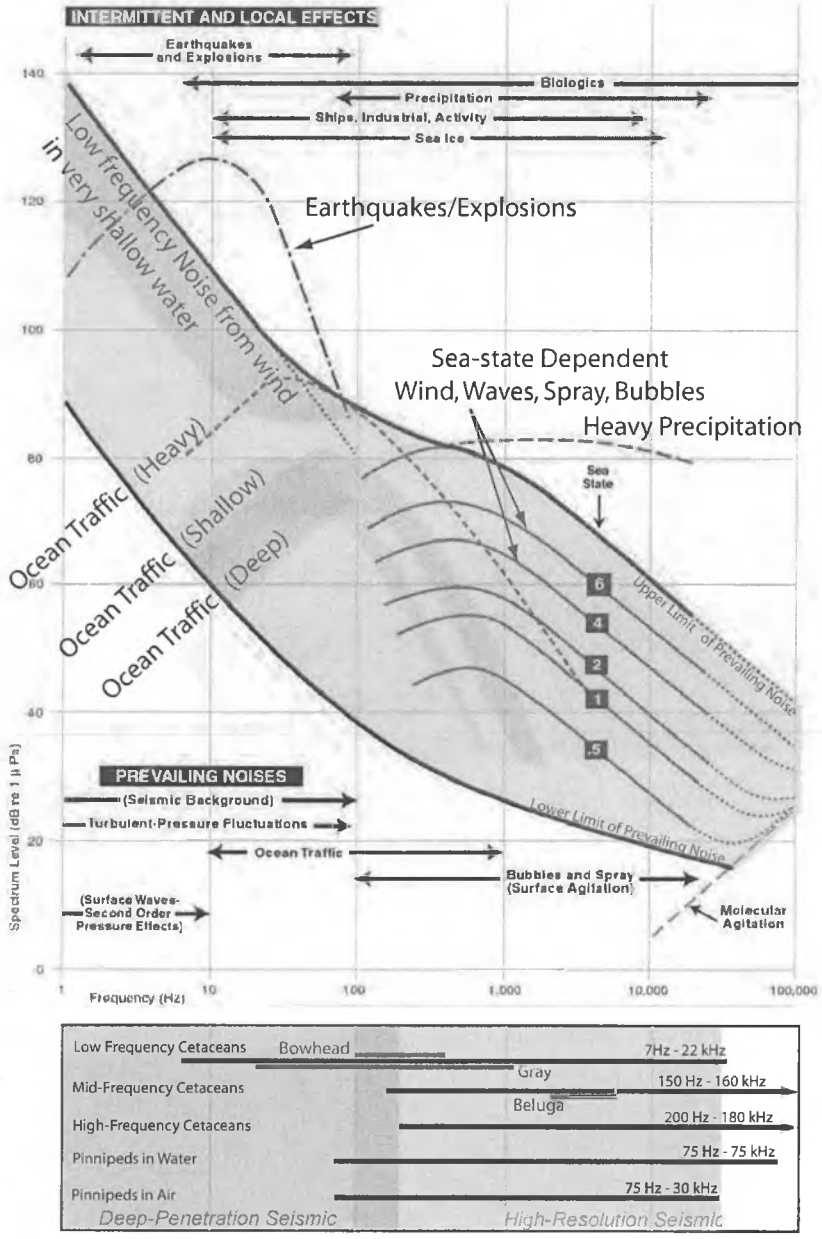

Figure 6–2. Upper: diagram showing pressure spectral density of marine ambient noise modified from Wenz (1962) and National Research Council (2003b). The gray shaded region gives the general band of ambient noise and the contained curves identify specific sources of sound contributing to the ambient noise. Lower: marine mammal hearing groups and their estimated auditory bandwidth (black lines) as defined by Southall and others (2007). Dominant bandwidth for selected whales (red lines) is from National Research Council (2000). Approximate frequency ranges for deep-penetration (blue) and high-resolution (green) seismic surveys are superimposed on the cetacean ranges.

Anthropogenic Sound Categories

For the purposes of understanding anthropogenic sound in the Arctic OCS, we use seven categories of sound. These categories discriminate among the source level, frequency (Hz), and temporal patterns of the sound. The source level is the SPL (rms) measured or estimated/modeled at 1 m from the source. The frequency is captured as a power spectrum that relates sound level and frequency. The temporal pattern of sound refers to its occurrence, as in transient (for example, explosion), continuous (for example, drilling), or pulsed (for example, seismic airguns). The seven categories are:

1. Deep-penetration seismic surveys

Deep-penetration, low-frequency seismic surveys are considered to be high-energy intermittent pulsed sounds, typically two-dimensional (2-D) regional surveys and three-dimensional (3-D) local surveys utilizing airgun arrays consisting of several large to many small airguns. The frequency level generally is from several to 100–250 Hz. The purpose of these surveys is to image geology at moderate to crustal depths for geologic framework and exploration purposes.

Statistics maintained by BOEMRE (See websites accessed April 30, 2011, at http://alaska.boemre.gov/re/permits/xpermits/arctic_charts.pdf, http://alaska.boemre.gov/re/permits/xpermits/arctic_table.pdf, and http://alaska.boemre.gov/fo/Geohazards/chukchi_hazard_surveys.mdb) show that deep-penetration surveys in the Beaufort and Chukchi regions for oil and gas exploration have been historically, and continue to be, the most plentiful types of surveys conducted. Since 1968, there have been 119 open-water exploration surveys in the Beaufort region and 48 in the Chukchi region. An additional 67 on-ice seismic surveys were conducted in the Beaufort region between 1970 and 2000. The peak in seismic permits for both areas occurred in the early to mid-1980s with a maximum of nine permits issued for marine 2-D geophysical surveys in the Beaufort region in 1984 and a maximum of six permits for similar work in the Chukchi region in 1985 (fig. 6–3). Recently (since 1994), there have been no 2-D surveys in the Beaufort region and only one in the Chukchi region (in 2006). This decrease in 2-D surveys contrasts with the growth of 3-D exploration surveys: since 1990, there have been ten 3-D surveys in the Beaufort region, but only three in the Chukchi region. The trends from these permits suggest that future oil and gas seismic exploration activity in the Beaufort and Chukchi regions is likely to be with 3-D surveys. Details about the surveys, such as time of year, lease block locations, and duration of surveys are available from BOEMRE. These BOEMRE statistics do not include seismic programs that might have occurred in Canada or Russia for oil and gas activities (for which the air gun sounds could propagate into U.S. waters). Nor do the BOEMRE statistics cover seismic activities conducted by U.S. or foreign research groups for non-petroleum related purposes (for example, 2005 NSF-funded seismic transect across the pole aboard the U.S. Coast Guard Cutter (USCGC) *Healy*, or the 2007–10 United Nations Convention on Law of the Sea (UNCLOS) work conducted aboard the Canadian icebreaker CGGS *Louis S. St-Laurent*). Hence these statistics are representative of the bulk of the seismic exploration work, but underestimate total seismic activities.

6.02. Finding: Despite the large number of seismic surveys conducted over time in the Beaufort and Chukchi Seas, an inventory/database of seismic sound sources used in the Arctic Ocean does not exist.

6.02. Recommendation: Such an inventory would provide standardized information about source arrays (for example, number of airguns, dimensions of arrays, frequencies, firing pressure), physical oceanographic conditions at the time of measurement, and timing and duration of surveys. Such a database could be used to evaluate multiple sound sources that a marine mammal might hear in space and time, and help validate models that estimate sound propagation. The database may ultimately reduce the need for expensive or redundant acoustic modeling and monitoring, especially in sensitive or biologically significant habitats as well as contribute to developing more effective mitigation strategies.

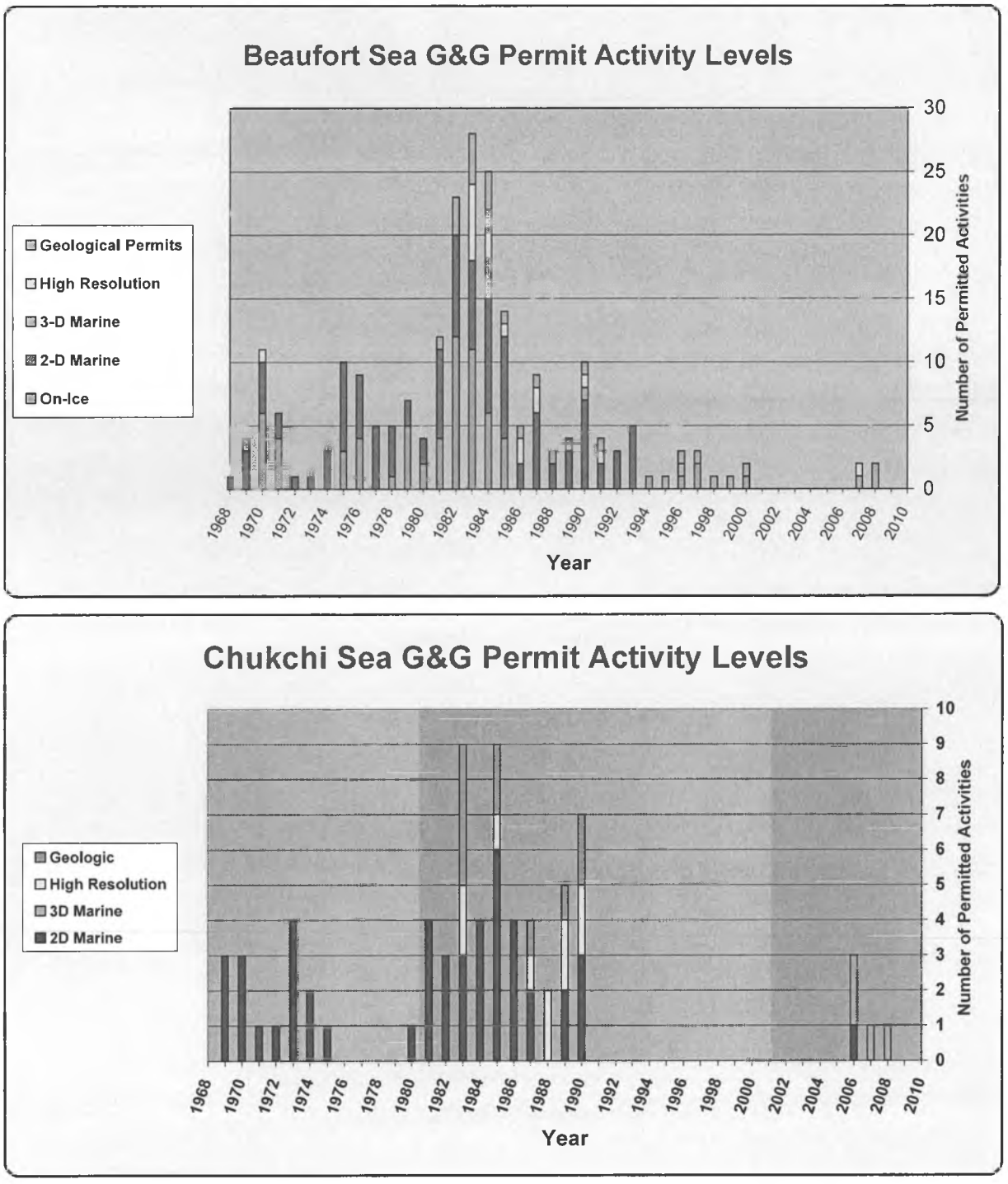

Figure 6–3. BOEMRE permitted exploration seismic activities in the Beaufort (upper) and Chukchi (lower) Seas since 1968. High-resolution seismic surveys done to address site-specific hazards related to drilling are not included in this chart. The peak number of seismic surveys occurred in the 1980s. Source: Bureau of Ocean Energy Management, Regulation and Enforcement, written commun., February 2011. G&G, geological and geophysical.

2. High-resolution seismic surveys

High-resolution seismic surveys are considered to be mid-to high-frequency, low-energy intermittent pulsed sound, typically used in shallow hazards surveys for siting drill holes (including strudel surveys to understand ice scour) or high-resolution surveys for understanding near-seafloor geologic evolution. The sources usually are not airgun arrays but consist of boomer, sparker, chirp, and individual (or arrays of several) small water guns or Generator-Injector airguns (GI-guns). The frequency range generally is from 100 Hz to several kilohertz.

High-resolution surveys related to oil and gas activities have occurred in the Beaufort Sea [see Minerals Management Service (2007) for permitted activities and see Horowitz (2002) for additional high-resolution surveys in the Beaufort Sea] and Chukchi Sea (see Minerals Management Service, 2007). These surveys are required to address safety and risk assessment prior to siting final drill locations. Hence, these kinds of surveys are expected to increase when drilling resumes in order to satisfy permitting requirements. Because of the generally lower energy and higher frequencies associated with these surveys, these surveys are often considered to be lower impact on marine mammals, although some studies are beginning to question this conclusion (for example, Southall and others, 2007).

The distinction between deep-penetration and high-resolution seismic categories separates both the frequency and energy levels of the different survey types. Figure 6–2 shows how the deep-penetration surveys overlap primarily with the low-frequency cetaceans (such as the bowhead and gray whales). The high-resolution surveys overlap primarily with the mid- and high-frequency cetaceans (such as the beluga whale). Figure 6–4 illustrates how the higher energy of the deep-penetration surveys results in significantly larger zones of mitigation under MMPA compared to high-resolution seismic surveys.

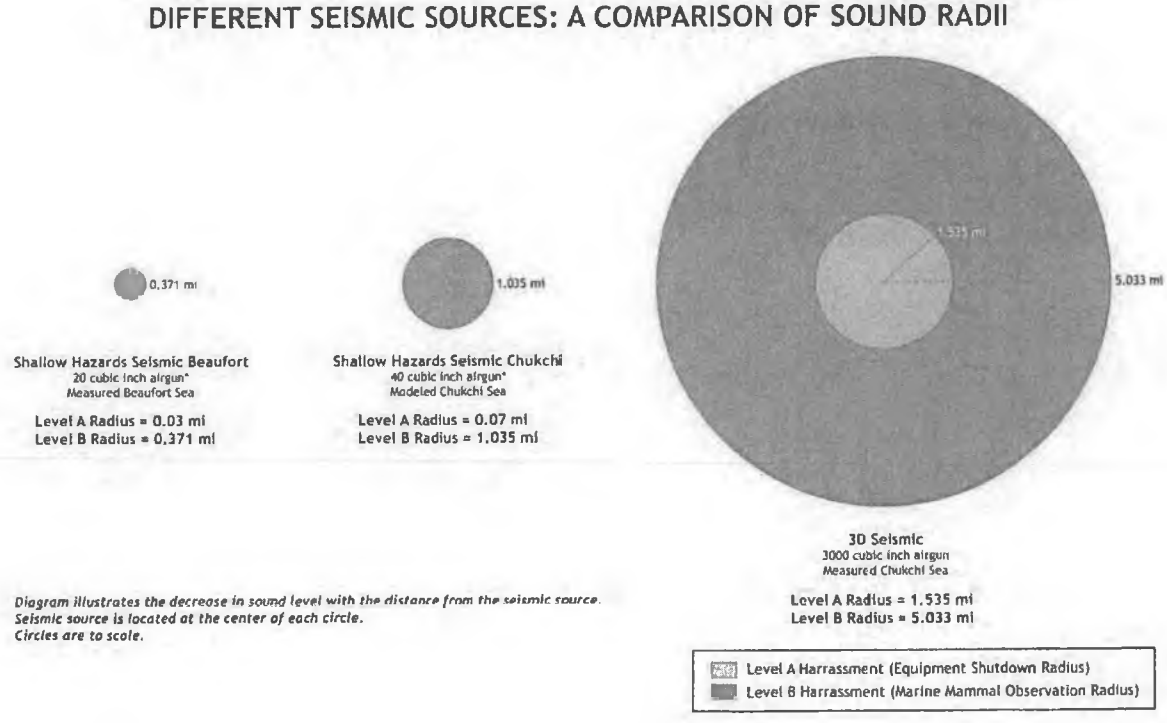

Figure 6–4. Comparison of zones of mitigation under MMPA for deep-penetration (right) and high-resolution seismic surveys (middle, left). Inner and outer circles are for Level A and B harassment, respectively. Source: Jana Lage, Bureau of Ocean Energy Management, Regulation and Enforcement, January 2011.

3. Drilling activities

Drilling activities generate continuous, generally low-energy sound at low frequencies (for example, less than several tens of hertz) that decay to ambient noise levels within 1 to several kilometers (Richardson and others, 1995). There are variations depending on type of drill rig (for example, gravel island versus semi-submersible) and type of drilling (for example, rotary versus hammering).

Drilling in the Arctic OCS has been limited to shelf-depth waters (generally less than 100 m water depth). Winter ice currently precludes the installation of year-round floating or semisubmersible drill rigs used in conventional open-water deep-water drilling operations. Benchmark noise studies of gravel-island and shallow-water caisson and semisubmersible drilling have been done for the Beaufort OCS around Prudhoe Bay (Greene, 1987; Richardson and others, 1995). Additional monitoring of the noise of drilling continues through the present (for example, with the BP Liberty gravel-island drilling reported in the last 3 years of NOAA/BOEMRE Arctic Ocean Open Water meetings). The data collected as part of monitoring are not publicly available, and the reports associated with these monitoring studies show images and analyses that are sometimes in peer-reviewed journals (for example, Blackwell and others, 2004a), but generally only available in gray literature.

4. Ships/Vessels

Ship and vessel noise is continuous and consists of a combination of frequencies that are both broadband (over a range of frequencies) and narrow band (tonal at specific frequencies). Ships are considered a major contributor to ocean noise at frequencies less than 500 Hz (National Research Council, 2005) with significant spatial variability associated with shipping lanes and ports. Levels and frequencies of sounds are dependent on vessel size, design, and mode of propulsion. Smaller vessels with small propellers and high revolutions per minute generate noise at higher frequencies. There is an abundant literature on shipping noise (for example, National Research Council, 2005).

Although there are currently no commercial shipping lanes in the Arctic OCS, the possibility exists for these routes to develop as summer ice retreats or disappears with climate warming, as well as for large cruise vessels to bring tourists to the Beaufort and Chukchi Seas. Currently, the commercial ship traffic occurs with barges in the near shore in open water during the summer, primarily to re-supply the Native community with bulk supplies. Gray literature exists for the sounds made by individual ships participating in oil and gas activities in the Arctic OCS as a result of permits issued under MMPA that generally require measurements of ship noise prior to the start of exploration activities. These data are not readily available digitally, although reports written as a result of the oil and gas activity sometimes include summaries of the noise studies.

6.03. Finding: As in Finding 6.02 for seismic survey-generated noise, there is a similar lack of an organized inventory/database for the noise generated by vessel types that presently frequent the Arctic Ocean, or may do so in the future with changing ice conditions.

6.03. Recommendation: An inventory and synthesis of vessel noise for vessels used in the Arctic Ocean will enable researchers to understand the contributions of potential new ship traffic to ambient background levels of noise in the Arctic. This inventory/database should contain standardized information about vessel noise, duration, time of measurement, and location. Most industry exploration activities measure ship noise prior to commencing surveying as part of the permitting process.

5. Icebreaking

Icebreaking is a special category of ship and vessel noise that is associated with higher levels of sound because of the additional power required for a vessel to break thin ice continuously or thicker ice through backing and ramming.

Icebreaking also is unique to ice-covered regions such as the Arctic. Some of the earliest studies on the sound of icebreaking were done in the Arctic (for example, Richardson and others, 1995, and references therein) and these studies continue to be cited extensively in the absence of more recent publications. Roth and Schmidt (2010) presents interpretations of the noise of icebreaking for USCGC *Healy* during a 2008 cruise and compares SPLs at 5/10 ice coverage and greater. The noise of continuous icebreaking exceeded the noise of backing and ramming by about 5 dB. The inclusion of icebreaking as potential impact for Level B marine mammal harassment under MMPA is new in 2010 (Haley and others, 2010).

6.04. Finding: Icebreakers, an important subset of vessels used in the Arctic from a noise and marine mammal encounter perspective, are highlighted in addition to the more general vessel topic of Finding 6.03. There are essentially no data relating the noise of icebreaking to the type of icebreaker, and the character of the ice (for example, percent coverage, age of ice, thickness of ice). Preliminary data included in Haley and others (2010) suggest that the noise from icebreaking is not of higher amplitude than a modest seismic array. But, the paucity of data on icebreaker-generated noise is particularly critical because of sea ice's importance as habitat for many marine mammals. It is difficult at present, if not impossible, to know how to define "takes" from icebreaking or how to predict its impact on marine mammals.

6.04. Recommendation: As in Recommendations 6.02 and 6.03, the development of a standardized inventory/database would greatly facilitate the accumulation of information required to better understand the characteristics of icebreaker-generated noise under different ice, oceanographic, and operating conditions.

6. Construction

Construction for the purposes of this report is considered to include localized relatively brief duration or one-time noise associated with, for example, siting drill rigs, installing pipelines, developing shore-based infrastructure such as docks and piers, building ice roads on sea ice, and so on. Similar to drilling activities, the noise associated with construction generally is at the lower frequencies (less than several hundred hertz) and attenuates relatively close to the location of construction. Unlike drilling, the noise generally is short-term for the duration of the construction project only.

For the Arctic OCS, shore-fast and winter sea ice preclude year-round floating or surface structures. Hence the noise of construction has been limited to near-shore (Beaufort) and shallow water (Chukchi) seasonal activities. A large literature exists on the sounds of construction related to developing the Liberty and Northstar prospects in the Beaufort Sea (for example, Richardson and others, 1995). Dredging is not yet an activity conducted along the North Slope (Beaufort/Chukchi) shorelines.

7. Aircraft overflight

Aircraft (including helicopters and fixed-wing aircraft) are a special category of noise because of (a) the potential transient nature of the noise, (b) the complications of relating source level and propagation paths through air and water, and (c) the potential impacts to marine mammals (seals, walrus, and polar bear) that spend considerable time out of the water. It is only for a relatively narrow angular cone beneath the aircraft (about 13° for calm water, Richardson and others, 1995) that the noise of the aircraft penetrates into the water. At larger angles, the sound is effectively reflected at the sea surface. Hence, the height and speed of the aircraft, in addition to the noise it generates, affect how much of the ocean surface will be insonified. Moreover, a persistent challenge in interpreting observations of marine mammal behavior associated with the presence of aircraft is to know whether the aircraft sound or the visual presence of the aircraft has triggered the disturbance.

In the Arctic OCS, aircraft are used in offshore oil and gas activities as well as in conducting monitoring and population assessments of marine mammals (for example, Bowhead Whale Aerial Survey Program, BWASP). Shell also has proposed using drones to monitor for marine mammals near seismic operations (A. Macrander, Shell Exploration and Production, oral commun., March 2010) to augment visual monitoring in areas far offshore (such as the Chukchi) where manned fixed-wing aircraft monitoring is impractical or unsafe.

6.05. Finding: Aircraft represent another potential sound source that must be considered along with seismic (Finding 6.02), vessel (Finding 6.03), and icebreaker (Finding 6.04) sources. Very little information exists that quantifies aircraft noise as a function of aircraft type and approach geometry.

6.05. Recommendation: Information that quantifies aircraft noise as a function of aircraft type and approach geometry would help to understand the responses of several species of Arctic OCS marine mammals to overflight.

8. Other Considerations

To completely understand the contribution and impacts of anthropogenic noise to the environment, knowledge of the levels and spatial-temporal variability of background (ambient, non-anthropogenic) noise is essential, as well as which anthropogenic sounds occur simultaneously. The magnitude of ambient sound gives context to understanding increased sound levels from anthropogenic sources. However, it is important to correctly characterize the sound, because not all these sounds are additive when occurring together, owing to the different frequencies, shapes, and amplitudes of the different sources of sound.

6.06. Finding: The overall ambient noise budgets of the Arctic, particularly how they vary temporally (for example, seasonally) and spatially (for example, shallow versus deep water) are not well known. Very little data exist to inventory the seasonal and spatial levels of ambient noise in the Beaufort and Chukchi Seas. Some annual measurements in specific locations are beginning to be done and seasonal measurements are recorded as by-recordings of listening to and locating whale calls before, during, and after seismic surveys in the Beaufort and Chukchi Seas (for example, Blackwell and others, 2007; Kosiara and others, 2008).

6.06. Recommendation: A time-series database of ambient ocean noise for the Arctic will be essential for understanding the changes to ambient noise created through climate warming and seasonal reductions in sea ice so that the distinction of impacts between anthropogenic and natural sources on marine mammals can be made.

A little-studied factor that also will affect sound measurements in the oceans is ocean acidification, the process by which the oceans become more acidic because of the anthropogenic emissions of carbon dioxide (for example, Ilyina and others, 2009). Because propagation of sound in the oceans is affected by the dissolved chemical constituents, an increase in ocean acidity will decrease the absorbtion of sound, that is, increase the propagation of sound. According to models, this affect may be greatest in high latitudes in the frequency ranges of 100 Hz to 10 kHz, or exactly in the range that encompasses both deep-penetration and high-frequency seismic surveys (Ilyina and others, 2009).

Potential Effects of Sound Exposure

A range of effects may result from exposure of marine mammals to anthropogenic sound, ranging from no observable effect to physical injury or, in the extreme, death. As with people, the reactions of marine mammals can depend on factors such as species, individual, age, sex, prior experience with the sound, activity at the time of the sound, and behavioral state. When observing animals in the natural environment, external non-auditory stimuli also may affect reactions. In this section, we describe some of the potential effects of exposure to anthropogenic sound sources, which may or may not result in observable or measurable behavioral changes.

1. No Observable Effect

Marine mammals have been observed in close proximity to loud sound sources associated with oil and gas activities (for example, Richardson and others, 1995). They could be unaffected by the sound, they could be tolerating the sound because critical resources were in the area (food, mates, open water, haulout sites, and so on), or they could be deaf. The individuals could be unaffected because their auditory systems are insensitive to the frequency-intensity combinations of the sound. Alternatively, the individuals may be able to detect the sound, and may have reacted during their first exposures, but over time have learned that the sound is of no consequence and thus have become habituated, evidence of which is reduced or absent response during subsequent exposures.

There are documented cases of apparent tolerance of marine mammals to noise, which also demonstrate much variability. For example, bowhead whales tolerated an increase in 40 dB in seismic survey noise when feeding in summer as opposed to during the fall migration (Richardson and others, 1995, 1999).

2. Sensitization

Sensitization occurs when an individual associates a specific sound with a specific outcome that alters the animal's behavior. Evidence of sensitization is observed in animals that change their behavior when they receive sound levels that are far below levels associated with auditory interference or injury. For example, seals that survive hunting or harassment (for example, by humans, polar bears, or killer whales) likely will take the appropriate actions as soon as they detect sounds made by the hunters in the future.

3. Avoidance/Displacement

Marine mammals may avoid sound sources, or be displaced from areas associated with the sound. This behavior has been observed in bowhead whales from underwater acoustic monitoring, which has shown that the calls of bowhead whales deflect seaward away from the sound of airguns during nearshore seismic surveys (Blackwell and others, 2007). An uncertainty associated with this deflection behavior is whether all whales exhibited the displacement or only those whales making calls. When whales cease calling in the presence of nearby seismic signals, this is a variant on avoidance and displacement (for example, Blackwell and others, 2010).

4. Masking

Masking is the decreased ability to detect one sound due to the presence of another sound. Fletcher (1940) suggested that masking of a signal is especially pronounced if the frequency spectrum of the masking noise overlaps within a critical band around the frequency of the signal. Most anthropogenic underwater activities produce sound at frequencies below 1 kHz, which is within the frequency band used for communication signals of baleen whales, and some toothed whales, such as belugas (for example, Clark and others, 2009). It may not be possible to distinguish hearing loss (that is, an animal that fails to detect a signal because of reduced hearing) from masking (that is, an animal with a normally functioning auditory system that fails to detect a signal because it is masked by a louder sound of similar frequency).

An increase in ambient ocean noise (for example, by increased shipping in a region) can contribute to masking. If marine mammal navigation or communication signals are masked by anthropogenic noise, there will be obvious implications for population cohesion and other social interactions. However, it is important to note that masking has never been conclusively demonstrated in free-ranging marine mammals, only implied by observations of animals changing their calling in the presence of anthropogenic sound.

5. Auditory Threshold Shift

Exposure to loud or repetitive sounds may degrade the individual's ability to hear, with effects ranging from reversible temporary threshold shifts (TTS) to permanent reduction in thresholds (PTS) at narrow or broad frequencies (Kryter, 1994). TTS is recoverable and is considered to result from the temporary, noninjurious distortion of hearing-related tissues. An animal that experiences a TTS suffers no injury to its auditory system but temporarily may not perceive some sounds due to the reduction in sensitivity. In contrast, PTS results from the nonrecoverable destruction of tissues within the auditory system and is considered an injury in the U.S. regulatory environment (see summary in Southall and others, 2007). Recent anatomical and behavioral studies suggest that cetaceans may be more resistant than many land mammals to TTS, having evolved in a relatively high noise environment. Data suggest, however, that, like humans, cetaceans suffer from hearing loss as a result of increasing age (Ketten, 1997).

6. Physiological Stress Responses

Although several reviews have entertained the possibility that noise induces a physiological stress response in marine mammals, there have been few studies. Romano and others (2004) exposed a captive beluga whale to sounds from a seismic water gun and measured various hormones in the blood, including cortisol, before and after exposure. They measured changes that were considered detrimental. These changes increased with increasing sound levels. Thomas and others (1990), however, did not find elevated stress hormone levels in the blood after playbacks of oil drilling platform noise to captive belugas. Because of the inherent difficulty, if not impossibility, of taking frequent tissue or blood samples from live wild animals, conclusions about physiological stress responses will remain the purview of studies of captive animals.

7. Physical Injury

PTS is considered an injury and can occur either after long exposure to a sound (for example, Richardson and others, 1995) or from instantaneous exposure to very high sound levels, such as an explosion. There is some speculation that anthropogenic sound has the ability to induce other injurious effects, such as debilitating bubble formation or tissue damage in deep- or long-diving species (Houser and others, 2001). While evidence of tissue damage (including auditory structures) has been reported, this has been associated with exposure to extremely loud sounds associated with use of explosives or military training and testing (Jepson and others, 2003; National Research Council, 2005). To the best of our knowledge, this has little relevance to the sound sources and levels and environmental acoustics associated with OCS oil and gas exploration and production.

8. Cascading Effects

Vessel noise, in addition to potentially impacting marine mammals, produces sounds in the hearing range of fish (Amoser and others, 2004). If anthropogenic sound affects the distribution of fish, it could therefore impact marine

mammals that rely on those fish. Vessels (that is, trawlers, ferries, small boats) also can alter behavior in fish (for example, induce avoidance, alter swimming speed and direction, and alter schooling behavior), similar to marine mammals (for example, Engås and others, 1995).

Although the above list produces convenient categories for describing the possible effects of sound on marine mammals, in actuality, linking an effect to an observation and an explanation is much more difficult. For example, if a marine mammal tolerates a sound, it may represent acclimation or habituation of some kind, but it also may represent an unrelenting need, for example, for feeding or reproduction, to remain in a particular location despite exposure to a potentially damaging sound. Alternatively, the sound may be harmless. Science, however, is based on observations, and in the absence of observable changes, it is risky to attempt to speculate about contributions of potential invisible factors.

6.07. Finding: Substantial challenges exist to confidently interpret the magnitude and significance of the potential effects of anthropogenic sound on marine mammals. Limitations in our understanding affect the confidence that many entities expressed during the USGS OCS Team expert consultations (see appendix A). The topic of the impact of anthropogenic sound on marine mammals remains a key topic of concern.

6.07. Recommendation: Continued or new attention to the following topics could significantly improve the assessment and potential mitigation of human-generated noise effects on marine mammals of concern. Some of these challenges are:

1. Attempting to distinguish between transient or ephemeral behavioral effects of sound versus those that are more meaningful to survival or reproduction. An example would be walruses waking up and raising their heads when they hear a sound, as compared to injury or mortality caused by the same walruses stampeding into the water when they hear a sound. A second example would be the movement of animals away from a sound source—is displacement fractional relative to the animals' normal movements, or is it substantial, and how long does it persist?
2. Using observations of individual animals to make inferences about possible implications for populations. In general, the body of available scientific information supports the potential for near-term reaction of individuals to various forms of anthropogenic sound sources, but long-term impacts at the population level are not well understood.
3. Using one set of observations for predicting reactions when the interaction parameters are different. The same sounds may elicit different responses at different times of year or in different locations associated with different types of activity (for example, migration, feeding, reproduction, sheltering).
4. The degree to which context of a sound influences a reaction. In some instances, animals of a given species may occupy locations with substantial types of some noise (for example, pipe-driving) but avoid other locations where the anthropogenic sound levels are much lower. For example, ringed seals may forage nearby active seismic surveys, but escape reactions will be elicited when they detect faint sounds of polar bears or subsistence hunting boats.
5. The degree to which we can discriminate between the effects of sound, other aspects of human activity, and environment variation, especially for understanding behavior of animals in the wild. An animal that is observed in close proximity to a loud sound source could be unaffected by the sound, it could be tolerating the sound because critical resources were in the area (for example, food, mates, open water, haulout sites), or it could be deaf. The observed behavior is the sum of the external environmental stimuli detected by the animal, behavior of its peers, behavior of other species, plus the animal's physiological state. Further, if the source of sound has been close enough to the animal that it was visible and perhaps detectable by other sensory cues, such as odor or vibration, the animal could be reacting to these other cues. Unless research demonstrates that individuals are exposed only to sound, the precautionary interpretation is that the sound can be associated with the behavior rather than that the sound explains the behavior.
6. Quantifying secondary or cumulative effects of sound on population persistence. While sound may alter the behavior of individual animals, other factors also may affect outcomes (for example if sound caused prey abundance or availability to change). Cumulative effects also may occur but are difficult to quantify (for example, if physiological stress caused by sound exposure combines with stress induced by environmental contaminants to affect a population). These are difficult, if not impossible, measurements to make on wild animals.

Monitoring and Mitigation

Both the ESA and the MMPA require monitoring and mitigation measures to protect marine mammals from potential harm caused by exposure to anthropogenic sound sources. The MMPA places a moratorium on "takes" of marine mammals, in which "take" means "to hunt, harass, capture or kill" (from National Marine Fisheries Service, 2008b). Exceptions exist, for example, for subsistence hunting, and exceptions also can be granted for example, for incidental takes associated with fishing. For permitting, harassment for MMPA is further defined as level A (in which the harassment has the potential to cause death or injury) or level B (in which the harassment has the potential to disturb the animal by disrupting its behavior) (National Marine Fisheries Services, 2009b).

The USGS OCS Team's expert consultations (appendix A) raised concerns about both monitoring and mitigation strategies, particularly by the Marine Mammal Commission and the Alaskan Native Community. Protected species observers are required participants on many oil and gas exploration and development activities to monitor marine mammals and determine when mitigation strategies must be implemented. Data recorded by these observers are inconsistent. This inconsistency limits how these datasets can be integrated and merged for a more complete picture of marine mammal behavior in the presence of anthropogenic sound. As technology advances, the requirements for monitoring also have evolved, so that deficiencies in visual observations (for example, only possible for daylight hours) can be augmented by acoustic observations (for example, passive acoustic monitoring). Despite the array of tools available for monitoring (ship observations, aerial observations, acoustic monitoring, infrared detection, and so on), no single monitoring strategy gives a complete picture of the marine mammal presence. Hence monitoring contains inherent uncertainty about missing animals, which raises questions about how effective monitoring is for ensuring whether "takes" occur.

Mitigation also is problematic. First, the objectives of mitigation (for example, to avoid hearing impairment or to minimize disturbance) may require multiple criteria. Yet, a single, simple criterion is the easiest to implement. Second, some mitigation measures significantly restrict human activities with little evidence of benefit to marine mammals. Third, a standard mitigation strategy is applied broadly (for example, one for cetaceans, another for pinnipeds). Yet, the hearing ranges and communication frequencies differ for different species, raising questions whether mitigations strategies should be specific to a species (for example, Southall and others, 2007). Fourth, practical decisions about regulatory and mitigation issues are being made based on best available, but incomplete, knowledge which raises questions about how defensible these decisions are. And, finally, many concerns and questions raised by managers require integration across a range of temporal and spatial scales, involve understanding the ecosystem in which the marine mammals live, and now commonly require evaluating species responses to climate change. Regulators and scientists are in agreement that additional data are needed for each marine mammal species, such as baseline data on current abundance, seasonal distribution, movements, population dynamics, and other basic biological information.

Bowhead Whale (*Balaena mysticetus*)

Of the five recognized stocks of bowhead whales, the Bering-Chukchi-Beaufort (BCB) stock frequents the Alaska Arctic coastal area. As part of its annual migration, the bowhead whale passes from the Bering Sea to the Chukchi and Beaufort Seas en route to its summer grounds in the Canadian Arctic and returns to the northern Bering Sea in the autumn (Moore and Reeves, 1993; Moore and others, 2000). Its migration routes along the Alaska coastline and in the Chukchi Sea (fig. 6–5) overlap with the current areas of leasing and oil and gas exploration and production.

Of the baleen whales, the U.S. bowhead is among the most studied. The convergence of three events served to promote research about the bowhead whale. First was the recognized depletion of the bowhead population, initially in the early 1900s when it was given protected status by the International Convention for the Regulation of Whaling and later when the bowhead was listed as endangered under the ESA of 1973 and further protected by MMPA. Second was the controversy accompanying the proposed ban on subsistence whaling by the International Whaling Commission in 1977, which led to negotiation of a reduced subsistence harvest to be accompanied by expanded research about the bowhead. Finally, the mid-1970s initiated the first oil and gas activities in the Arctic OCS for which research into the impacts of oil and gas activities on the bowhead whale was required under ESA and MMPA. Consequently, the late 1970s and early 1980s were a time of many observations and publications about BCB bowhead whales, especially as they reacted to anthropogenic activities (for example, Richardson and others, 1986, 1987). These early studies were followed by seminal syntheses in the 1990s (for example, Richardson and others, 1995) and served to raise awareness more broadly of marine mammal and ocean sound issues (for example, National Research Council, 1994). As mentioned earlier, the bowhead whale is still listed as endangered under ESA. The Native community participates in setting hunting quotas and bowhead management through the Alaska Eskimo Whaling Commission (2007, website accessed April 30, 2011, at http://www.alaska-aewc.com/aboutus.asp).

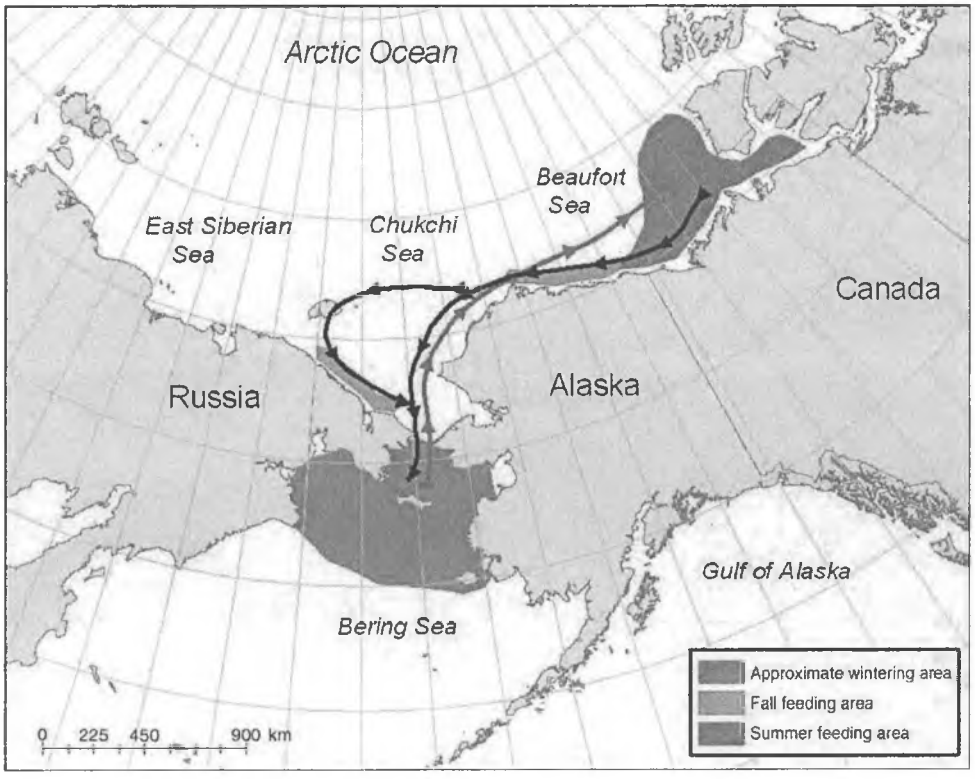

Figure 6–5. Seasonal occurrences of the Bowhead whale in winter (blue), summer (purple), and fall (green) migration feeding areas, together with general migration paths (arrows). From Moore and Laidre (2006).

Many of these early studies combined observations of bowhead behavior with anthropogenic noise, for example seismic surveys (Fraker and others, 1985; Richardson and others, 1986), ship movement (LGL Ecological Research Associates, Inc., 1982), drilling and dredging (Richardson and others, 1987, 1990), icebreaking (Richardson and others, 1995), and aircraft noise (Richardson and others, 1985). Details of these studies identify sound levels, whale distances from the sound sources, context of whale activities where available (for example, feeding, migrating), and behavioral changes. These studies also revealed the general vocalization frequencies of bowhead whales (100–400 Hz dominant, 25–3,500 Hz range), calling patterns, and loudness (for example, Ljungblad and others, 1982; Clark and Johnson, 1984; Würsig and others, 1989; Würsig and Clark, 1993), although the age, sex, and activity associated with the individuals making the sounds were largely unknown. Missing from these early studies is whether the observed behaviors and (or) behavior changes are biologically meaningful and affect the survival of either the individual or the bowhead population. The BCB bowhead population, however, is estimated at about 9,400 and is increasing at about 3 per year (Allen and Angliss, 2010).

Since the mid-1990s, both observational data and new kinds of studies have focused on understanding the habitat, behavior, and distribution of BCB bowhead whales, both in relation to anthropogenic noise and as baseline data to help understand the life histories of the species. One of the longest term monitoring programs is the Bowhead Whale Aerial Survey Project (BWASP; Bureau of Ocean Energy Management, Regulation and Enforcement, 2011) begun in 1979 and now a multi-agency effort to understand the distribution of whales during the summer, open-water months. A parallel effort, the Chukchi Offshore Monitoring in Drilling Area (COMIDA), began in 2008. One objective of this effort was to study the distribution of whales during the summer, open-water months in the Chukchi Sea Planning Area, a resumption of similar surveys that were conducted for many years between 1979 and 1991. The Bowhead Whale Feeding Ecology Study (BOWFEST) is a multiyear and multi-organization collaborative study integrating aerial surveys, physical oceanography, acoustic monitoring, local traditional knowledge, and ecosystem analysis to understand the late summer distribution of bowhead whales and sources of food in the vicinity of Barrow, Alaska (for example, Ashjian and others, 2010; Moore and others, 2010). The aerial surveys also can be used to study other topics, such as the relationship

between the ice edge and location of migration (Treacy, 2002; Treacy and others, 2006). Researchers are conducting long-term (multi-year) deployments of acoustic buoys to record ambient ocean noise and build baseline time series datasets of ambient ocean noise, at least for the few locations where the buoys are located (Scripps Whale Acoustic Lab, 2007). Most of these long-term and new-generation studies are funded to collect data for better understanding the impact of petroleum-related activities on the bowhead whale.

A significant database of bowhead whale vocalizations exists as a result of BOEMRE research (for example, Heimlich and others, 2010) and both BP and Shell drilling and seismic activities in the Beaufort Sea (for example, Blackwell and others, 2007). The BOEMRE research has utilized long-term buoy deployments as part of BOWFEST. BP has utilized Directional Autonomous Seafloor Acoustic Recorders (DASARs) to localize and record bowhead whale calls around the Northstar production facility on a gravel island offshore Prudhoe Bay. This monitoring has occurred since the facility began production in 2000. Shell also has funded acquisition of acoustic data from multiple arrays of DASARs on the Beaufort Shelf as part of its monitoring and mitigation strategy for its seismic exploration program (for example, Thode and others, 2008). DASARs have been deployed in multiple years for more than 50 days in open-water conditions with the intention of being able to conduct statistical analyses of whale vocalizations before, during, and after seismic surveys (for example, Mathias and others, 2008). Despite shorter peer-reviewed publications interpreting the results of these studies, these databases of vocalizations generally are proprietary and the substantive reports associated with full analysis reside in industry archives that are not routinely accessible by the public. These DASAR records also have been used to investigate long-range sound propagation under the ice and in open water north of Alaska (Thode and others, 2010).

Perhaps the greatest challenge in observations of any marine mammal, including the bowhead, is that of visual observations (such as with BWASP) can miss animals that are submerged or hidden, and acoustic monitoring (such as with DASARs) misses animals that are not vocalizing. Adding a new dimension to understanding the behavior and distribution of bowhead whales is a tagging program that began in 2006, utilizing Native community whaling captains and scientists working together to tag bowheads in the Barrow (AK) and Tuktoyaktuk (Canada) areas. Satellite tracking of individual whales has provided information on dive behavior, movement and use of habitat (Alaska Department of Fish and Game, 2011). Integrating these observations with the details of seismic (or other anthropogenic) noise is not always rigorous because the details of the seismic (or other anthropogenic) signals are not always publicized or known other than in a general sense.

For the seven noise categories, we discuss observations of bowhead behavior for all but the seismic low-energy category. In the summers of 1980–84, general activities of bowheads exposed to underwater pulses from seismic vessels 6–99 km away were observed (Richardson and others, 1986). Activities were indistinguishable from those without seismic noise; there was no detectable avoidance. In a test involving a seismic vessel (30 airguns, source level 248 dB re: 1 μPa, closest point of approach = 1.5 km), bowheads began to orient away when the airgun array began to fire 7.5 km away. However, some whales continued apparent near-bottom feeding until the vessel was 3 km away. In general, bowheads exhibit avoidance reactions when they receive seismic pulses stronger than about 160 dB re: 1 μPa. Evidence of reactions to lower received levels remains inconclusive.

Playback studies have found that most bowhead whales avoided drillship or dredging noise with broad-band frequency range (20–1,000 Hz) when received levels were around 115 dB re 1μPa, levels that could occur 3–11 km from typical drilling and dredging vessels (Richardson and others, 1990). This equates to a response threshold of about 110 dB re 1μPa in the 1/3-octave band where industrial noise is most prominent. Whales may be observed in locations with higher noise levels, possibly because alternative habitat is not available (Richardson and Greene, 1993).

Bowheads reacted to boats or small ships in two main ways. When boats were nearby, whales altered their surfacing and diving patterns by decreasing the mean time at the surface and mean dive duration. When boats closed to within 3 km, the whales, in addition to the above responses, swam rapidly away from the boat and scattered (LGL Ecological Research Associates, Inc., 1982). In contrast, bowheads were sighted as close as 6 km from a seismic ship firing 12 large sleeve exploders. Surfacing and respiration behavior was similar to that without seismic noise.

Bowhead whales were less responsive to passing aircraft when actively engaged in feeding, social activities, or mating, than when resting (Richardson and others, 1995). Opportunistic observations of behavioral responses of bowhead whales to a helicopter and fixed-wing aircraft suggested that the helicopter elicited only few responses, and most of those occurred when the helicopter was at altitudes equal to or less than 150 m and lateral distances equal to or less than 250 m. For the fixed-wing aircraft, very few bowheads were observed to react, and of those, most reactions occurred when the fixed-wing aircraft was at altitudes equal to or less than 182 m and lateral distances equal to or less than 250 m. Most observations of aircraft disturbance have been made from aircraft creating the disturbance, greatly limiting what can be observed, and precluding comparison of behavior before, during, and after disturbance.

In many of these studies, conclusions often have qualifications, for example, of bowhead deflection in one observation but not in another. These studies have raised the importance of understanding context of the whale activity at the time of the observation. Limited visual or acoustic observations of wild animals or of small sample sizes emphasize the difficulty of generalizing from specific animals in specific conditions to conclusions about the potential effects on the population. As a whole, there are essentially no observations about physical injury or quantitative indicators of stress responses, because of the difficulty of making these measurements on wild animals. Moreover, although there are exceptions, physiological measures of stress rarely point to a single causal factor and thus typically are better indices of overall health of the habitat in which the population lives.

6.08. Finding: There are many observations and databases related to bowhead whales, but no major integration or synthesis, especially for linkages to anthropogenic noise.

6.08. Recommendation: A synthesis of existing databases on bowhead population abundance and structure with databases giving sources and levels of anthropogenic noise would provide a comprehensive framework for analyzing how sounds impact the whales. This would presumably require public access to the many databases that are within government and industry purview for rigorous integration. Particularly illustrative will be integrating observations from tagged animals to overall activities.

For the first time in 2010, NOAA, together with BOEMRE conducted a peer-review analysis of applications for oil-and-gas-related activities in the Beaufort and Chukchi OCS areas, and has publicly released the summary of their findings (National Marine Fisheries Service, 2010e). One of the recommendations is to consider sound from an ecosystem perspective. They recommend transitioning away from using a single metric of acoustic exposure (that is, sound pressure level) to measure the potential effects of anthropogenic sound on marine mammals; and to integrate single-criteria mitigation strategies (the practical approach) with comprehensive assessment. Additional recommendations for improving aerial surveys, near-field and far-field visual monitoring, and collecting routine baseline biological information were included. This peer-review panel integrated scientists, regulators, and members of the Native community.

For all that is known about the BCB bowhead whale and behavior in the presence of anthropogenic sounds, relatively little is known about long-term trends or the biological significance of these observations. During the Incidental Harassment Authorization permitting process for seismic surveys, NOAA receives comments from the Native community, non-governmental organizations, and the Marine Mammal Commission (among others) that tend to consistently cluster into categories:

6.09. Finding: Although research is ongoing, the understanding of essential spatial and temporal habitat needs of the bowhead whale, particularly the oceanographic parameters that most influence foraging, breeding, raising young, and migrating is not yet sufficient to confidently determine the times and places where whales might be most impacted by anthropogenic sounds.

6.09. Recommendation: Understanding the essential spatial and temporal habitat needs for the bowhead whale (for example, Ashjian and others, 2010) needs to include those areas where the introduction of anthropogenic sounds might significantly disrupt the whale at key parts of its life cycle. This knowledge base should incorporate local traditional knowledge of bowhead whales (and other marine mammals) and their habitat contributed by the Native community.

(a) More baseline data are needed to understand behavior when there are no seismic surveys;

(b) More verification of sound source levels is required;

(c) More holistic monitoring strategies that integrate visual, acoustic, and other observations are needed; and

(d) More precautionary approaches to mitigation and defining the radii of safety zones are warranted.

6.10. Finding: Much scientific attention focuses on understanding the cumulative impacts of anthropogenic sounds at the population demographic level for marine mammals, in large part because of regulatory requirements. However, the USGS OCS Team heard often in our expert consultations that how noise affects individual behaviors, short of any health effect, is of great importance to Native communities because of concerns of impacts on potential hunting success of the subsistence community (see appendix A). For example, if the impact means a whale deflects offshore it then is unavailable for subsistence use.

6.10. Recommendation: Behavioral alterations are important factors that need to be understood and monitored to ensure effective mitigation during the hunting seasons to minimize impacts to subsistence hunting. This issue would benefit from enhanced integration of industry and agency acoustical monitoring network data (whale vocalizations), satellite telemetry data of whale movements, local traditional knowledge observations, and application of new statistical approaches to assess behavioral responses (for example, Blackwell and others, 2010) as a framework to better judge under what conditions whales may behaviorally respond to (for example, avoid) noise sources.

Beluga Whale (*Delphinapterus leucas*)

The Beluga, or white, whale has long been known to be a highly vocal species (for example, Schevill and Lawrence, 1949) and carries the nickname of canary of the sea. Using sound, particularly for echolocation, is a trademark of this species (Au and others, 1985, 1987).

Beluga whales are managed as two distinct populations in the Arctic OCS: the Eastern Chukchi stock and the Beaufort stock. This distinction is based on distribution patterns (Lowry and others, 1989) and is supported by molecular genetic studies (O'Corry-Crowe and others, 1997). The Beaufort stock is estimated to be ten times larger than the Eastern Chukchi stock (32,500 versus 3,700; Allen and Angliss, 2010). Neither of the Eastern Chukchi or Beaufort stocks is considered threatened or endangered (National Marine Fisheries Service, 2010f). Analysis of biological samples of beluga whales harvested for subsistence use has revealed much about stock structure, contaminant levels, age, growth, and reproductive status, though these statistics may be biased by hunting method (for example, Suydam, 2009). Belugas are harvested primarily by villages along the Chukchi Sea: a recent analysis of historical data showed that only 1 percent of the subsistence take of whales in Barrow between 1962 and 1982 was beluga whales, and none were harvested between 1987 and 1989 (Braund and Kruse, 2009). The Native community participates in managing the Eastern Chukchi and Beaufort stocks through the Alaska Beluga Whale Committee.

Beluga whales also were among the first whales tagged and tracked in the Arctic (National Marine Fisheries Service, 2010g). These early tagging studies revealed that some beluga whales ventured deep within ice of greater than 90 percent coverage in the summer (for example, Suydam and others, 2005). These tagging studies have been used to understand beluga movement and distribution (for example, Richard and others, 2001; Suydam and others, 2001) as well as diving behavior (Heide-Jørgensen and others, 1998; Kingsley and others, 2001). Arctic OCS belugas migrate annually from their wintering grounds presumably in the Bering Sea to their summer grounds in the Chukchi and Beaufort Seas (Allen and Angliss, 2010). Thus it is important to include seasonal information for understanding potential effects of anthropogenic sound on these stocks.

Beluga whales survive in captivity and are therefore accessible for research on life habit and functions that could not be conducted easily on whales in the wild. For example, they can directionally echolocate targets in a narrow and slightly upward tilted forward direction (Penner and others, 1986; Au and others, 1987). Although the underwater hearing sensitivity of belugas is quite large (Awbrey and others, 1988; Johnson and others, 1989b), they are most sensitive to about 20–80 kHz, which is mostly above the frequencies produced in large energy low-frequency seismic surveys used in oil exploration (fig. 6–2). In-air hearing has not been measured in belugas, but cetacean ears are adapted for underwater function and thus in-air hearing likely is very insensitive. Belugas also have been extensively studied for temporary threshold shifts in hearing, documented through disruption of trained behaviors (Finneran and others, 2000, 2002; Schlundt and others, 2000). Full recovery of baseline hearing and responses occurred within hours. These studies suggest that there is potential for acoustic disturbance, possibly from low-frequency surveys but more likely from higher frequency sound than is used in deep-penetration surveys.

There are many published studies about hearing, behavior, and responses of beluga whales to the kinds of sounds associated with Arctic oil and gas activities. When exposed to vessel noise, beluga whales can exhibit a variety of behaviors ranging from no response to fleeing (see Wartzok and others, 2004). Behavioral responses associated with this type of noise exposure often are considered transient. An unknown is whether repeated short-term behavioral responses translate to cumulative or population-level impacts (Bejder and others, 2006). At this time, there is limited information on whether and to what extent beluga whale migration will be affected by changes in shipping.

Beluga reactions to icebreaking are among the most cited and dramatic in the literature. Observations of changes in pod cohesion, surfacing behavior, and call types indicate that belugas detected the presence of icebreaker vessels at distances greater than 80 km. They exhibited strong avoidance responses at distances 35–50 km away and travelled up to 80 km from the ship track and typically remained away for 1–2 days (Finley and others, 1990). Bioacoustic models suggest that bubbler systems and cavitation associated with icebreaker movement have the ability to potentially mask hearing and vocalization of Arctic inhabitants (Erbe and Farmer, 1998, 2000). For beluga whales, it was hypothesized that the zone of masking could extend from 14 to 71 km from the source (Erbe and Farmer, 2000). There is an increased possibility of temporary threshold shift if animals are exposed

6.11. Finding: Beluga whales appear to be unusually sensitive to the sounds of icebreaking.

6.11. Recommendation: Understanding the sensitivity of beluga whales to icebreaking might require knowledge of the history of exposure to icebreaking or other anthropogenic factors to account for the possibility that some belugas may be either habituated or sensitized to this type of human activity. Application of telemetry to capture information on individual movement histories and access to noise histories (for example, from inventories suggested in Findings 6.02, 6.03, and 6.04) may be required.

to these types of sounds for an extended duration (that is, for animals that do not or cannot alter behavior to avoid this type of exposure if, for example, they are confined to a lead within heavy ice).

The reaction of beluga whales to drilling activities has been mixed and may be related to context. Observations have been made around "operational" artificial islands (Fraker, 1977a, 1977b; Fraker and Fraker, 1979), around a stationary drillship (Norton Fraker and Fraker, 1982), and in playback experiments with drilling noise (Richardson and others, 1990, 1991a). The variety of responses (or lack of responses) from these observations "may be another example of the degree to which belugas can adapt to repeated or ongoing manmade noise when it is not associated with negative consequences" (Richardson and others, 1995, p. 283).

Short-term behavioral responses of beluga whales to helicopters and fixed-wing aircraft have been noted since the late 1970s. Behaviors classified as reactions consisted of short surfacings, immediate dives or turns, changes in behavior state, vigorous swimming, and breaching (Caron and Smith, 1990; Richardson and others, 1991b, 1995). For both helicopters and fixed-wing aircrafts, the observed avoidance reactions by belugas generally occurred when the aircraft was at altitudes equal to or less than 150 m and lateral distances equal to or less than 250 m. The dominant low-frequency components of aircraft sound may be inaudible, or at most only weakly audible, to belugas. Mid-frequency sound components, visual cues, or both, probably are important in eliciting beluga reactions to aircraft.

6.12. Finding: The present understanding of the essential spatial and temporal habitat needs of the beluga whale in the Arctic is limited and constrains the ability to confidently understand and efficiently mitigate potential anthropogenic noise impacts. Similar data limitations exist for many other marine mammal species that will be noted in subsequent Findings and Recommendations.

6.12. Recommendation: Better understanding and inventory of essential spatial and temporal habitat needs of the beluga whale, particularly the oceanographic parameters that determine foraging, breeding, raising young, and migrating, will help managers determine how best to protect belugas from the impacts of anthropogenic sounds. Knowledge of these critical habitats for the beluga whale will enable managers to better identify and protect those places and times where the introduction of anthropogenic noise might significantly disrupt the whale at key parts of its life cycle.

Gray Whale (*Eschrichtius robustus*)

The gray whales that frequent the Chukchi and Beaufort Seas are managed as part of the eastern North Pacific gray whale population. Gray whales were first listed as endangered in 1970 in the Endangered Species Conservation Act, the precursor of the Endangered Species Act. After status reviews in 1984 and 1991, the eastern North Pacific gray whale was delisted from ESA in 1994 (see historical summary in National Marine Fisheries Service, 1994). The NMFS conducted a 5-year status review of the stock in 1999 (Rugh and others, 1999). In October 2010, the NMFS received a petition to again list the gray whale under ESA (California Gray Whale Coalition, 2010), but declined to do so in the 60-day review (National Marine Fisheries Service, 2010c). The eastern Pacific stock has an estimated minimum population size of about 17,500 with a population increasing at 1.9–2.6 percent per year (Allen and Angliss, 2010). Gray whales typically are not harvested as a subsistence resource.

Gray whales engage in one of the longest annual migrations of any marine mammal, travelling thousands of kilometers from as far south as Baja California in the winter to the Chukchi Sea in the summer. Although gray whales sometimes are seen around Barrow, they are a rare occurrence when seen east of Barrow in the Beaufort Sea (Nelson and others, 1993). The long coastal migration may expose this whale to more anthropogenic threats than the other Arctic whales because of its migration past major urban centers and sources of pollution (Rugh and others, 1999). There are some indications that, in the last decade, gray whales have moved farther into the Beaufort Sea and delayed their southbound migration in the fall (for example, Moore and others, 2003, 2007; Moore and Overland, 2008). Gray whales have been sighted more frequently near Barrow and their calls have been recorded in instruments deployed on the Beaufort Shelf during the winter (Stafford and others, 2007). Some of these changes may be related to changes in the physical environment of the north Bering Sea (Grebmeier and others, 2006).

Studies show gray whales, similar to other baleen whales, produce sounds generally below 1 kHz (Crane and Lashkari, 1996). Whereas gray whale response to anthropogenic sound has been studied in lower latitudes, the degree to which those results are predictive of whale responses in the Arctic OCS areas is speculative in part because the whales have highly structured annual cycles of feeding (summer in high latitudes) and breeding (winter in low latitudes). In one experiment with a long-range sonar, migrating whales avoided exposure to the signals when the source was placed within their migration corridor (Clark and others, 1999). However, in all cases, whales resumed their normal activities within tens of

minutes after the initial exposure to the signal, making minor course changes to go around the source. When the source was relocated outside of the migration corridor, but with the signal level increased so as to reproduce the same sound field inside the corridor, the whales continued their migration unabated. This result stresses the importance of context in interpreting animals' responses to underwater sounds (Clark and others, 1999).

Gray whale responses to airgun shots included changes in swimming speed and direction away from the sound sources (Malme and others, 1984), changes from feeding with a resumption of feeding after exposure (Malme and others, 1988), changes in call rates and structure (Dahlheim, 1987), and changes in surface behavior (Moore and Clarke, 2002). Some behavioral responses were dramatic—whales were seen to move into the shallow surf zone and into sound shadows of rocks (Malme and others, 1983, 1984). Approximately one-half of the gray whales exposed to a single airgun in the Bering Sea showed avoidance and noticeable changes in respiration behavior (Malme and others, 1986, 1988). There is essentially no information describing gray whale behavior in the presence of mid- and high-frequency pulsed sources.

Drilling and other continuous sounds have triggered avoidance responses in playback experiments with migrating gray whales (Malme and others, 1983, 1984). There are some data suggesting that gray whales respond to variations in underwater noise by changing the structure and timing of their calls (Dahlheim and others, 1984; Dahlheim, 1987), but it is unknown whether these changes in calling affected survival or reproduction. Gray whales were virtually absent from a wintering lagoon in Baja California, for several years during which shipping increased, possibly caused by the near-constant dredging needed to keep the channel open. Whales returned to the lagoon after shipping decreased (Jones and Swartz, 1984). Much of the nearshore range of the gray whale is heavily used by vessels and other human activity, which suggests habituation to or coexistence with noisy human activities (Richardson and others, 1995).

Gray whale responses to aircraft are variable and may be context dependent. Some observations suggest that mother-calf pairs off Alaska may be particularly sensitive to small (for example, turboprop) survey aircraft (Ljungblad and others, 1983). Mating gray whales did not react immediately to the arrival of a survey aircraft but dispersed after it had circled for a few minutes (Clarke and others, 1989). Migrating gray whales rarely showed detectable reactions to a straight-line overflight by a fixed-wing aircraft at 60 m altitude (Green and others, 1992). Playbacks of helicopter noise caused minor avoidance reactions in gray whales, suggesting that helicopter sound (rather than visual cues) could affect gray whales (Malme and others, 1983).

6.13. Finding: The present understanding of the essential spatial and temporal habitat needs of the gray whale in the Arctic is limited and constrains the ability to presently confidently understand and efficiently mitigate potential anthropogenic noise impacts.

6.13. Recommendation: Better understanding and inventory are needed of essential spatial and temporal habitat needs of the gray whale during its summering in the Chukchi and Beaufort Seas, particularly the oceanographic parameters that determine foraging, breeding, raising young, and migrating. Knowledge of these essential habitats for the gray whale will enable managers to better identify and protect those places and times where the introduction of anthropogenic noise might significantly disrupt the whale at key parts of its life cycle. The Chukchi Sea is of primary interest because it is a major foraging ground for the gray whale (Rice and Wolman, 1971; Fay, 1982). Because the development of petroleum resources (or mining for sand) in the Chukchi Sea could occur in regions of high concentration of prey species, the gray whale may be particularly vulnerable to petroleum-related development in the Arctic OCS (Nelson and others, 1994).

Polar Bear (*Ursus maritimus*)

Polar bears, the top predators in the Arctic marine ecosystem, are managed as two distinct populations, the southern Beaufort stock (primarily in the southern Beaufort Sea) and the Chukchi-Bering stock, which occurs farther south and west in both the U.S. and Russian Chukchi Sea (Amstrup and others, 2004). Based on satellite radio-telemetry data, a large overlap occurs between these two populations (Amstrup and others, 2004, 2005). In 2008, the U.S. Fish and Wildlife Service (2008) published a final determination to list polar bears as threatened under ESA. In 2010, the USFWS further published a final determination of critical habitat associated with the listing (U.S. Fish and Wildlife Service, 2010).

Polar bears are a well-studied Arctic marine mammal. Research on polar bears in Alaska has occurred since the late 1960s and numerous estimates of population stock exist (for example, Amstrup, 1986, 1995; McDonald and Amstrup, 2001; Allen and Angliss, 2010). Radiotelemetry was initiated in 1981, followed soon after with satellite telemetry, for understanding survival and recruitment. Genetic studies have helped identify discrete populations (for example, Paetkau and others, 1999; Amstrup, 2003). Sufficient data exist to model their distribution and denning patterns and examine population status and trends (for example, Aars and others, 2006).

Studies also have associated polar bears with "ecoregions" (for example, Amstrup and others, 2007). Polar bears tend to be more abundant over shallow water of the polar continental shelves, suggesting that these areas of higher productivity and therefore higher concentrations of potential prey are preferred habitat (Amstrup and others, 2000, 2004; Durner and others, 2007). Polar bears move in response to changing ice conditions and prey availability (Stirling and others, 1993; Arthur and others, 1996; Ferguson and others, 2000a, 2000b; Mauritzen and others, 2001; Durner and others, 2004, 2006, 2009). There are some data indicating that polar bear distribution may reflect factors such as prey availability, energetic costs, and safer ice conditions (for example, Mauritzen and others, 2003).

Despite the abundant research on the baseline biological information of the polar bear, relatively little information exists regarding its hearing, use of its auditory functions in survival or reproduction, and impacts from anthropogenic sounds. Importantly, in contrast to other marine mammals, the polar bear spends most of its life out of the water. When swimming, it carries its head above the water surface. Thus, while extremely intense underwater sound may impact a polar bear while in the water, the impacts of anthropogenic sound are considered primarily to be from sounds in air.

There are no measurements of the underwater hearing of polar bears. In-air hearing was measured using evoked auditory potentials on three anesthetized polar bears for frequencies of 1.4–22.5 kHz (Nachtigall and others, 2007). Results can not be taken as measures of absolute sensitivity, but sensitivity was relatively flat across the range of frequencies tested with a slight peak from about 11.2–22.5 kHz.

Ecological observations support these measured hearing ranges. Ringed seals (*Phoca hispida*) and bearded seals (*Erignathus barbatus*) are prominent in the diet of polar bears. Ringed seals produce underwater sounds in these frequency ranges (2–8 kHz; Stirling, 1973) suggesting that polar bear hearing can optimally detect and locate this preferred prey. Playback of ringed seal calls in the air has triggered changes in behavior in captive polar bears (for example, Cushing and others, 1988). Polar bears also may be able to detect and locate bearded seals by their distinctive underwater trills (Stirling and Thomas, 2003).

Many observations document polar bear responses to anthropogenic sound. On-ice seismic techniques (Vibroseis) have caused polar bears to locally (and temporarily) leave the area (Richardson and others, 1995). Moore and Quimby (1975) reported that females with cubs abandoned their dens during nearby seismic exploration activity, and this effect was more pronounced early in the denning season (Linnell and others, 2000). Polar bears appear to tolerate sounds and vibrations associated with stationary drill rigs on caissons and artificial islands (Stirling, 1988; Amstrup, 1993). Polar bear reactions to vessels and icebreakers are unremarkable (Fay and others, 1984). Reactions may include walking, running, or swimming away, and generally are of short duration; some bears show no reactions (for example, Richardson and others, 1995, and references therein). Helicopters are sometimes used to frighten polar bears away from human activities or facilities, and low-flying aircraft are known to cause polar bears to run away (Shideler, 1993). In general, these studies support the notion that polar bears may be sensitive to some kinds of in-air sounds.

6.14. Finding: Joint industry-agency programs have successfully mitigated, to date, the disturbance effects of oil and gas activities, including noise, on polar bears in the U.S. Arctic. An example of this has been the development of polar bear denning models to help define potential denning sites for avoidance during winter on-land seismic surveys and the application of Forward-Looking Infrared (FLIR) imagery for real-time monitoring and den avoidance. But declines in sea ice are resulting in changes in polar bear distribution and in denning habitat, as well as body condition and survival patterns, and portend declines in overall population size.

6.14. Recommendation: Broadly, and with respect to noise, to successfully mitigate the effects of existing and new development in the Arctic under changing climate conditions will require continual reassessment of what is understood about polar bear distribution and habitats to ensure mitigation measures are accomplishing intended outcomes.

Ice Seals

Of the Arctic marine mammals, ice seals remain the least known and studied. For each of the ice seal species, the 2009 stock assessment begins "A reliable minimum population estimate for this stock cannot presently be determined because current reliable estimates of abundance are not available" (Allen and Angliss, 2010). Subsistence harvests are incompletely known (for example, Allen and Angliss, 2010). Some progress is being made to identify habitat requirements (for example, Cameron and others, 2010). The large range over which these animals are found, their generally low densities, cryptic or incompletely understood behaviors, their habitat across multiple political boundaries, lack of information about how ice seals use habitat, the inability to correct inventories for seals in the water, and the high costs associated with surveying large areas remain the greatest impediments to improving the knowledge base (Boveng and others, 2008, 2009).

6.15. Finding: There is a basic lack of information about ice seals. Key information about the abundance, distribution, and vital aspects of ice seals is incomplete. (Information on ice seal auditory characteristics and response to sound also is lacking and will be discussed in Findings and Recommendations 6.16 and 6.17).

6.15. Recommendation: Habitat requirements of ice seals need to be better identified and quantified, particularly the importance of habitat in the context of seasonal activities. Annual harvest rates for subsistence needs should be estimated more consistently. Knowledge of such basic biological information should be integrated across political boundaries of the Nations in which the species occur (for example, Canada and Russia). For example, ringed seals from the Beaufort and Chukchi Seas were radio- and satellite-tracked showing that in the summer, they ranged up to 1,800 km from their winter/spring home, but returned to the same small (1–2 km^2) winter sites (Kelly and others, 2010). During the ice-bound winter and spring (including breeding season), ringed seals are therefore spatially limited in their foraging ability for significant parts of the year. If ringed seals cannot habituate to oil and gas activities or utilize human-free habitat, they may be limited in their ability to adapt.

Four species of ice seals are found in the Chukchi and Beaufort Seas: bearded (*Erignathus barbatus*), ribbon (*Histriophoca fasciata*), ringed (*Pusa hispida*), and spotted (*Phoca largha*). In contrast to the three species that are year-round Beaufort and Chukchi inhabitants, the spotted seal is only a seasonal summer visitor to the Beaufort and Chukchi Seas. Neither spotted nor ribbon seals are listed as threatened or endangered according to ESA (table 6–3).

The distribution and life history of these seals are intimately linked to the presence of ice and snow: mating occurs near the ice edge; subnivean lairs (for the ringed seals) are utilized as dens for whelping and nurturing pups; whelping coincides with near-maximum ice extent; and adult seals undergo annual molting after which seals spend prolonged periods out of water on the ice warming the skin in the sun during late spring and summer (Hopcroft and others, 2008). The timing of snow and ice melt may be critical to the survival or reproduction of ringed seals (for example, Kelly, 2001; Smith and Harwood, 2001; Stirling and Smith, 2004). When they are not breeding, ice seals may move hundreds or thousands of miles through the Arctic and surrounding waters (Kapel and others, 1998; Lowry and others, 1998; Harwood and others, 2000).

During the late 1970s and 1980s, the OCS Environmental Assessment Program (OCSEAP) funded and supported numerous studies of ice seals in conjunction with the increased OCS exploration activities in the Arctic, identifying some of the diet and trophic relations for these animals. After a hiatus in the 1990s, renewed research began with the formation of the Ice Seals Committee in 2005 consisting of members of the Native community for the purpose of developing a coordinated plan for management of ice seals in Alaska (for example, Ice Seal Committee, 2006). Tagging of bearded seals (starting in 2004) and ringed seals (starting in 2007) initiated with the Native village of Kotzebue (http://kotzebueira.org, accessed April 14, 2011) and biologists significantly added to the knowledge base about specific individuals for the duration

Table 6–3. Ice Seals—Endangered Species Act (ESA) Information.

Seal	Status review	Federal Register Notice	ESA listed for the Arctic
Bearded	Cameron and others, 2010	December 10, 2010	Candidate
Ribbon	Boveng and others, 2008	December 30, 2008	No
Ringed	Kelly and others, 2010	December 10, 2010	Candidate
Spotted	Boveng and others, 2009	October 20, 2009 October 22, 2010	No

of the tagging (generally less than 1 year). Each of the ice seal species has undergone extensive reviews in the past 4 years as part of the process by which the NOAA determines whether the species should be listed under the ESA. The major reviews summarizing biological knowledge of the species and associated Federal Register notices for ice seals are given in table 6–3.

Bearded and ringed seals are primary prey of polar bears as well as food for the Native community. The bearded seal is the largest of the seals and preys on benthic organisms. Hence they are more frequently found in shallow water areas where light can sustain a benthic ecosystem (for example, less than 200 m water depth). The ringed seal, also an important food source for the Native community, is the smallest of the ice seals and feeds on fish, so it can travel long distances over deep water along and within the ice (Kelly and others, 2010).

As with other marine mammals, ice seals are thought to use sound to aid in navigation, to socialize, and to avoid predators. Typically, pinnipeds are thought to spend as much as 80 percent of their time in the water (Gordon and others, 2004); thus anthropogenic sound associated with seismic surveys, vessel noise, icebreaking, and drilling may potentially disturb their habitat, distribution, and behavior. Ice seals make variable vocalizations in the water, generally associated with mating (for example, Watkins and Ray, 1977; Boveng and others, 2009; Cameron and others, 2010). The underwater hearing sensitivity for ringed seals showed peak sensitivities between about 4–16 kHz, although sensitivity to frequencies below 1 kHz was not measured (Terhune and Ronald, 1975). Based on the similarity of these hearing ranges to the hearing of many other pinnipeds, one might expect that the other ice seals also have hearing at similar ranges (Moore and Schusterman, 1987). A recent review suggests that the auditory bandwidth generalized for all pinnipeds in water should be about 75 Hz – 75 kHz (Southall and others, 2007). Most seismic surveys have peak energy below 200 Hz, hence the level of disturbance expected from large seismic surveys is at the low end of pinniped hearing.

6.16. Finding: Basic auditory information about ice seals is lacking.

6.16. Recommendation: Key information about the amplitude, character, seasonal variation, and function of vocalizations of ice seals as well as studies of pinniped diving profiles, auditory structures, and physiological effects of sound are needed. This information is essential for determining whether and how anthropogenic sounds could mask, impact, or injure these animals.

The effects of seismic surveys on ice seals have been summarized in the 2010 status review of the bearded seal:

> "Reported seal responses to seismic surveys have been variable and often contradictory, although they do suggest that pinnipeds frequently do not avoid the area within a few hundred meters of operating airgun arrays (Brueggeman and others, 1991; Harris and others, 2001; Miller and Davis, 2002). Telemetry work by Thompson and others (1998) indicated that harbor seals and grey seals (*Halichoerus grypus*) exhibit strong avoidance behavior of small seismic airgun arrays, including swimming rapidly away from seismic sources, ceasing feeding activities, and hauling out, possibly to avoid underwater noise. The behavior of most of the seals reportedly returned to normal within 2 hours of the seismic array falling silent. The authors suggested that responses to more powerful commercial arrays might be more dramatic and occur at greater ranges."
>
> (Cameron and others, 2010, p. 162)

Tagging studies conducted on ringed seals in 2001, when Canadian marine seismic surveys were occurring, did not appear to affect the timing or route of the western fall migration of ringed seals in the Beaufort Sea (Cott and others, 2003). Ringed seals in the Prudhoe Bay region often tolerated exposure to high received levels (180–190 dB re: 1 µPa rms) of low-frequency sound pulses from airgun arrays, with little evidence of changes in behavior and no more than localized avoidance (Harris and others, 2001; Moulton and Lawson, 2002). Many seals remained within 100–200 m of the operating airguns, which is often within the radius where received sound levels are greater than 190 dB re 1 µPa (rms). There are seemingly inconsistent results concerning reactions of seals to small airgun sources (Blackwell and others, 2004b). The seals may initially show an avoidance response to these sounds, but rapidly habituate, demonstrated by their adjustment to Acoustic Harassment Devices that are similar to sounds used in sub-bottom surveys (Richardson, 2002).

There are few data on auditory threshold shifts, either temporary or permanent, for ice seals. In experiments done primarily on sea lions, the results from pulsed sounds (Finneran and others, 2003) and continuous, but lower energy, octave band noise (Kastak and others, 1999, 2005) demonstrated the importance of considering both amplitude and duration when estimating the impacts of sounds on marine mammals and these results are reiterated by Southall and others (2007). Each of the ice seal reviews conducted by the NOAA (table 6–3) suggested that "Although it is unlikely that airgun operations during most seismic surveys would cause PTS in (bearded, ribbon, ringed, or ice) seals, caution is warranted given the limited knowledge about noise induced hearing damage in this species."

Reactions of most pinnipeds to drilling and related activities have not been extensively studied. Ringed seals are often seen near drillships drilling in the Arctic during summer and autumn. As part of construction efforts for the Northstar oil production island 5 km offshore of Long Island, northwest of Prudhoe Bay, Alaska, in the western Beaufort Sea, ringed seals showed little or no reaction to any industrial noise except approaching helicopters (Blackwell and others, 2004b). There is no evidence of reduced seal densities near the Northstar gravel island drilling platform (Moulton and others, 2003). Very few data exist for the effects of vessels and icebreaking on ice seals, but observations suggest sensitivity occurs only when icebreaking occurred within several hundred meters of the seals (for example, Kanik and others, 1980; Brueggeman and others, 1992). It was not clear whether vessel noise or visual cues triggered the escape responses.

Noise disturbance to ice seals also must account for in-air sound, although few data exist for this. When on the ice, ringed seals and bearded seals often dive when approached by low-flying aircraft or helicopters, but do not always do so (Burns and others, 1982). Spotted seals may be particularly sensitive to low-flying aircraft leading to concerns about potential separation of mothers and pups during nursing (Frost and others, 1993; Richardson and others, 1995). The levels of received sound are unknown in these observations.

6.17. Finding: There is a lack of information on the response of ice seals to aircraft or differential response to fixed-wing aircraft versus helicopter.

6.17. Recommendation: Controlled exposure (sound playback) experiments with ice seals might aid in understanding their hearing sensitivities and reactions. At any given moment, behavior in free-ranging animals is controlled by a multitude of factors including the individual's internal physiological state, physical environmental conditions, time of day and time of year, the behavior and distribution of peers, behavior and distribution of other species (including predators and prey), and human activity. When making passive observations, any observed behavior in an individual may be caused by the anthropogenic factor under study, other natural factors, or some combination of both. Controlled exposure is a quasi-experimental method used to evaluate response to sound by observing the behavior of free-ranging animals before, during, and after exposure to specific sound (for example, Tyack, 2009), either by playback of recorded sounds using an underwater sound system or by controlling the sound of a vessel, sensor (for example, sonar), or tool (for example, airgun, bubbler, pipe driver).

These experiments might determine whether observed responses could have been caused by the sight, sound, or vibration associated with the noise.

Pacific Walrus (*Odobenus rosmarus divergens*)

The Pacific walrus ranges across the continental shelf of the Bering and Chukchi Seas but is only infrequently observed in the Beaufort Sea (for example, Allen and Angliss, 2010). Walruses winter in the Bering Sea in large communities and move north with the ice edge as the pack ice recedes each summer (Fay, 1982). Ice is essential for their existence, providing a location to rest, molt, give birth, and escape predators (Richard, 1990). Land aggregations are becoming more common as the ice recedes north of the Chukchi and Beaufort Shelf edges (Jay and Fischbach, 2008). Although walruses can dive deeper than 200 m (Born and others, 2005), they typically live where water depths are less than 80 m so that the benthic communities they prefer for prey are more easily reached (Fay and Burns, 1988; Jay and others, 2001). Radio tags and more recently satellite tags are beginning to yield more continuous measurements of walrus activities (Jay and Fischbach, 2008). Walruses can significantly disturb seafloor sediment during feeding on benthic organisms, and are thought to be a major influence the structure of benthic ecosystems of the Chukchi and Bering Seas (for example, Oliver and others, 1983).

The current estimate of minimum population size for the Pacific walrus is approximately 129,000 individuals, with insufficient data to determine annual trends in abundance (Allen and Angliss, 2010). As a result of a petition filed by the Center for Biological Diversity in 2008, the USFWS issued a 90-day finding on September 10, 2009, that the petitioners had submitted enough scientific information to indicate that listing of the Pacific walrus under ESA may be warranted (U.S. Fish and Wildlife Service, 2009). On February 10, 2011, the USFWS issued their 12-month finding that listing the Pacific walrus as endangered or threatened is "warranted but precluded" (U.S. Fish and Wildlife Service, 2011).

Walruses can be extremely vocal when out of the water and produce a variety of sounds in the water (Ray and Watkins, 1975). Only the male walrus makes the unusual "bell" sound comprising two frequencies produced in succession (Schevill and others, 1966). Tests of hearing on captive walruses indicate that underwater hearing sensitivity covers a broad range of frequencies, with the best hearing generally above 1 kHz, although sensitivity was good down to 125 Hz (Kastelein and others, 2002). In-air hearing sensitivity was measured from 125 Hz to 8 kHz, with best sensitivity between 1 and 8 kHz and rapid decline below 1 kHz (Kastelein and others, 1993, 1996). Similar to ice seals, low-frequency seismic surveys are likely to impact the low-end of the walrus hearing spectrum whereas medium- to high-frequency hazards surveys are more likely to coincide with the range of walrus hearing.

Walrus appear to be sensitive to some noises and can stampede from haulouts in response to sight, sound, and odors of humans (for example, Fischbach and others, 2009). It is not currently understood whether these reactions are uniformly caused by visual, olfactory, or vibrational cues rather than noise. A similar uncertainty exists about the cause of some walrus reactions to vessels either in open water or during icebreaking, particularly whether avoidance responses are triggered by ship noise versus sight and smell of the vessel (for example, Fay and Kelly, 1982; Fay and others, 1984). When near icebreakers, most walruses on ice were more cautious of vessels compared to walruses in the water (Fay and others, 1984). The observed reactions were commonly waking up, raising their heads, or entering the water. Some walruses in the water reacted by hauling themselves out of the water.

Walrus responses to drilling operations are closely linked to icebreaking because of ice management during drilling. During the 1989–91 drilling of the Popcorn, Burger, Crackerjack, and Diamond wells in the Chukchi Sea (Minerals Management Service, 2005), escape responses were more frequent the closer the icebreaker operated to the walrus (Brueggeman and others, 1990, 1991, 1992). Evidence from aerial surveys in one study suggested that walruses may have avoided the area of icebreaking by as much as 10–15 km (Brueggeman and others, 1990), which contrasts with reports of avoidance only at much shorter distances (Fay and others, 1984). Icebreaking may have the potential to cause behavioral avoidance or injury, and for these communal large animals, may degrade habitat by reducing floe size and availability for haul out. Animals that show no avoidance may be undisturbed, but alternatively may be disturbed but have no avenue of escape.

Responses of walrus to aircraft (both helicopters and fixed-wing aircraft) were similar, in that the level of response was usually related to distance and altitude of the approaching aircraft (Johnson and others, 1989a). Aircraft overflight of walrus haulout locations have triggered stampedes from flight elevations of 150–800 m (Fay, 1981; Ovsyanikov and others, 1994). Stampedes may lead to trauma, injury, and death of walruses, particularly calves. One study identified different reaction distances depending on whether a helicopter approached the walrus group from an upwind or downwind direction (Fay and others, 1984), raising the possibility that smell could have been a factor in the response.

6.18. Finding: Considerable uncertainty exists about whether walrus reactions to anthropogenic activities are caused by sight, sound, or smell. Quantitative data are lacking about the character of deep-penetration, high-resolution seismic and other acoustic sounds (such as sonar or chirp) and the responses of walruses to these sounds.

6.18. Recommendation: Basic information about walrus reactions to anthropogenic sound, particularly seismic and acoustic sounds, needs to be better documented and studied. Detailed studies that examine responses in controlled environments could help efficiently elucidate key areas of walrus response. This information coupled with quantitative characterizations of anthropogenic noise sources could better define whether and how these kinds of anthropogenic sounds could mask, impact, or injure walrus.

6.19. Finding: There is a newly emerging, yet still incomplete understanding of the manner in which walruses select their benthic foraging habitats (Jay and others, 2011) and limited information on the role of walruses in ecosystem structure. Such information is needed (in concert with information in Recommendation 6.18) to assess if seasonal, annual, or persistent sources of anthropogenic sound may cause walruses to avoid certain places or times. And, if so, what the effect might be to both population and ecosystem.

6.19. Recommendation: Better understanding and inventory of essential spatial and temporal habitat needs of Pacific walrus during its summering in the Chukchi Sea, particularly the oceanographic parameters that determine foraging, are needed. Should evidence develop that walrus are displaced due to human-generated sound, future studies will be needed to assess if cascading ecological consequences result. Walrus modify the seafloor during their foraging by resuspending sediments, which in turn may enhance primary productivity by releasing nutrients into the water and maintaining sand substrates on the seafloor as fine-grained muds and silts are suspended, for example, and carried by the Alaska Coastal Current (Nelson and others, 1994).

Conclusions: While scientific uncertainty exists regarding the scope and nature of environmental disturbances arising from anthropogenic sound sources in the oceans, and particularly in the Beaufort and Chukchi Seas, some simple conclusions may still be drawn.

- Sound is of vital biological importance to the marine mammals of interest in the Arctic, and anthropogenic noise can have various adverse effects. The wide-scale introduction of commercial, military, and research activities into Arctic areas that will accompany oil and gas activities, with concomitant associated increases in anthropogenic sound, are very likely to impact both the acoustic environment and the sound-centric marine mammals living there.
- Vessel activities and other industrial sound sources increase sound in the oceans; the Beaufort and Chukchi Seas offer the unique opportunity to measure and understand both the increase in anthropogenic sound and its potential impacts on marine mammals because these areas are essentially pristine with limited anthropogenic sound sources compared to the rest of the oceans around the United States.
- Different species hear and use sound differently. Therefore, impacts from anthropogenic sound will vary by sound source (for example, vessel operation, seismic, and hydroacoustic devices, icebreaker operations), as well as by marine mammal species.
- Very few of the impacts from anthropogenic sound are expected to include direct physical injuries to hearing (or other systems) of the marine mammals.
- Concern regarding behavioral disturbance and avoidance of key areas is a major concern for the Native community. Any change in individual marine mammal behavior that causes the animal to move away from coastal waters, particularly the bowhead whale, has the potential to make the animals unavailable for subsistence hunting.
- Cumulative-, population-, and ecosystem-level impacts of exposure to chronic sources of anthropogenic sound from oil and gas activities remain poorly understood but are important considerations, particularly for the survival, sustainability, and reproductive health of marine mammals.
- Key knowledge gaps include baseline data from which to measure the changes that might be caused by the introduction of anthropogenic sound, inventories of anthropogenic sound (especially vessels and seismic sources), and the spatial and temporal habitat needs of the marine mammals of concern.
- The Native community has much at stake in the regulatory process and has much knowledge, both traditional and local, to offer in augmenting scientific studies about marine mammals and anthropogenic sound.

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Chapter 7

Cumulative Impacts

By Brenda Pierce

Introduction

The final topic the USGS OCS Team was asked to consider was that of cumulative effects. Here we examine the state of cumulative impact or effect assessment approaches and the present challenges of conducting science-based cumulative effect analyses in the Arctic. Cumulative impacts are the combined, incremental effects of human activity.

Cumulative impacts can result from factors that may be insignificant by themselves but significant when interacting and (or) accumulating over time and space, through repetition, or in combination with other effects. When actions are considered individually or independently, their combined consequences—or cumulative impact—may not be fully considered or evaluated. This results in not understanding, and not considering, the long range impact of multiple decisions over a large area.

The impetus to study and evaluate cumulative impacts lies with the passage of the National Environmental Policy Act (NEPA) of 1969. The NEPA requires Federal agencies to develop Environmental Impact Statements and Environmental Assessments for major projects. However, if these studies are done independently of one another and considered separately, the studies may not take into account cumulative effects from each activity on the whole and the projects' effects may not be fully accounted for nor be taken into account in the final decision.

The Council on Environmental Quality (CEQ) was established under NEPA. The CEQ's regulations (40 CFR Part 1500–1508) implementing the procedural provisions of the NEPA (Council on Environmental Quality, 1997) define cumulative effects as:

> "The impact of the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

The words "effects" and "impacts" are used synonymously in CEQ's NEPA regulations, which govern NEPA implementation (Council on Environmental Quality, 1984). Effects and (or) impacts are meant to be inclusive and include ecological, aesthetic, historical, economic, social, and health, and are both beneficial and detrimental.

Cumulative effects result from spatial (geographic) and temporal (time) environmental disturbances and both must be given consideration in analyzing cumulative impacts.

The National Research Council (NRC) conducted a study on the cumulative effects of oil and gas activities on Alaska's North Slope (National Research Council, 2003). That study, which focused on the onshore portion of oil and gas development, is the most comprehensive look at the considerations that should go into cumulative impact analyses. The National Research Council (2003) emphasized the fact that significant research has been carried out in Arctic Alaska over the last several decades, but that an integrated, comprehensive assessment of those effects has not been attempted. That is still true today—there are a significant number of important and landmark environmental studies, and there are some studies of cumulative effects, but no integrated, comprehensive assessment of those effects has been conducted or even attempted.

Policy decisions are usually made at the regional or national level, but environmental effects are usually analyzed and assessed at the project level. Decisions and permitting of industrial activities are often done on a case by case basis by many different entities and therefore without the benefit of a comprehensive plan or understanding of the scope, intensity, and consequences of the industrial activities. Long-term decision making and land and resource management must take into account the cumulative impact of the nature and extent of the benefits and challenges and the costs of both.

Considerations in Conducting Cumulative Impact Studies

The Council on Environmental Quality's (1997) guidance emphasizes the need to incorporate a cumulative impact evaluation in the development of alternatives for an Environmental Analysis or Environmental Impact Statement. It stresses that only by considering cumulative effects can appropriate mitigation and monitoring measures be effectively developed.

The CEQ suggests that in conducting cumulative impact analysis, the life cycle of effects and impact zones, rather than individual projects, should be evaluated. It emphasizes that looking at the affected environment in a cumulative impact analysis is basically the same as it is in a project-specific analysis, with the important addition that the analysis should be extended in terms of geography, time, and the potential for resource or system interactions. In project-specific NEPA analysis, description of the affected environment is based on a list of resources that may be directly or indirectly affected by the proposed project. In cumulative effects analysis, there is an attempt to identify and characterize effects of other actions, including those of other geographic areas or other time frames, on these same resources.

To conduct a cumulative effects analysis, one should understand what would occur in the absence of a given activity. This is best done when there are reliable baseline data available for the analysis and by using tools that indicate ecological integrity and landscape conditions. This is important because when an analysis is performed, the baseline or thresholds of environmental change are set, thus influencing the cumulative impact assessment. Effects typically accumulate as the result of repeated activities, but also may be affected by a single action or event if significant. Therefore, a full cumulative impact analysis requires multiple assessments.

It is very important to be transparent regarding the uncertainties associated with any of these studies, especially in cumulative impact. There will always be uncertainty, as there will never be enough data and information on every facet of the impact of development to know the impact in its full extent. Therefore, it is important to be transparent about what data do or do not exist and what is modeled and what is empirical, so the users of the information understand the extent of the uncertainty surrounding the assessment or impact.

Conducting cumulative impact analysis needs to be an iterative process. Results from cumulative impact assessments should contribute to refining alternatives and designing mitigation techniques and approaches. Thus, monitoring change and the accuracy of the predictions made is an important part of cumulative impact analysis and contributes directly to the success of the mitigation measures.

The U.S. Environmental Protection Agency (USEPA) has review guidance regarding the NEPA and cumulative effects and suggests that its reviewers determine whether resources are cumulatively impacted by considering the following (U.S. Environmental Protection Agency, 1999):

1. Whether the resource is vulnerable to incremental effects;
2. Whether the proposed action is one of several similar actions in the same geographic area;
3. Whether other activities in the area have similar effects on resources;
4. Whether these effects have been historically significant for this resource; and
5. Whether other analyses in the area have identified a cumulative effects concern.

Some project analyses consider only certain resources and only direct impacts or limited impacts among those particular resources. To conduct a cumulative impact analysis, consideration must be given to a broader array of effects, such as ecosystems functions (for example, ability to minimize downstream flooding or improve water quality) instead of simply the acreage of wetland potentially lost by a project. Other potential effects to consider, as suggested by the U.S. Environmental Protection Agency (1999), include changes in hydrologic patterns, alteration of discharge and water retention rates, changes in water velocity, secondary or tertiary effects of chemicals in the wetland and how plants may take up those chemicals, to name just a few.

Additionally, some analyses limit the area considered to those areas over which an agency might have direct purview or management authority (U.S. Environmental Protection Agency, 1999). This limits the full evaluation of cumulative impacts, because impacts may be caused by factors outside the specific project's spatial or temporal scope, including the life of the project. For example, the effects sometimes last longer than the project's useful life, and (or) future related or unrelated projects will be additive to the effects of the one considered project, and so should not be evaluated independently.

The USEPA guidance document (U.S. Environmental Protection Agency, 1999) points out that past environmental conditions are not adequately addressed in most cumulative impact analyses—not fully analyzing how the system has changed from previous conditions and thus not fully accounting for the cumulative impact. Because the Arctic has had very little development thus far, we are in a somewhat unique situation in which there have been few previous impacts so today's conditions form our baseline.

It is true that there have been activities in the Arctic, including seismic surveys in State and Federal waters, some drilling, acoustic surveys, vessel traffic, aircraft surveys, and hunting activities, but the amount is less than in many other areas under consideration for oil and gas development. Human industrial activities in the Alaskan Arctic have been limited primarily to petroleum-related activities in the southeastern Beaufort Sea. The Arctic environment is experiencing large-scale transformation associated with climate change that eventually may result in an opening of frontier areas to increased human developments and commerce associated with fisheries, shipping, and tourism. The relative absence of human activity presents a unique regional opportunity to develop and analyze the cumulative impacts in a relatively pristine environment and show how cumulative effects can be studied and properly evaluated.

To evaluate or analyze cumulative impacts, one needs to determine whether the effects interact or accumulate over time and space. Effects most often accumulate as a result of repeated or compounded activities. However, individual or single actions also can contribute to cumulative impacts, especially if the effects persist for a long time and (or) are augmented by the effects of other activities. As early as 1986, a National Research Council (1986) study identified the most important factors in regards to cumulative effects (and were reiterated in the 2003 NRC study). These factors generally agree with the Council on Environmental Quality's (1997) identified examples of cumulative effects:

- Time crowding—frequent and repeated effects on a single environmental medium.
- Space crowding—high density of effects on a single environmental medium.
- Compounding effects—synergistic effects attributable to multiple sources on a single environmental medium.
- Thresholds—effects that become qualitatively different once some threshold of disturbance is reached.
- Nibbling—progressive loss of habitat resulting from a sequence of activities, each of which is fairly innocuous, but the consequences for the environment accumulate.

Because cumulative impact assessments are difficult undertakings, the National Research Council (2003) described several essential components:

- Specify the class of actions whose effects are to be analyzed.
- Designate the appropriate time and space domain in which the relevant actions occur.
- Identify and characterize the set of receptors to be assessed.
- Determine the magnitude of effects on receptors and whether those effects are accumulating.

Thus, for example, specific *activities* might include seismic exploration and whether these activities had significant effects on specific *receptors*, such as specific species or subsistence hunting. One of the most challenging aspects of conducting a cumulative impact analysis is determining the area and vulnerable resources over which the effects have occurred or will occur.

In addition to identifying and evaluating the accumulation of effects, factors such as magnitude, biotic impact, recovery times, and socioeconomic importance must be evaluated.

Arctic Alaska

Energy and mineral resources are significant in Arctic Alaska (Chapter 2, Geological Context), and the large potential of oil and natural gas resources is of near term interest. Production of some of these resources is already underway, especially onshore, yet many of the areas of Arctic Alaska have not yet been influenced by such industrial activity. As sea ice continues to retreat and allows for more navigation, use of Arctic waters for activities, such as tourism and shipping, is expected to add to the effects of industrial development. Further complicating the issues are those of transboundary impacts—including the United States and Canada for the Beaufort Sea and the United States and Russia for the Chukchi Sea. These factors complicate the delineation and understanding of cumulative impacts, as well as the ability to develop effective monitoring.

There are benefits to energy and mineral production, but there also are social and environmental costs and impacts. Each individual development activity affects the ecosystem, including marine life, habitat, air quality, water quality, and local communities. These effects, combined with those of other projects or activities, will have unanticipated additional, or cumulative, impacts. Climate change adds significant complexity to cumulative impacts, perhaps more so in the Arctic where its effects may be more pronounced. The climate of the Arctic (Chapter 4, Climate Change Considerations) is a complicating factor in evaluating cumulative impacts in that recovery from disturbance in the Arctic may take much longer than in warmer climates.

Cumulative effects analyses have been done by various groups since the passage of the NEPA, but conducting such analyses remains extremely challenging because of the complexity and variety of factors that might impact cumulative disturbances. Although studies and research have been done by many organizations on many factors in the Arctic, there has been relatively little specific focus on a holistic, integrated, comprehensive assessment of cumulative effects of industrial activities in the Arctic.

An additional complicating factor is that Arctic research is conducted by a myriad of entities, and the management of Arctic resources is overseen by many different groups with different mandates, interests, and budgets, and thus research needs. Different agencies have different responsibilities—for air, water, endangered and (or) migratory species, and so on. No single organization has the responsibility for comprehensive planning for oil and gas development in Arctic Alaska. This is, in part, why much of the information is not synthesized or integrated. There is value to having different groups conduct research and analysis, and to some degree management, but there needs to be more coordination and an integrated decision-making process for these large areas that are potentially going to be developed. If an integrated decision-making process is not implemented, then the project-based approach to environmental impact analysis will preclude true cumulative impact analysis or evaluation.

7.01. Finding: Cumulative effects analysis can benefit from applications of sophisticated geospatial technologies, regular synthesis of environmental data and information, ecological forecasting, and multidimensional evaluations of planned human developments. These elements exist for the Arctic OCS at some level, but are insufficient or not well integrated to support comprehensive cumulative impact analyses.

7.01. Recommendation: More coordination and comprehensive planning are needed among the various stakeholders in the Arctic, including those with responsibility for resources, those that conduct research, and those that use resources. These groups should all have input into coordinated, comprehensive cumulative impact analyses. Shared stakeholder visions regarding purpose and data sharing may reduce redundancies and help streamline regulatory processes. These actions must be informed by improved access to information through geospatial technologies, regular synthesis of research, forecasting, and multidimensional evaluations of human developments.

Further complicating the analysis of cumulative impact, especially in the Arctic, the National Research Council study (2003) pointed out that technological advances have significantly changed many factors related to petroleum development, including the type of resource obtained, as well as how and where it can be produced (for example, directional drilling, ice roads, and so on). Technology develops very rapidly when the stakes are large, and it adds a complicating factor to predicting cumulative impact. Climate change, also, significantly impacts the ability to predict or even determine cumulative impact. As climate change is expected to accelerate in the future, its effect on cumulative impact is difficult to predict. It will, however, likely influence petroleum and other development and in turn, those activities on the environment.

The National Research Council (2003) study outlined specific issues (only some of which follow) that must be addressed when considering cumulative effects on Arctic Alaska. Many of these issues are related to onshore development, as the study was focused on the Alaska's North Slope. However, this list, which is not comprehensive, gives a sense of the many issues that must be considered when addressing comprehensive cumulative impact assessments:

- Industrial activity has grown on the North Slope with oil field development, pad development, interconnecting roads, pipelines, power lines, and other infrastructure. Environmental effects of these structures occur both at the site as well as up to a few miles/several kilometers away, but visual impact can be farther. There also is an issue of legacy sites, including abandoned infrastructure and unrestored landscapes. However, there has been significant improvement in reducing the drilling footprint with technological advances, such as directional drilling, replacing gravel pads with ice pads, and other developments.
- Off-road damage to tundra originates primarily from seismic operations. Most of the damage is legacy damage, caused by earlier surveys, but is long term and persistent. Technology, as well as seasonal limitations to off-road travel, has substantially improved and has significantly reduced, but not totally eliminated, damage to the tundra. It is difficult to predict what will be the impact as drilling expands into new areas and as climate continues to warm.
- Roads affect areas of development like they do in many areas by increasing dust, habitat fragmentation, and permafrost effects. Roads also can allow access by hunters, tourists, and others to an area previously difficult to access. Yet, roads can enhance communications among isolated communities and increase contacts between the North Slope and those communities outside the area.

- Animal and plant impacts (terrestrial and marine) include those to bowhead whales and denning polar bears. These may affect predator densities (related to new food sources people bring to the oil fields) and may impact the reproductive capabilities of some species, but that is not yet known. Some species on the North Slope are in decline here and elsewhere, and industrial activities may affect those trends. The Arctic Coastal Plain contains some of the richest areas of Arctic fens, thaw lakes, and tussock tundra in the World. Despite its low biological productivity, the Arctic Ocean supports a specialized biotic community, especially near the coast. Many species of plants and animals are found onshore and offshore.

- Oil spills to date have been from pipelines but there have been no major oil spills from oil field operations. Small spills in the oil fields are not large enough nor frequent enough to be considered in a cumulative impact evaluation, but a future large oil spill, especially offshore in sea ice, would likely accumulate, especially as there is no comprehensive method for clean-up of spilled oil in sea ice.

- Air quality and the effects of air pollution on the North Slope are areas in which relatively little research is conducted. As a result, there is no quantitative baseline and it is very difficult to determine local effects from long-range transport of air contaminants.

- Human factors—

  Socioeconomic changes.—Oil development, and attendant modern Western culture, has resulted in major and most likely irreversible changes to North Slope communities. Changes include funds for schools, housing, health care, and other community services, as well as changes in culture, diet, disease, and economic systems. These changes, which are viewed by some as both positive and negative, are complex and cumulative, because they are multifactoral and interactive. Just as oil revenues have changed the North Slope community, both positively and negatively, declining revenues also will affect life there and additional cumulative impacts will occur should financial resources decline.

  Impact on subsistence activities.—The Iñupiat of the North Slope have a nutritional and cultural relationship with the bowhead whale and offshore industrial activity is largely viewed as a major threat. Bowhead whales are affected by noise (as discussed in Chapter 6, Marine Mammals and Anthropogenic Noise), which alters their migratory pathways, which in turn puts hunters at risk by having to travel farther, by increasing exposure to adverse weather, and by increasing the possibility that the whale meat will not last on the return journey home. Increasing awareness of these risks has led to agreements on limiting or moving activities, but the Iñupiat still view the possibility of an offshore oil spill as a potential catastrophe. These threats are cumulative because they interact and because they are repeated with each new lease sale or activity.

  Aesthetic, cultural, spiritual impacts.—Oil development activities have changed the Alaskan landscape so that there is an accumulation of aesthetic, cultural, and spiritual consequences, including lessening scenic values and diminishment of the solitude of the area, the wilderness, and the "spirit of the land."

  Human health effects.—The direct health effects of petroleum activities have not been well documented in Arctic villages. Within Native communities, there are increased alcohol and drug use, increasing obesity, and other issues, but it is not possible to determine which are specifically tied to petroleum activities. Effects on traditional foods and their consumption are of great concern. It also is not possible to determine the degree to which increased financial resources have contributed to improving the quality of health care and accessibility and have offset the adverse effects of oil and the oil industry.

7.02. Finding: There are no known studies that attempt to separate the effects of oil and gas activities from other causes of socioeconomic change in communities of the North Slope of Alaska.

7.02. Recommendation: Develop a cost/benefit analysis of petroleum activities on residents of the North Slope of Alaska, to understand what effect onshore development has had and to provide a baseline for the effects of potential offshore development.

The National Research Council (2003) cumulative effects report makes the point that some information on the effects of development should be gathered concurrent with information on oil and gas activities, so as to maximize learning opportunities and promote better and (or) adaptive management. The study recommended filling the knowledge gaps by undertaking numerous studies. We have only included those that have specific impact on offshore development potential:

1. Comprehensive planning—decisions generally are made on a case-by-case basis, without a comprehensive plan or regulatory strategy;
2. Ecosystem research—ecosystem-level research is largely lacking at the regional scale in Arctic Alaska; most studies have been local in nature;
3. Offshore oil spills—this was of such concern to the NRC committee that it recommended research into mitigating their effects, as well as research in how to deflect marine mammals from spill areas, and clean-up technologies should a spill occur;
4. Zones of influence—impacts from industrial development are not limited to the specific area of development, but extend some ways beyond and there is a need for quantification of those effects;
5. Human communities—there is important missing information on the effects (beneficial and harmful) to the North Slope communities; a better mechanism is needed to increase Alaska Native input into the research process and a way to translate their observations into hypotheses that can be addressed by research;
6. Human health effects—health effects of oil and gas activities are not well documented;
7. Air contamination and its effects;
8. Bowhead whales—better information is needed on the migratory and acoustic behavior of bowhead whales, including from multiple sources and their feeding patterns;
9. How to deal with uncertainty—because there will never be sufficient data to meet all needs for information, transparency is needed when a model or statistical evaluation is performed to assess an environmental effect, which gives voice to the uncertainty surrounding the use of models;
10. Trade-offs—effects of industrial development may accumulate despite efforts to minimize impacts; it is open to discussion whether the benefits derived from oil and gas activities are worth the trade-offs of their impacts; the nature and extent of these impacts must be fully acknowledged and incorporated into regulatory strategies and decision making.

There is a significant body of work on the actual and potential effect of oil and gas activity in Arctic Alaska, as well as on the physical, biotic, and human environment that could be used for cumulative impact analysis. For example, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) provided figure 7–1 showing the progression in understanding through time of the social systems in Arctic Alaska. This is but one organization that funds research in the Arctic.

The BOEMRE formally consults with other organizations regarding environmental impacts on potential petroleum development in the Beaufort and Chukchi Seas, including the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS). These organizations have published biological opinions and environmental impact statements regarding development (National Marine Fisheries Service, 2008, 2009; National Oceanic and Atmospheric Administration, 2009; U.S. Fish and Wildlife Service, 2009).

There is a growing recognition of the interaction of factors and issues. Shell Gulf of Mexico Inc. submitted an Exploration Plan to the BOEMRE for several exploration blocks from OCS Lease Sale 193 (February 2008) in the Chukchi Sea, Alaska, in July 2009 to conduct exploration drilling and evaluate petroleum potential in three prospects (Minerals Management Service, 2009). Shell proposed to drill several exploration wells within its lease blocks. Its Exploration Plan (EP) includes an environmental impact analysis, a Chukchi Sea Regional oil discharge prevention and contingency plan, environmental monitoring information, site-specific geohazards survey data and assessment, and mitigation measures. With the EP, Shell submitted a Plan of Cooperation to reduce potential conflicts with subsistence activities, and a description of their Cultural Awareness and Health, Safety, Security, and Environmental Awareness Programs. In addition to these documents, Shell submitted reports relating to distribution and abundance of seabirds, acoustic modeling of underwater noise, bird strike avoidance, marine mammal surveys, and drill mud impacts from exploratory drilling.

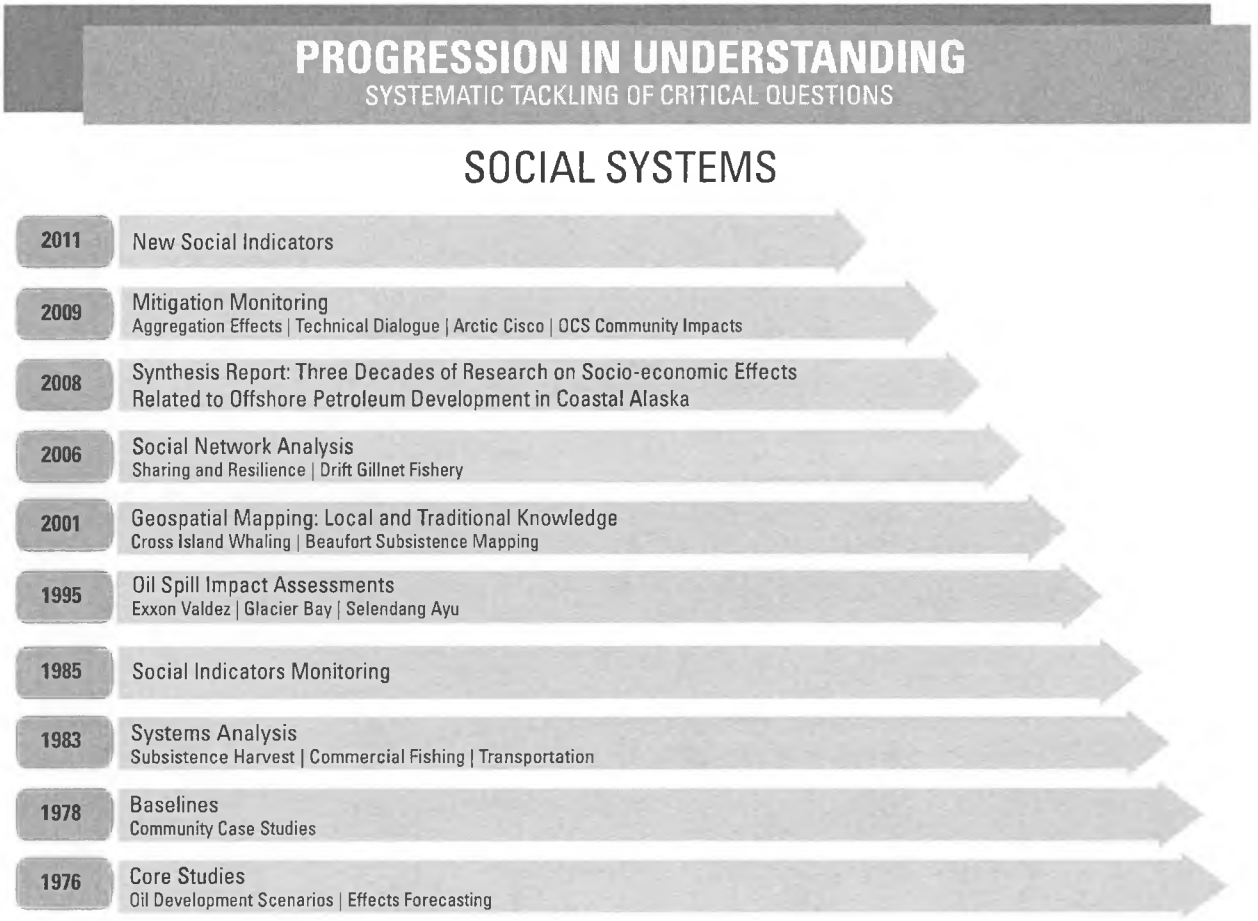
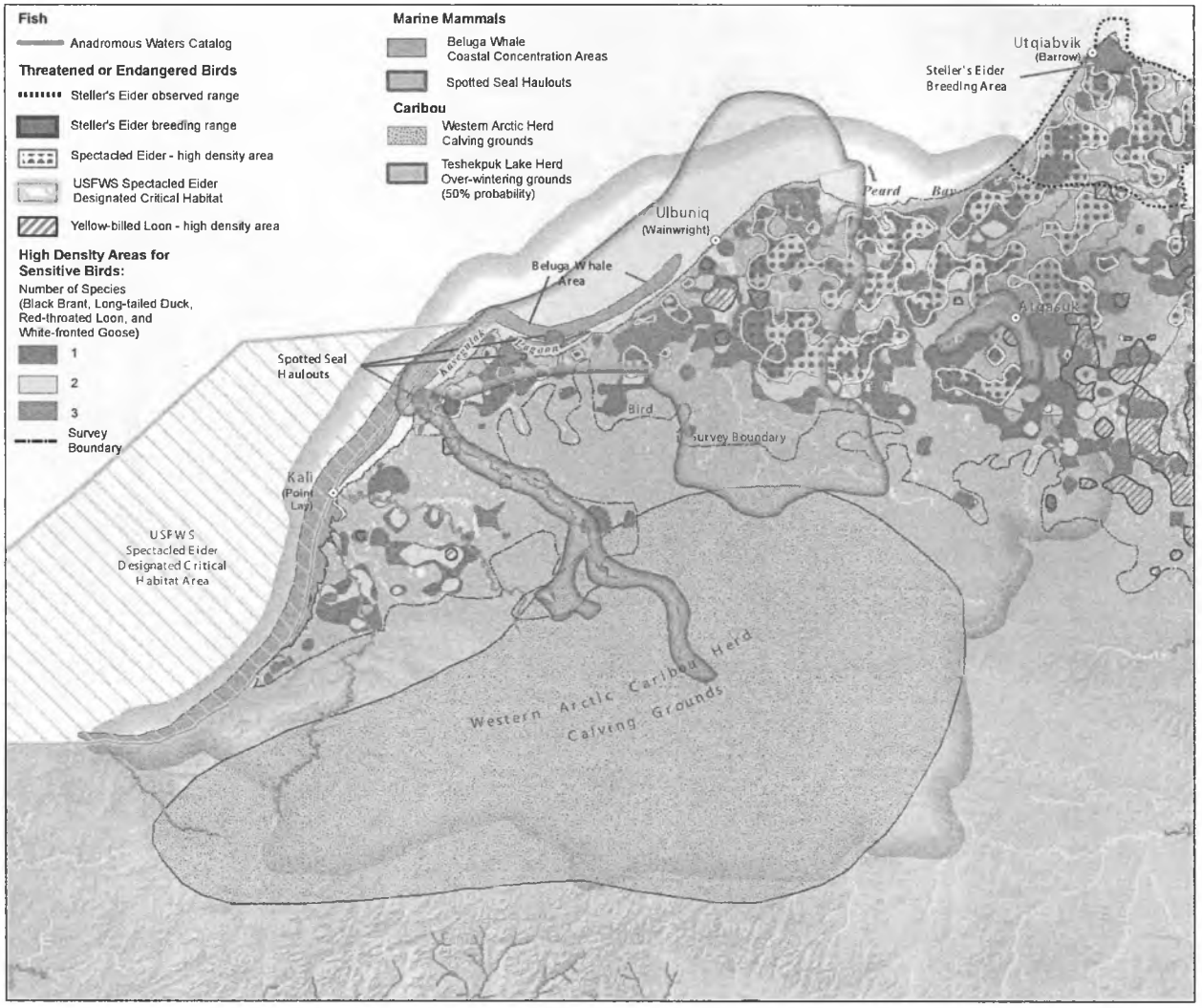


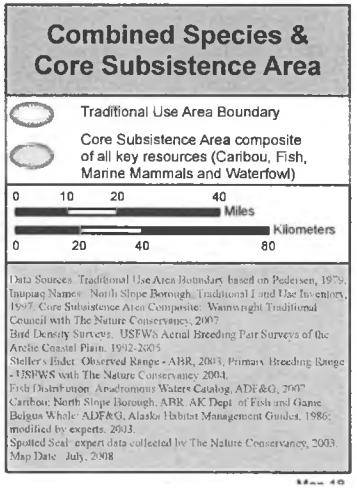
Figure 7–1. Example of studies funded by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE, written commun., 2011).

Despite the growing awareness and care that is taken to evaluate environmental impacts, there is still grave concern regarding the cumulative impacts to the environment as a whole and to native communities. This concern was voiced in a number of our structured discussion sessions (see appendix A).

Although there is a great deal of information on the Arctic Ocean, including the Chukchi and Beaufort Seas, the information is not synthesized and is not integrated. This has implications for impact analysis, but especially for cumulative impact analysis. The data and information also are not collected in a geospatially sufficient manner to provide as strong a data underpinning as we have on land (fig. 7–2).

There also is a body of knowledge regarding behavioral animal studies related to drilling activities (related to the full range of activities including impacts from boats, aircraft, noise, light, and more), but some studies are anecdotal and cite behavior of animals in certain circumstances, certain times of the year, with certain activities. It is unclear if there is any synthesis of cumulative impacts, especially of repeated behavior. Because there is not yet offshore development in the U.S. Arctic, now is the optimal time to develop studies to determine cumulative impact, which includes a full synthesis of the literature and studies that are available to determine what is already known and what remains uncertain. There is a great deal of literature on different species, activities, behavior, and a synthesis of these studies would likely show findings different than individual studies.





This map combines the core subsistence areas from Map 11 and the combined sensitive species habitat areas from Map 17. There is strong overlap between the combined core subsistence area and the important habitat for many sensitive and Threatened and Endangered species, demonstrating the biological and cultural importance of these areas. The importance of these habitats demonstrates the need for careful land use planning.

As land use decisions are made in the NPR-A, the information in this report can be used as a tool for crafting management recommendations that balance conservation and development. Well informed decisions that consider all available information can ensure that areas of high cultural and ecological value are conserved.

Figure 7–2. Map showing combined sensitive species habitat areas and core subsistence areas for onshore Arctic Alaska. Similar data and visualizations are yet not available at this level for the Arctic OCS. (The Nature Conservancy and Wainwright Traditional Council, 2008.)

7.03. Finding: There is a growing volume of scientific information for the Arctic and the Arctic OCS, more specifically, that is not synthesized and is not integrated. This has implications for confident impact analyses, but particularly for the development of rigorous cumulative impact analyses.

7.03. Recommendation: A thorough synthesis of the existing Arctic literature needs to be conducted to develop a body of knowledge about cumulative impacts. This analysis would point out where studies show consistency and where there is need for more robust analysis of cumulative impacts on certain species or during certain times of the year or during certain behaviors (breeding, feeding, migrating, molting, staging, for example). Significant mitigation measures are being planned and in many cases may be enough (temporary disturbance for certain species during certain times of the year). But a thorough analysis of the literature would give greater assurance of the scientific validity of such assumptions, especially since the literature is detailed and plentiful for some species and sparse and anecdotal for others. This literature synthesis and evaluation should be supplemented with local traditional knowledge. This baseline for cumulative impact analysis will also help in dealing with the effects of climate change on cumulative impact. The data reviewed in the synthesis need to be made digital, where appropriate, so as to facilitate combining data sets and providing a foundation upon which to add more data and to identify data gaps.

Through reviewing the literature and looking at the issues associated with industrial activity, this author compiled a list of just some of the issues that need to be evaluated and how they accumulate when considering a comprehensive cumulative impact evaluation of offshore development:

1. How the resource will be transported—pipeline or tanker?;
2. What onshore infrastructure will be needed to support offshore exploration and development?;
3. How this onshore infrastructure will impact current Alaska North Slope oil and gas development and the cumulative impacts of that development and the two (onshore and offshore) combined;
4. Whether or not offshore development will affect or be affected by the coastal erosion currently occurring at unprecedented rates;
5. Invasive species;
6. Potential from oil spills (not just from drilling activities, but from other factors, such as ships);
7. Socioeconomic changes to affected communities; and
8. Effect on or interaction with subsistence activities.

This is but a small list of factors that need to be considered, in addition to the others listed in this chapter (climate change effects and others) and the other chapters of this report (such as effect on marine mammals, ecosystems, and oil-spill risk).

Effects of Climate Change on Cumulative Impact Analysis

Climate change and resulting ecosystem changes complicate evaluating cumulative effects. Continued climate change effects will themselves accumulate and affect sea ice, plant and animal distribution (both terrestrial and marine), permafrost, human activities, and oil field operations.

The National Research Council (2003) found in their assessment that it appeared customary for practitioners to assume that the only source of environmental change in the evaluation of cumulative impacts is the action under study and that the environmental setting itself does not affect the analysis. Climate change, however, alters this assumption especially in Arctic Alaska, because the climate is changing rapidly and is affecting the landscape and environment itself, independent of, and in addition to, any potential petroleum activity. These factors must be taken into account when evaluating cumulative effects.

Climate change is only peripherally considered in most cumulative impact evaluations or assessments. Climate change can have significant effect on the ecosystem, which in turn will be additive to other impacts, although not directly related. An excellent example of this can be seen in figure 7–3, which illustrates the shift from benthic to pelagic ecosystems, which is already being documented in Arctic waters.

The conditions that are postulated to occur with climate change may have a profound effect on the environment even in the absence of development, and thus will have a profound effect on any cumulative impact analysis. Yet little is understood about how to incorporate these changes into a cumulative impact assessment.

7.04. Finding: Climate change considerations in cumulative impact evaluations are often peripherally handled with limited analytical rigor. Yet, climate change can significantly affect ecosystems, which in turn will be additive to other impacts under consideration.

7.04. Recommendation: A methodology needs to be developed to incorporate climate change effects into a cumulative effects analysis that is transparent, robust, and sufficiently structured to incorporate existing scientific uncertainty about future climate scenarios.

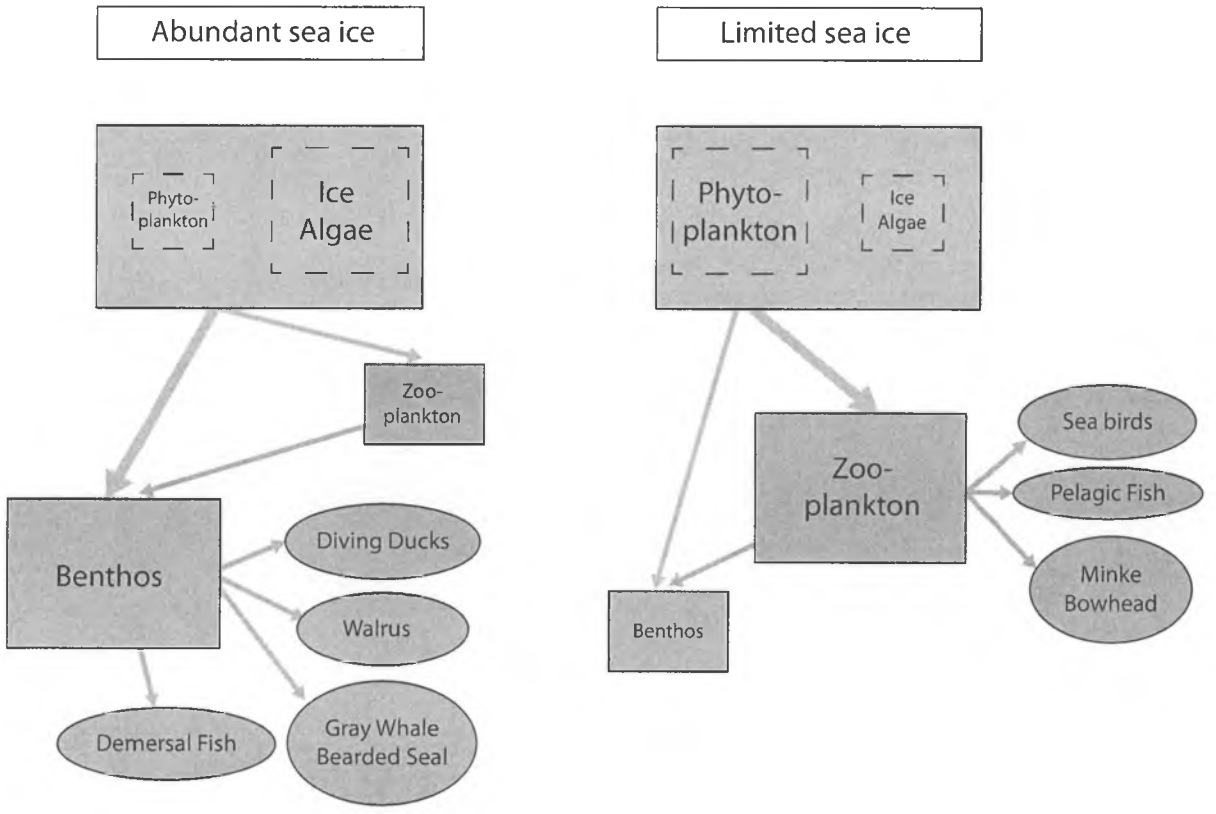


Figure 7–3. How different ice conditions may affect Arctic marine ecosystems (Bluhm and others, 2008).

Methodology for Cumulative Impact Analysis

No universally accepted framework or approach for cumulative effects analysis exists and, thus, there are different approaches to cumulative impact analysis. Further, each government agency handles it differently. This leads to the perception that cumulative impacts are ignored, or when not ignored, are met with confusion. This issue was voiced in each of the structured listening sessions. However, there are accepted general principles that need to be included in all cumulative effects analysis—the analysis needs to be conducted within a context of understanding the resources, ecosystem, and human community thresholds, that is, levels of stress beyond which the desired condition degrades (Council on Environmental Quality, 1997). Determining this threshold is often difficult and problematic. Cumulative impact analysis is complex and difficult, and impacted by a number of factors, but confusion is increased by the different approaches and scales. The different approaches make the results or findings very difficult to compare and contrast. A single methodology could be consistently applied to different areas, account for regional variables, and allow for a comparison of results. Different factors are currently counted in many different ways and words and terms are used differently by different groups: for example, what are threshold indicators; what mitigation measures are prompted when (what kind of threshold has been passed); what are acceptable impacts. A single Department of the Interior approach (1) could alleviate the perception that factors are not being weighed equally (either positive or negative impacts); (2) will resolve the issue of cumulative impact analysis being done differently in different planning areas by different agencies; and (3) will increase the clarity about what is really being considered. One approach also will address the perception that individual development projects are not being adequately addressed by cumulative impact analysis.

The National Research Council (2003) report was unable to attribute the absolute degree of importance to effects, so it attempted a descriptive approach to the importance of the effects. Since then, there have been efforts to develop standardized, quantitative approaches to cumulative effects [for example, Johnson and others (2005) and Halpern and others (2008)], but these have only described some of the impacts and no benefits of proposed activities. Another study that bears watching is the BP- and North Slope Borough-funded study at the University of California, Santa Barbara to develop an approach to quantitatively assess the cumulative impact of noise on marine mammals (namely gray whales and bowheads). These are excellent examples from which to build, but more work needs to be done.

What seems to be missing from many of the cumulative impact analyses is the consideration of future actions. This is very difficult to do, but in an area such as the Arctic where development is still relatively new, one must consider future development in order to account for cumulative impact. The challenge of trying to determine future development is exacerbated by the various oversight responsibilities of the different agencies. Consideration must be given to developing a consistent approach to "reasonably foreseeable future actions," to account for the various projects among and between the various agencies, geographic regions, and time frames, but not overestimate projects that may never be developed. What is considered reasonable and foreseeable is going to be different in each area, but guidelines, definitions, and thresholds need to be developed so they are common and consistent.

Monitoring is an important part of the iterative nature of cumulative impact analysis, to assess the accuracy of predictions of effects and to evaluate the success of mitigation. Consequences should be evaluated repeatedly in the cumulative impact analysis and a monitoring program should include the following (Council on Environmental Quality, 1997):

1. Measurable indicators of the magnitude and direction of ecological and social change;
2. Appropriate timeframe;
3. Appropriate temporal and spatial scales;
4. Means of assessing causality; and
5. Means of measuring mitigation.

It also is important to note that possible effects, both positive and negative, are perceived differently by different groups and individuals. It is not clear that there is a method to attribute a degree of importance to effects, so often the effects are descriptive or qualitative instead of quantitative.

Recently, ecosystem-based marine spatial planning (MSP) is being discussed as a possible tool for assessing and managing for cumulative effects of multiple activities (Foley and others, 2010) as well as a viable strategy for managing human activities in Federal waters. Marine spatial planning is a comprehensive, adaptive, integrated, ecosystem-based spatial planning process for analyzing current and anticipated uses of the oceans (National Ocean Council, 2010, accessed March 31, 2011, at http://www.whitehouse.gov/administration/eop/oceans/cmsp). MSP is a process that analyzes the spatial distribution of activities in the ocean so that ecosystem health and services can be protected and that existing and future uses can be maintained, reducing use conflict. Some MSP efforts, notably those in Norway, explicitly cover multiple sectors including oil and gas development (Olsen and others, 2007). Marine spatial planning takes into account two fundamental principles, namely those of context and uncertainty (Foley and others, 2010), as well as stakeholder input—all issues mentioned previously as important to consider when conducting cumulative impact analysis. Marine spatial planning, as outlined in a number of studies, many of which are described in Foley and others (2010), can be used to reduce the level of cumulative impacts in any one area, as well as the number of trade-offs and conflicts between users and between users and the ecosystem.

7.05. Finding: No universally accepted framework or approach for cumulative effects analysis exists, which leads to the perception among some stakeholders that cumulative effects are ignored. The lack of a clear structure and quantitative analytical process leads stakeholders to question the sufficiency of approaches taken and validity of resulting findings.

7.05. Recommendation: A methodology for comprehensive, quantitative cumulative impact analysis that is transparent, externally vetted, and adopted consistently across at least the Bureaus of the Department of the Interior should be developed. In order to help develop the methodology, an evaluation of the various approaches should be conducted, including marine spatial planning, to determine best practices of all agencies both domestic and international. A common language and a common set of metrics should be developed. One methodology that can take into account regional variables should be developed. The analysis should include more than single projects, and the scope of the analysis should be determined by an expert panel. The approach should define the information needed for a decision and what to do when a decision is required but there are no data. The methodology and resultant analysis should include a plan for the number and types of projects in the region and be able to account for both positive and negative tradeoffs. An approach must be developed to incorporate or predict reasonable future development and monitoring of impacts as development progresses.

Conclusion

The evaluation of cumulative impacts—the combined, incremental effects of human activity—has a basis in NEPA and is guided by CEQ guidelines. In practice, study of cumulative impacts is complex and difficult, especially when consideration is given to potential future development and the overprint of climate change. There is confusion among all parties interested in cumulative impacts regarding what they are and how to evaluate them. Several agencies and organizations evaluate cumulative effects, but there is little coordination of efforts or resultant findings. Furthermore, there is no universally accepted methodology for the study of cumulative impacts. Society's ability to judge the potential effects of oil, gas, and other development considerations in the Arctic would benefit greatly from the creation of a methodology for comprehensive cumulative impact analysis to be adopted consistently. To develop such a new methodology will require an evaluation of best practices across all agencies, domestic and international, and taking advantage of new analytical approaches emerging in fields outside of environmental sciences. A consistent national approach, with common language and a common set of metrics that can take into account regional variables, would allow for the scientific underpinning of an assessment for Arctic development to be viewed relative to actions elsewhere. Efforts to develop such a methodology should consider how best to incorporate more than single projects. Any new approach needs to define the amount of data needed for a decision and what to do when a decision is needed and there are few or no data. The methodology and resultant analysis should include a plan for the number and types of projects in the region and be able to account for both positive and negative tradeoffs. An approach must be developed that is flexible and robust enough to incorporate or predict reasonable future development and define essential monitoring of impacts as development progresses. Synthesis activities must be regularly conducted to document our growing understanding of ecosystems and effects. Development and implementation of cumulative impact analysis must include the various stakeholders in the Arctic. A thorough synthesis of the existing Arctic literature is needed to develop a body of knowledge about cumulative impacts from which to develop the cumulative impact assessment. This synthesis also will aid in incorporating climate change into the new cumulative impact assessment methodology. Only in this way will we start to appreciate what cumulative impacts, both positive and negative, will truly be associated with development in the Arctic.

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Chapter 8

Conclusions

By Brenda Pierce and Leslie Holland-Bartels

The Arctic has had relatively little industrial development thus far, giving us a unique opportunity to determine the future land use and resource management of this area and "get it right." We have the chance to study the environment and all its components and how any changes (human-induced or natural, including climate change) will affect the Arctic. Specific and detailed USGS summaries of key existing scientific information, key knowledge gaps, and recommendations are found in each chapter. Those recommendations are important for understanding what the USGS discovered in the course of this study and to help inform and improve decision making. Within this conclusions section, we provide a higher level summary and synthesis of our findings to help inform the Secretary of the Interior's considerations of the right places and the right ways in which to develop oil and gas resources in the Arctic Outer Continental Shelf.

Impacting all Arctic components and affecting any resource management strategies will be climate change. Climate conditions in the Arctic have recently been undergoing a marked change, particularly during the last 20 years. Environmental changes include warmer air and ocean temperatures, earlier spring snowmelt, a marked decrease in the extent and thickness of sea ice, accelerated coastal erosion, permafrost degradation, an increase in shrubs on the Arctic coastal plain, and other habitat changes. These changes in the physical environment influence biological, human, and industrial systems in a number of ways:

- The distribution of some animal species (for example, walrus and polar bear) is responding to changes in, or the loss of, critical habitat (for example, sea ice) during parts of the year.
- This in turns impacts subsistence hunting.
- The number of days seismic exploration vehicles can operate on the tundra without causing environmental harm has decreased from 200 to 100 over the last 30 years.

Climate projections for the next 50–100 years produced by global climate models consistently show a pronounced warming over the Arctic, accelerated sea-ice loss, and continued permafrost degradation. Of all areas on Earth, the Arctic has the greatest sensitivity to changes in greenhouse gases, with some of the largest changes expected to occur in the Bering, Beaufort, and Chukchi Seas. If realized, these projected climate changes will ultimately affect nearly every aspect of the Arctic environment. This is a major concern from a biological standpoint because the indigenous plants and animals are so highly adapted to the specific extreme conditions that have been the norm in the Arctic.

The effects of climate change are anticipated to influence all components of the Arctic ecosystem, and Arctic Outer Continental Shelf energy activities may exacerbate those changes, unless careful analysis of risks and tradeoffs is conducted. By judiciously planning when energy activities occur, environmental risks associated with those activities may be reduced. For example, extreme cold is a contributing factor in drilling accidents and spills, and thus the significant warming of mean autumn and winter temperatures expected by mid-century will lessen the likelihood of accidents and spills. Although portions of the Chukchi and Beaufort Seas are expected to be ice-free for a greater period of time each year, the pack ice is predicted to be more dynamic at certain times, increasing the risk of accidents and making oil-spill response more

difficult during these times. Ice seasons of shorter duration and longer open-water seasons could have profound effects on many different components of the Arctic system, likely affecting Arctic ecosystems and the species within them, especially in areas of particularly high biological productivity and potentially allowing for longer seasons of energy development and transportation.

Climate change also may affect:

- clouds, which in turn affect visibility;
- icing conditions, which are a significant hazard in the Arctic, and can increase the potential for accidents and make response more difficult;
- precipitation, an increase of which would hinder spill response and increase the potential for accidents;
- storms (possibly increasing in frequency or intensity during certain parts of the year);
- sea-level rise, which can affect coastal areas and infrastructure;
- ocean acidification, which can significantly impact calcifying organisms due to the corrosive effect of the acid on their shells and would have reverberations throughout the Arctic food chain;
- ocean circulation patterns, which are likely to change, although what those changes would be and what their effects would be are highly uncertain.

Climate change also will impact organisms in the Arctic (including fish, birds, whales), pinnipeds (ice seals and walrus), and polar bears in many different ways including through the warming of Arctic waters from sea-ice declines and from changes in the food chain notably from the potential effects of acidification of the Arctic Ocean.

Understanding climate change is an important piece of any type of development in the Arctic. More research needs to be conducted on the proposed effects of climate change on factors such as storms and ocean circulation. Storminess will directly affect the safety of oil and gas development. Ocean circulation patterns are critical in shaping both the physical and biological environments of the Arctic Outer Continental Shelf. The science community is actively engaged in developing state-of-the-art global climate models, but these models currently lack the resolution needed to address many of the issues discussed in this report. The United States, as one of the Arctic Nations, would benefit greatly from participating in the development of fully integrated (atmosphere-ocean-land) regional climate modeling efforts. Continued and enhanced efforts in this arena, specifically for the Arctic region, will provide a fundamental tool needed to better understand the degree and nature of any consequences of climate change as it relates to decisions regarding energy development in the Arctic. Periodic Arctic climate impact assessments can help ensure that an up-to-date scientific understanding of climate is achieved.

This theme of fully integrated regional modeling and analysis resonated throughout every topic that we studied. Our analysis of the many different literature sources—scientific reports, public policy documents, workshop findings, web sites—and discussions with a diverse range of stakeholders has resulted in a recognition that in recent years there has been a concerted effort to obtain more data and information on and conduct more research in the Arctic, so there is a great deal of information existing about the Arctic. Yet, in many ways, relatively little is known about the Arctic in large part because many of the studies are targeted in focus and independently conducted with limited synthesis, even within studies on the same topics. There is a critical need for large-scale synoptic efforts that synthesize the many different studies on the full range of topics by the numerous researchers and organizations examining the Arctic. However, there also is a need for some very specific research to address the identified science gaps (in the previous chapters, specifically, and here in general).

Recent research and evaluation efforts in the Arctic have resulted in better understanding of Arctic geology, including the acquisition of geophysical data, offshore mapping, and successfully completing the first Arctic research drilling expedition. Such efforts also have enhanced our understanding of the tectonic and climatic history of the Arctic system, including carbon cycling, and delineating Arctic petroleum systems. Yet, there is a growing need for 3-D seismic data in the Arctic in order to better understand the geologic history of the area and its oil and gas potential (conventional and unconventional), to provide information regarding the safe development of these resources, and to support claims regarding the Outer Continental Shelf under Article 76 of the U.N. Convention on Law of the Sea.

Improved estimates of the oil and gas resources in the Arctic are needed to provide a better baseline for effective resource management. But characterization of the oil reservoir volume and pressure also is needed throughout the Arctic Outer Continental Shelf, as these parameters have direct bearing on oil-spill risk assessment and oil-spill contingency planning. Underpinning research in foundational geology and geophysics can provide an improved understanding of how oil and gas resources are formed and emplaced in reservoirs in the Arctic.

Information on the physical oceanography (such as circulation processes and wind) is critical for oil-spill modeling, oil-spill response, and cleanup efforts, as well as for understanding biological resources. The physical oceanography and meteorological Arctic Outer Continental Shelf characteristics that are inputs into this modeling are highly dynamic as a result of complex factors including ocean

source waters, freshwater inflows, and ice melt differences between the Chukchi and Beaufort planning areas. Such complexities are not yet well understood because of the challenge of instrumenting a remote ice-influenced system such as the Arctic Outer Continental Shelf. Thus, the physical understanding of the Arctic Outer Continental Shelf is not comparable with that of the Gulf of Mexico Outer Continental Shelf, nor is the circulation or weather modeling that informs oil-spill trajectory models yet of similar rigor. Outputs from such trajectory models also influence ecological effect analyses, as well as spill contingency planning and real-time response considerations. These analyses are limited by the accuracy and precision of the physical data that inform them. In addition, physical oceanographic and meteorological data help inform a wide variety of issues in the Arctic beyond trajectory modeling or contingency planning. The United States and Canada might benefit from the development of multi-purpose, multi-agency funded monitoring networks that could inform climate forecasting, aviation and shipping safety, and oil-spill response and mitigation plans. The visualization and serving of data through tools of the Alaska Ocean Observing System (AOOS) and (or) the Emergency Response Management Application under development for the Arctic (Arctic ERMA) would ensure efficient access to information and improved asset planning that is critical in the high cost instrumentation environment of the Arctic.

Development in the Arctic is challenging and complex because of the many unknowns and because of the inherent risks of working in frontier and relatively pristine environments. Beyond the focused question of "science gaps" the USGS Outer Continental Shelf Team was challenged with, we observed a need to evaluate all relevant information available to help develop guidelines, best practices, regulations, and policies. Lessons learned from all existing Arctic or sub-Arctic examples must be used to inform future decisions and optimize future actions. The *Exxon Valdez* oil spill in 1989 was the largest oil spill in United States waters until the *Deepwater Horizon* spill of 2010. The lessons learned from the *Exxon Valdez* oil spill are included in our report for the purposes of highlighting Alaska-based experience ranging from spill response through Natural Resource Damage Assessment components. Any Arctic Outer Continental Shelf evaluation and planning effort for oil development can benefit from the lessons learned from *Exxon Valdez* oil spill, which can better inform overall preparedness and particularly oil-spill prevention and response.

Current information and recent baselines developed for different components of the Arctic ecosystems need to be supplemented with ongoing monitoring so as to understand the changes in the ecosystem and monitor its health. Information is needed on all levels of species, from phytoplankton, microbes, and zooplankton, to fish and birds, to marine mammals. It is important to include not just those species that live in the Arctic year-round, but also migratory species as well.

A particular concern, voiced by many stakeholders and cited in the literature, is the impact of noise on marine mammals. Even with multiple studies conducted on ocean noise and marine mammals, large uncertainty still exists in understanding how impacts to individual animals may affect characteristics in the populations and research is needed on this topic. An inventory of seismic sound sources used in the Arctic Ocean does not exist. Such an inventory would provide standardized information about source, physical oceanographic conditions, and timing and duration of surveys. This database could be used to evaluate multiple sound sources that a marine mammal might hear in space and time, and help validate models that estimate sound propagation. The database may ultimately reduce the need for expensive or redundant acoustic modeling and monitoring, especially in sensitive or biologically significant habitats, as well as contribute to developing more effective mitigation strategies. Further, there is a need for an inventory of all non-natural noise in the Arctic Ocean, such as vessel noise, ship-induced icebreaking, and aircraft. Such databases will be important to distinguish between anthropogenic and natural sources of noise impacts to marine mammals and will point out where there are significant information gaps (there is relatively little information on any of these). Data gaps also include the overall ambient noise budgets of the Arctic and how these vary seasonally and spatially. These data are needed because substantial challenges remain for scientists to understand the magnitude and significance of potential effects of anthropogenic sound on marine mammals. Additional research is needed to discriminate between the effects of sound, other aspects of human activity, and environmental variation (natural background). A synthesis of existing data on whale population abundance, structure, and habitats would provide a framework for analyzing how sound impacts whales and help managers determine times and places where whales might be most impacted by anthropogenic sounds. Similarly, fundamental biologic and habitat information about ice-dependent species, such as ice seals, is lacking, as is any information on how anthropogenic sound impacts them. This information needs to be obtained and integrated into these anthropogenic effects databases. In addition, walrus reactions to anthropogenic sounds also need to be better documented and studied (there is even considerable uncertainty as to whether walrus reactions to anthropogenic activities are caused by sight, sound, or smell) and a better understanding and inventory of habitat needs for walrus are needed.

There is a continuing need to facilitate the collection, integration, and sharing of multi-scale data sets to advance our understanding of the Arctic as a complex, interdependent system. Such multidisciplinary data sets need to be used to develop comprehensive, holistic approaches to resource development and impact scenarios to inform planning. The multiple agencies, responsible for different parts of the system, make this task challenging, but it is a critical need. There must be a comprehensive approach taken to any type of industrial development in the Arctic. This comprehensive approach would benefit greatly from international cooperation and coordination. We share a border with Canada, which faces many of the same questions and challenges that we do, and other countries, particularly those of northern Europe, have experience from which we could benefit.

Also resonating throughout many of the issues examined was the challenge of relating the rapidly emerging science and technical information to the decision-making process. The level of information, the number of agencies and entities generating information, and the manner in which information from these sources is served is becoming more important as attention is turned towards the Arctic in general, and resource development in the Arctic more specifically. These information sources, while individually well structured, roll up to a complex information picture that is a challenge to interpret. It is difficult, if not impossible, in attempting to examine such information holistically, to know which needs are being addressed fully or partially, what new information needs or insights have emerged, how one weighs the relative importance of the information, and which new or continued investments are critical to reducing uncertainty among vested parties.

This information challenge is particularly important when it comes to evaluating cumulative impacts. Cumulative impacts are the combined, incremental effects of human activity. Cumulative impacts can result from factors which may be insignificant by themselves but significant when interacting and (or) accumulating over time and space, through repetition, or from a combination with other effects. When actions are considered individually or independently, their combined consequences—or cumulative impact—may not be fully considered or evaluated. This results in misunderstanding, and failure to consider the long range impact of multiple decisions over a large area or over time. Policy decisions are usually made at the regional or national level, but environmental effects are usually analyzed and assessed at the project level. Decisions about and permitting of industrial activities are often done on a case by case basis by multiple entities responsible for oversight of different aspects of the activity. These entities often operate without the benefit of a comprehensive plan or understanding of the scope, intensity, and consequences of the industrial activities, especially if overseen by another entity. Long-term decision making must take into account the cumulative nature and extent of the development benefits and challenges, and the costs and risks of both.

Cumulative effects analysis requires application of sophisticated geospatial technologies, regular synthesis of environmental data and information, ecological forecasting, and multidimensional evaluations of planned human developments. Thus, there is need for more coordination and comprehensive planning among the various stakeholders in the Arctic, including those with responsibility for resources, those that conduct research, and those that use resources. In order to conduct cumulative impact analysis, a thorough synthesis of the existing Arctic literature that builds on the initial work in this report needs to be conducted to develop a body of knowledge about cumulative impacts, a theme that resonates throughout this report. It is critical that this cumulative impact information synthesis and evaluation include local traditional knowledge. The indigenous, subsistence community is extremely knowledgeable about the environment, ecosystem, and changing conditions of the Arctic. Local traditional knowledge is a critical resource and should be incorporated into all of the above syntheses and databases described throughout this report.

Equally important is the critical need to develop a methodology for comprehensive, quantitative cumulative impact analysis that is transparent, externally vetted, and adopted consistently. An evaluation of the current approaches should be conducted, including marine spatial planning, to determine best practices and develop a common language and a shared set of metrics. An approach must be developed to incorporate or predict reasonable future development and the monitoring of impacts as development progresses.

The subsistence community and culture are an essential component of the Arctic and all of the issues studied in this report will have an impact on these people and their way of life. To predict with any degree of accuracy the future of Arctic subsistence, with or without energy exploration and development, will require a greater understanding of the potential changes in local environments and ecologies because subsistence patterns closely correlate to these factors. Thus, subsistence patterns are vulnerable to the effects of climate change and anthropogenic development (whether it be oil and gas development, shipping, tourism, or another). Additional information is needed to determine the potential hazard to native subsistence livelihoods from oil and gas exploration and development, since such development can impact all parts of the spectrum from the specific subsistence animals themselves through their food chain and ecosystem.

In discussions with individuals and groups in the course of our assignment, and to some degree in the literature, it became clear that evaluating the science and filling identified science gaps will not be enough to address the issues surrounding energy development in the Arctic. Opinions on development run the gamut from "there is already enough science" to "there will never be enough science." There are areas of significant scientific research that form a sound basis upon which to make decisions; there are areas where additional science is needed; but there also is an area in which more than science is needed. For that reason, we offer the appendix on Structured Decision Making (SDM), as an example of a type of tool that might be used to help inform decisions about energy development in the Arctic. SDM is a tool to help decision makers when a great deal of complex information and substantial uncertainty exists about the potential effects of development on the many resources of management interest. SDM consists of deconstructing decisions into their component parts, analyzing each part, and synthesizing the parts into a decision framework that can produce direct recommendations to decision makers about which decision is most likely to lead to attainment of their management objectives. This process helps the decision maker develop the fullest possible understanding of the complexities of the decision, including decision objectives, tradeoffs, uncertainties, and risks.

As stated in Chapter 1, Framing the Assignment and Process, our discussions and analyses highlighted that science sufficiency and science gaps are not absolutes but exist in large part in the eye of the beholder. As dynamic concepts, they are tied to an individual's or organization's held beliefs and what weighs most heavily in the decision process when complexity and uncertainty come into play. Whether to develop oil and gas resources, where they might be developed, when they might be developed, and what science is needed to inform those decisions are complex questions because Arctic Outer Continental Shelf development, particularly in the Chukchi Sea, would be a new, frontier activity with limited information and previous experience to guide the decisions being made. Positions about how to deal with any complex issue are informed by a mix of held and technically derived beliefs, and science influences those beliefs to different degrees. So, the questions become:

> How necessary does the vested party consider new information to its decision process? and
>
> How informative is the available science to be considered (uncertainty, applicability)?

Because of the complex nature and diversity that exist across human belief structures and the difficult-to-study and changing nature of Arctic ecological systems, development of full agreement about science sufficiency is a challenge.

Thus, while there is a growing base of scientific and technical information for the Arctic, which is synopsized in this report, as are critical science gaps to be addressed, many of the challenges emerging in Arctic oil and gas development decision making are beyond the ability of science alone to resolve. There is no "silver bullet." However, we believe a few strategic actions can better support decision making and make for a more transparent process for all vested parties to express, understand, and perhaps balance their respective views on tradeoffs associated with "inaction until more information is in hand" versus "action not sufficiently informed."

In conclusion, the use of SDM approaches brings vested and interested stakeholders into the decision process in a transparent and documented way. The process allows for learning and adaptation, which are critical concepts in a changing frontier environment like the Arctic and we encourage its use. Second, oil and gas development decision making occurs within the broader context of Arctic issues. A collaborative and comprehensive Arctic science planning process would bring great value to the decisions required to proceed with development of oil and gas and other strategic assets in the Arctic in a changing climate environment. Such a science plan and its implementation must be informed by an SDM-like process and the syntheses of information we discussed earlier. Third, the Arctic science and resource community, and particularly the Alaska community, is a model of collaboration. We found throughout our consultations an open and energized desire to understand different views on development and to find means to move forward. Thus, the development of integrated monitoring efforts and collaborative science efforts across governmental, industry, and nongovernmental entities can be accomplished. However, we believe focused attention is required to envision and implement such a fully collaborative environment. Finally, our study found many excellent examples of thoughtful analyses of science and technology needs to inform oil and gas development decisions in the Arctic. Our recommendations and findings add to those already in the literature. To move forward, we strongly recommend that a collaborative implementation process that includes appropriate measures of accountability for all responsible parties/entities be put in place. In our many discussions, we heard from managers, responders, scientists, and community members that they are willing to engage in discussing information needs but that they have a growing expectation that those needs will be considered and, if appropriate, addressed in a visible and traceable manner.

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Appendix A. Expert Consultations

Table A–1. Input received during the five facilitated expert consultations and the North Slope Public Session.

[Participants were asked to identify issues/gaps under each of the four Issue Topics (Climate Change, Oil-Spill Response, Marine Mammals and Noise, and Cumulative Impacts) requiring scientific knowledge that will affect their ability to accomplish their jobs. Sessions often did not cover all four Issue Topics as noted by dark blue. EIS, Environmental impact statement; LTK, local traditional knowledge; NSB, North Slope Borough; OCS, Arctic Outer Continental Shelf]

Issue topics and detailed input	Industry session	North Slope session	Federal session	Non-regulatory session	State session	North Slope public session
Climate change						
Hardware for data collection, especially in shoulder seasons	X					
Lack of climate data	X					
Ability to down scale models to regional development	X			X		
Lack of data collection network/coordination of research (data sharing…)	X					
Issues created by multiple agencies' climate agendas	X					
Unknown biological response to climate change and adaptability			X	X		
Adequacy of physical models for climate change				X		
Baseline data for biological systems (spatial and temporal)				X		
Use of existing technology/resources to understand climate change in the Arctic				X		
Predictability of refugia in time and space				X		
Relationship between water chemistry and environmental changes due to climate change				X		
Human response to climate change (for example, ship traffic, noise, hunting patterns, fishing, subsistence)				X		X
Relationship between subsistence use/Native culture and changing environmental conditions				X		X
Construction must be sufficient to cover any range of conditions including climate change						X
What happens to platforms at the end of their productive life?						X
Oil-spill response						
Inability to conduct field tests	X					X
Secondary data are perceived as not applicable	X					
Inability to access gray literature (in electronic forms)	X					
Detection and tracking				X		
Mechanical response				X		
Risk assessment				X		
Ice management				X		
Non-mechanical response options—Dispersants				X	X	X
Ecosystems and human response to spill				X		
Impacts of spill response on ecosystems and human systems				X		
Capacity assessment				X		
Fate and effect of spill				X		X

Table A–1. Input received during the five facilitated expert consultations and the North Slope Public Session.—Continued

Issue topics and detailed input	Industry session	North Slope session	Federal session	Non-regulatory session	State session	North Slope public session
Oil-spill response—Continued						
Baseline for damage assessments				X		
Sensitivity mapping and response planning				X		
Planned response options				X		
Protocols and standards (damage assessment, restoration)				X		
Information availability				X		
Well safety/control					X	
Systems for humans monitoring wells and identifying issues, ability to reduce human error					X	
Regulations to prevent accidents					X	
Public perception on response capability					X	
Contaminant load in environment—baseline					X	
Ability to test response equipment and methods					X	
Decision making and critical time needs during response					X	
Length of time oil persists in the Arctic environment					X	
Oil spill response gap analysis						X
A combination Coast Guard Oil Spill Response Team						X
Toxicity of dispersant on Arctic ocean organisms						X
Timing of drilling of relief well(s) in case of blowouts						X
Closeness/locations of oil spill cleanup team and equipment						X
Drilling only during favorable times of the year, to mitigate the chance of a catastrophic event						X
Marine mammals and noise						
There is no standard for measuring underwater sounds (science)	X		X		X	
Acoustic propagation is not well understood	X	X				
Lack of understanding of what sound levels cause impacts (behavioral changes, fallout from behavior changes, and other considerations)	X					X
Context of received noise levels for marine mammals, feeding versus migrating, habitual versus naïve	X	X				
Mitigation/quieting technology	X					
Development of remote sensing technology	X					
Effects of anthropogenic sound on bowhead whales from multiple sources/projects	X	X	X			X
Baseline data for species other than bowhead whale, especially related to climate change and seismic noise	X	X			X	X
Knowledge of spatial/temporal distribution, use of satellite tagging/aerial surveys/acoustic surveys	X	X		X		
Baseline data for the current state of the Chukchi Sea and ability to track changes and new species		X	X			

Table A–1. Input received during the five facilitated expert consultations and the North Slope Public Session.—Continued

Issue topics and detailed input	Industry session	North Slope session	Federal session	Non-regulatory session	State session	North Slope public session
Marine mammals and noise—Continued						
Ability to translate impacts on individual bowhead whales to larger bowhead populations		X				
Ability for LTK to document changes in the area as well as identify new species		X				
Information sharing among groups to reduce the risk of redundancy (seismic)		X	X			
Baseline information on natural sound levels and anthropogenic sound levels	X	X				
Information on the ability of marine mammals to communicate function with increased anthropogenic noise (ship traffic from multiple sources) and animal health		X	X			
Information about climate change and ice		X				
Information on ship strikes/ship interactions/entanglements		X	X			
Amount of seismic information being collected		X				
Need for alternatives to seismic surveys		X				
Process for assessing the effects of multiple activities (for example, seismic) on marine mammals, information available for decision making	X	X				
Information on duration of deflection, on individual as well as populations, when/if marine mammals return after deflection		X				
Ability to access information about where and when proprietary seismic activities take place to access the impacts on bowhead whales, both on individuals and populations		X				
Information on the physiological effects of noise	X	X				
Baseline information about how animals use habitats			X	X		
Impacts on marine mammals by spills/leaks			X			
Population dynamics of species (birth, growth, death) and sensitivities to disturbances at these life stages, behavioral changes			X	X		
Behavioral changes of animals and impacts these changes have on humans who depend on them			X			
Data that reflect trends and variability in species baseline			X			
Ability to identify differences between adaptation from climate change and seismic activity			X			
Information on state-of-the-art seismic activity for on-ice and in-water use (what it is and how it is used)			X			
Data on functional relationship between seismic technology use and marine mammals			X			
Data on the thresholds for seismic impacts to marine mammals			X			
Cascading effects of impacts to marine mammals resulting from impacts to other species			X			

Table A–1. Input received during the five facilitated expert consultations and the North Slope Public Session.—Continued

Issue topics and detailed input	Industry session	North Slope session	Federal session	Non-regulatory session	State session	North Slope public session
Marine mammals and noise—Continued						
Efficacy of monitoring and mitigation efforts of seismic activities (180/190 Criteria)	X		X		X	
Sensitivity to noise and variation in time and space				X		
Cumulative impacts, acute and chronic, time and space				X		
Chronic effect at drilling structure				X		
Unique behavioral patterns in the Arctic				X		
Synthesis of existing science				X		
Unique acoustics in Arctic				X		
Cumulative impacts to behavior from industrial activities (not just noise)				X		
Ambient noise mapping				X		
Avoidance capabilities of wildlife				X		
Habituation potential				X		
Predictive models for wildlife impacts and climate change impacts to species				X	X	
Baseline environmental contaminant level for marine mammals					X	
Creation of a marine mammal co-association to help monitor and study the cumulative impacts on the marine mammals						X
Ability to detect marine mammals during the seismic activity						X
Plankton and noise						X
Ocean bathymetry/seafloor relief data for both Chukchi and Beaufort Seas from coast line to 200 mile area for NSB						X
Cumulative impacts						
Lack of updated guidelines on how cumulative impact activities for EISs are written and used (sufficiency and applicability)	X	X		X		
Outcomes of cumulative impact assessments are not functional for intended purposes	X	X			X	
Lack of clear indicators and standards for cumulative impact analysis, inconsistencies between agencies, how science is incorporated	X	X			X	
Coordinated effort among industry to reduce impacts (for example, sharing seismic equipment/data)	X				X	
Efforts to integrate current cumulative impacts data into industry planning	X					
Cumulative impacts of exploratory drilling on food availability, breeding, behavior, predator/prey relationships, and contaminant levels		X	X			X
Functional relationship between existing/historical data management decision-making needs		X				

Table A–1. Input received during the five facilitated expert consultations and the North Slope Public Session.—Continued

Issue topics and detailed input	Industry session	North Slope session	Federal session	Non-regulatory session	State session	North Slope public session
Cumulative impacts—Continued						
Access to information on activities in Russia and Canada that effect cumulative impacts on animals exposed at multiple locations along migratory routes or over multiple years		X				
Ability to link onshore and offshore activities in cumulative impacts assessment		X				
Connection between cumulative impacts on species and on human subsistence/traditional (cultural) uses and social structure		X			X	
Information on drilling muds, discharges and what effects it might have on subsistence food sources		X				
Meaningful analysis of impacts to human health		X				
Attribution of impacts and thresholds (impacts for oil production versus other sources) (thresholds for unacceptable impacts to species)			X			
Data on functional relationships between risk factors			X			
Lack of data to run integrated multi-variant models of cumulative impacts			X			
Cumulative effects: linking spatial and species Bayesian models			X			
Waste management				X		
Amount of scientific information on cumulative impacts			X	X		
Consideration of the time and space scales that cumulative impacts are assessed				X		
Relationship between technology and cumulative impacts				X		
Risk assessment/technology changes of various development scenarios				X		
Terrestrial/marine interaction				X		
Uncertainty in development levels and potential development, unlikely scenarios included in decision making				X	X	
Unknown mitigation efforts to respond to cumulative impacts					X	
Inability to identify independent and cumulative impacts				X	X	
Public perception of cumulative impacts					X	
Not equally weighing positive and negative outcomes					X	
Cumulative impacts of on-land infrastructure for OCS exploration, damage to the tundra, and abandonment of infrastructure with end of exploration						X
Sea currents and winds will carry the spilled oil all over the Arctic, chain reaction destruction of the food chain						X
Increased shipping in OCS resulting in black carbon/soot emissions-cumulative impacts ocean acidification, chemical sink						X
Permitting is issued on individual bases and does not account enough for multiple activities						X
Disposals of all leases–total of all permits issued						X

Table A–1. Input received during the five facilitated expert consultations and the North Slope Public Session.—Continued

Issue topics and detailed input	Industry session	North Slope session	Federal session	Non-regulatory session	State session	North Slope public session
Other concerns						
Social impacts with new development; income, population, lifestyle, way of life, lack of privacy					X	X
Effectiveness of mitigation acts					X	
Efficiency of mitigation acts					X	
Utilize traditional knowledge, western science alone is a fraction of knowledge of what the Iñupiat know						X
Are studies being conducted to look at the socioeconomic effects on the people of the NSB?						X
Publicize all findings from ALL study groups						X

Table A–2. Information-Consideration Grid to organize science and issue needs used in the U.S. Geological Survey Arctic Outer Continental Shelf (OCS) Team's facilitated expert consultation sessions.

[This information was used to consider science sufficiency as illustrated in figure A–1]

How important is issue XX in your decision making associated with oil and gas leasing, development, and policy topics?				
Not a consideration	**Minimally important**	**Moderately important**	**Important**	**Critically important**
	Some consideration, but as an ancillary topic, not enough to result in accommodation in project design or policy topic	One of several main issues considered in project design or policy topic	One of a few issues that are considered in decision outcomes	Foundational to determining decision outcomes
0	1	2	3	4

Please assess the body of scientific information status for issue XX				
None	**Minimal body**	**Moderate body**	**Good body**	**Robust**
No information available at all	Information with high uncertainty or very limited in scope, scale, or applicability to Arctic OCS	Body of information expanding but with notable insufficiencies, functional in most cases	Good body of information across most aspects of issue with limited uncertainty, data gaps may exist for minor elements	Robust information directly applicable to Arctic OCS decision making
0	1	2	3	4

Table A–3. Example of science questions and assessment of sufficiency for one of the expert consultation sessions, the non-regulatory session.

[Information-Consideration Grid scores (see table A–2) for four respondents are provided; however, for some issues, not every respondent provided a score. General judgment of sufficiency is based on the definitions provided in table A–2 and placement of the score within the Grid Graphic (see figure A–1). Scores that fell generally within red and orange zones of the graphic were placed as a gap. Often individuals differed either in the value of the topic to their decision making or to their opinion about status of the body of scientific information on the topic. These are listed as "variable" responses in Sufficiency column]

Issue/gap	Information-Consideration Grid Score Importance, Information Status	Sufficiency
Climate change		
Unknown biological response to climate change (models), adaptability	2,2; 3,1; 4,1; 3,1	Gap
Adequacy of physical models for climate change	1,2; 3,2; 4,1; 3,3	Variable
Baseline data for biological systems (spatial and temporal)	3,2; 4,2; 4,1	Gap
The ability to link larger models to near shore processes/response (down scale)	0,1; 2,2; 3,1; 2,1	Variable
Use of existing technology/resources to understand climate change in the Arctic	2,3; 2,1; 2,2	Variable
Predictability of refugia in time and space	1,1; 4,1; 4,0; 2,1	Gap
Relationship between water chemistry and environmental change due to climate change	0,1; 2,2; 1,2; 1,1	Reassess
Human use response to climate change (for example, ship traffic, noise, hunting patterns, fishing, subsistence)	0,1; 3,2; 4,1; 4,2	Gap
Relationship between subsistence use and changing environmental conditions	1,2; 2,2; 4,1; 2,2	Variable
Relationship between human cultural changes and changing environmental conditions	0,1; 2,2; 2,1; 1,2	Reassess
Oil-spill response		
Detection and tracking	4,2; 4,1; 4,0; 4,1	Gap
Mechanical response	4,2; 4,2; 4,1; 4,2	Gap
Risk assessment	2,1; 4,2; 4,1; 4,2	Gap
Ice management (includes subcategories)	4,2; 4,1; 4,1	Gap
Non-mechanical response options	3,2; 3,1; 4,2	Gap
Ecosystems and human response to spill	4,2; 4,1; 4,1; 3,2	Gap
Impacts of spill response on ecosystems and human systems	4,1; 3,1; 2,1; 3,2	Gap
Capacity assessment	3,1; 4,3; 4,2; 4,2	Variable
Trajectory assessment/models	3,1; 4,0; 3,2	Gap
Fate and effects of spill	4,2; 4,1; 4,1; 3,1	Gap
Baseline for damage assessments	3,3; 3,1; 4,1; 4,1	Gap
Pre-identification of sensitive areas	2,3; 4,1; 4,1; 3,1	Gap
Sensitivity mapping and response planning	3,3; 4,1; 4,1; 3,1	Gap
Planned response options	3,3; 3,2; 2,2	Good
Protocols and standards (damage assessment, restoration)	3,2; 2,1; 3,1	Gap
Information availability	4,2; 3,1; 4,1	Gap

Table A–3. Example of science questions and assessment of sufficiency for one of the expert consultation sessions, the non-regulatory session.—Continued

Issue/gap	Information-Consideration Grid Score Importance, Information Status	Sufficiency
Marine mammals and noise		
Location/tracking (habitat use)	4,1; 4,1; 3,3	Variable
Sensitivity to noise and variation in time and space	4,2 ; 3,2	Gap
Cumulative impacts, acute and chronic, time and space	4,0; 4,2, 4,0; 4,1	Gap
Chronic effect at drilling structure	3,1; 4,1; 2,2	Gap
Unique behavioral patterns in the Arctic	3,2; 2,1; 2,2	Gap
Modeling wildlife impacts	3,1; 4,1; 2,1	Gap
Synthesis of existing science	4,1; 4,1; 4,2	Gap
Unique acoustics in Arctic	2,1; 1,1	Reassess
Relationship between changes in behavior and changes in sensitivity	3,1; 1,1	Variable
Cumulative impacts to behavior from industrial activities (not just noise)	3,1; 4,1; 3,1	Gap
Ambient noise mapping	2,0; 2,1	Gap
Avoidance capabilities of wildlife	3,1; 2,1; 2,1	Gap
Habituation potential	2,1; 2,1	Gap
Cumulative impacts		
Waste management	2,3; 2,1; 2,2	Variable
Amount of scientific information on cumulative impacts	4,1; 4,0; 4,1	Gap
Methods to conduct cumulative impacts assessments (sufficiency and applicability)	3,2; 4,1; 4,1	Gap
Knowledge of individual impacts	3,2; 3,1; 2,1; 3,2	Gap
Consideration of the time and space scales that cumulative impacts are assessed	3,1; 4,1; 4,2	Gap
Relationship between technology and cumulative impacts	1,1; 2,1; 3,2	Variable
Risk assessment/technology changes of various development scenarios	1,1; 4,1; 3,0; 2,1	Variable
Infrastructure development scenarios related to oil/gas development	1,1; 3,1; 4,0; 4,1	Variable
Terrestrial/marine interaction	2,2; 3,1; 4,1; 1,2	Gap
Uncertainty in resource condition	3,1; 2,1; 2,1	Gap
Uncertainty in development levels and potential development	3,1; 4,0; 3,1	Gap

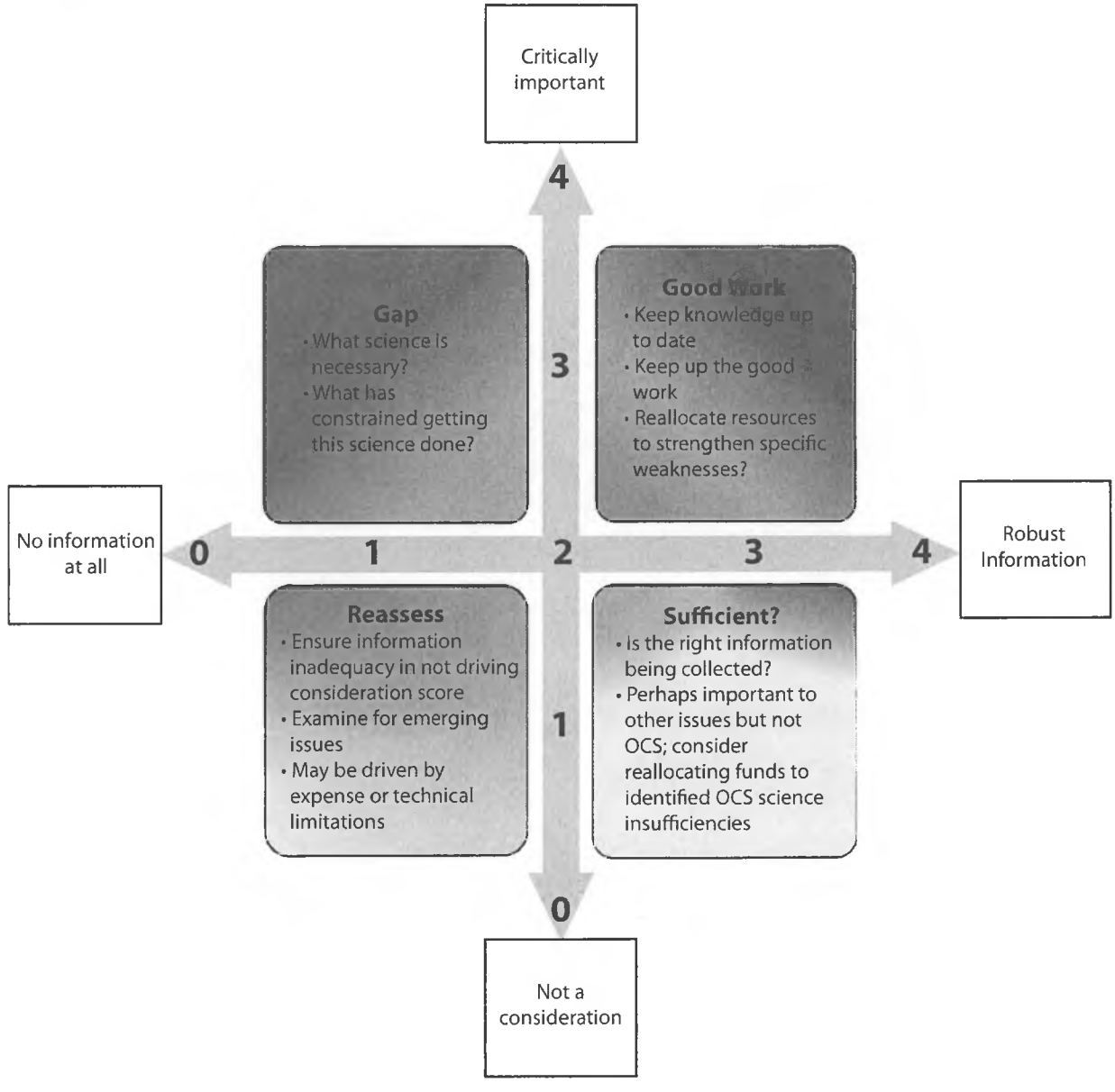

Figure A–1. Grid tool used in the first series of structured consultations sessions. *Y*-axis represents the importance of an issue to an individual's decision making associated with oil and gas development. *X*-axis represents the participant's view of the status of the body of scientific information for that issue. When scores (see table A–3) generally fell within a red or orange portion of the grid, the topic was considered a gap.

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Appendix B. Science Workshop

As part of our series of expert consultations the USGS Outer Continental Shelf (OCS) Team participated in the January 2011 Alaska Marine Science Symposium in Anchorage, Alaska, to gain focused input from the science community on key topics that had arisen during our assignment. The USGS OCS Team participated in the Symposium's Poster Session to interact with participants and held a 3 hour facilitated technical workshop to obtain scientific input on areas of critical and fruitful investigation or approaches informative to the science gap analysis. The discussions were centered on four overarching scientific questions on topics that were consistently mentioned during our other expert consultations or in our literature assessments and that cross-cut the issues that are the focus of our science gap analysis (fig. 1–4). These topics were:

- What weather and oceanographic data are immediately needed to improve spill risk assessments, response planning, and spill response; what approaches are recommended to obtain such data?
- What supplements to agency monitoring and approaches to integrated ecological monitoring are needed for improved development impact assessment, including spill assessment (Natural Resource Damage Assessment, recovery, and restoration) efforts.
- Given gaps in spatial and temporal understanding of resources, how (methods, approaches) can the extensive industry site-specific monitoring be coupled with synoptic governmental efforts to improve broader scale understanding.
- What are the important differences in the physical and ecological conditions of the Beaufort and Chukchi Seas that need to be clearly understood to address the Secretary's commitment to OCS exploration in the "right place/right time."

The participants were provided background on the USGS OCS Team's assignment, context for each of the questions, and several discussion starter questions. They then were asked to self-select one of the four break-out groups to participate in. After 45 minutes of facilitated discussion, groups were disbanded and participants self-selected another break-out group to participate in. In this second series of discussions, participants started with the materials developed by the first group and continued discussion. At the end of these discussions, each break-out group reported out to the full workshop. Input from those break-out groups is summarized in appendix tables B–1 and B–2.

The following includes the materials that were provided to Symposium participants at the poster session in preparation for the January 21, 2011 USGS-sponsored 3-hour workshop.

Break-Out Topic One: What weather and oceanographic data are needed immediately to improve spill risk assessments, response planning, and spill response; what approaches are recommended to obtain such data?

Framing the Topic: Information, assumptions, and predictions of weather, ice, currents, and other physical oceanographic data occur throughout pre-decisional documents and implementation plans for oil and gas development. Such information and its uncertainty influence infrastructure design and placement decisions; spill risk probability determination; modeled spill trajectories and predicted ecological outcomes; and spill contingency planning, response gap estimates, and real-time spill response. The importance of these data to sound decision making is acknowledged and reflected in ongoing study efforts. For example, a recent Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)-sponsored product by Weingartner and others (2010a) provides recommendations on physical oceanography studies for the Beaufort Sea. New technologies also are being assessed in BOEMRE- and industry-funded efforts as in Potter and Weingartner (2009) or Weingartner and others (2010b) who examine the use of a high-frequency radar system to map surface currents for improved spill trajectory models and spill response planning and how viable such systems are in partially ice-covered waters. However, what the potential fate and effect of oil might be from an accidental spill, the level of risk to be tolerated, and the sufficiency of science informing these topics remain points of discussion and disagreement among vested parties.

In this break-out group, we would like to know what is going well and needs to continue, what is a good start and needs enhancement, what has not been addressed and should be and WHY. In the latter two cases, we would appreciate your understanding of how proposed increases in existing efforts or new data would inform the decision process.

Discussion Starter Questions:

1. Are there proven technologies and sampling regimes that should be expanded temporally or spatially, or initiated? If so, how might that happen?
2. Logistics in the Arctic are challenging. Are there alternate technologies that should be investigated or whose use can be enhanced to obtain sufficient metocean data to support effective spill assessment, planning, and response?
3. The Arctic is not a static system, but is undergoing climate-driven change. What data collections and approaches should be considered to improve our ability to understand and forecast key weather and oceanography information to improve risk analyses over the multi-decade horizon of leasing decisions?
4. Are there different data needs or approaches that should be considered for the Chukchi Sea versus Beaufort Sea and vice versa?
5. What are some "low hanging fruit" opportunities, if any, that could be considered immediately?

References Documents: (intended only as examples of a few study efforts)

Potter, R., and Weingartner, T., 2009, Surface circulation radar mapping in Alaskan coastal waters: Beaufort Sea and Cook Inlet: Final Report OCS Study MMS (BOEMRE) 2009-049.

Weingartner, T., Pickart, R., and Johnson, M., 2010a, Recommended physical oceanography studies in the Alaskan Beaufort Sea: Final Report OCS Study MMS (BOEMRE) 2010-018.

Weingartner, T., Winsor, P., Potter, R., and Statscewich, H., 2010b, Chukchi Sea surface currents: accessed March 31, 2011, at http://www.ims.uaf.edu/hfradar/.

Break-Out Topic Two: What supplements to agency monitoring and approaches to integrated ecological monitoring are needed for improved development impact assessment, including spill assessment (NRDA, recovery) efforts?

Framing the Topic: : Information and assumptions about the status and trends of ecosystem components occur throughout pre-decisional documents and implementation plans for oil and gas development. Such information and its uncertainty influence estimation of potential ecological impacts in Oil Spill Risk Assessment Models by providing likely resource intersections based on spill trajectory models. Spill contingency planning incorporates best understanding of ecologically sensitive areas to be protected during response. Status and trends in distribution, demographics, physiological condition, and the like provide the foundation for assessing damage under the National Resource Damage Assessment (NRDA) process and later inform restoration strategies, recovery goals, and progress towards those goals. In addition, experience from the 1989 *Exxon Valdez* Oil Spill restoration effort demonstrates the need for understanding of individual species to be coupled with a more holistic ecosystem framework in which to assess and judge recovery. Cumulative effects analyses also examine species and community perspectives. There is significant investment to develop improved species and system's knowledge. Various Federal and State agencies have ongoing mission-specific population-level sampling. The BOEMRE's Environmental Studies Program also funds key work across a wide spectrum of ecological components informative to the OCS planning process. Examples range from traditional knowledge as reported in Quakenbush and Huntington (2009) and satellite telemetry (Alaska Department of Fish and Game, 2010) collected to provide a broader understanding of single species such as bowhead whale, to studies of species groups such as shorebirds (Powell and others, 2009) to integrated biomonitoring/bioaccumulation sampling for nearshore areas (Neff, 2010). However, what the potential ecological consequences might be from oil and gas infrastructure or an accidental spill, the level of risk to be tolerated, and the sufficiency of science to inform these topics remain points of discussion and disagreement among vested parties.

In this break-out group, we would like to know what is going well and needs to continue, what is a good start and needs enhancement, what has not been addressed and should be and WHY. In the latter two cases, we would appreciate your understanding of how proposed increases or new data would inform the regulatory decision process.

Discussion Starter Questions:

1. Are there proven technologies and sampling regimes that should be expanded temporally or spatially, or initiated? If so, how might that happen?
2. Many different monitoring, population, and ecosystem studies and sampling efforts are ongoing within the BOEMRE, other Federal and State agencies, and academic and non-governmental organization communities within the Arctic OCS, both specifically to inform oil and gas development decisions and with other goals, informative to OCS decision making. Are there science frameworks or modeling approaches that might be fruitful to bring knowledge from such sources together in a transparent way to better inform annual study priority setting and determination of progress towards filling data gaps?
3. Logistics in the Arctic are challenging. It may not be feasible to sample all populations and communities of interest at the desired intensity to reduce uncertainty. Are there alternate metrics that could be added to existing population survey efforts as surrogates for population status?
4. The Arctic is not a static system, but undergoing climate-driven change. What data collections and approaches should be considered to improve our ability to understand and forecast key population and ecological functions to improve cumulative effects and risk analyses over the multi-decade horizon of leasing decision?
5. Are there different data needs or approaches that should be considered for the Chukchi Sea versus Beaufort Sea and vice versa?
6. What are some "low hanging fruit" opportunities, if any, that could be considered immediately?

References Documents: (intended only as examples of a few study efforts)

Alaska Department of Fish and Game, 2010, Satellite tracking of Western Arctic Bowhead Whales: Alaska Department of Fish and Game (ADFG) Final OCS Study BOEMRE (MMS) 2010-033.

Neff, J., 2010, Continuation of the Arctic nearshore impact monitoring in the development area (cANIMIDA) - Synthesis, 1999–2007: Final Report OCS Study BOEMRE 2010-032.

Powell, A., Taylor, A., and Lanctot, R., 2009, Pre-migratory ecology and physiology of shorebirds staging on Alaska's North Slope: OCS Study MMS (BOEMRE) 2009-034.

Quakenbush, L., and Huntington, H., 2009, Traditional knowledge regarding Bowhead Whales in the Chukchi Sea near Wainwright, Alaska: Final Report OCS Study MMS (BOEMRE) 2009-063.

Break-Out Topic Three: Given gaps in spatial and temporal understanding of resources, how (methods, approaches) can extensive industry site-specific monitoring be coupled with synoptic governmental efforts to improve broader scale understanding?

Framing the Topic: There are inherent uncertainties in estimates of undiscovered oil and gas resources and in economic conditions that define when and where development may occur as a result of a leasing program. From 5-year Lease Sale Plans through specific sale EIS documents, estimates of environmental effects must rely on assumed exploration and development scenarios. The question often asked is—how is what we know, at the scale we know it, applicable to environmental assessments. How much confidence should we have in that understanding.

In this break-out group, we would like to discuss your thoughts on mechanisms that could be considered to gain greater knowledge and improve scales of inference through strategic linkages of project or scale-specific studies or process studies by industry, academia and others with larger scale synoptic efforts.

Discussion Starter Questions:

1. What are the types of site-specific studies underway today? Process studies? Broader scale synoptic efforts?
2. Are there mechanisms in place to facilitate linkages among different scaled studies? If not, what would you like to see?
3. Could modeling and process study design approaches, such as those in the North Pacific Research Board-National Science Foundation Bering Sea Integrated Ecosystem Research Project, be fruitful to Arctic OCS decisions? Are there other such ecosystem-based "tactical" efforts that could be examined?
4. What are some "low hanging fruit" opportunities, if any, that could be considered immediately?

Break-Out Topic Four: What are the important differences in the physical and ecological conditions of the Beaufort and Chukchi Seas that need to be clearly understood to address the Secretary's commitment to OCS exploration in the "right place/right time."

Discussion Starter Questions:

1. Consider the other Break-out Topics (1) metocean data, (2) monitoring information, and (3) addressing scales of inference. Is there a difference in sufficiency or importance of specific science between the Beaufort and Chukchi Seas that need to be highlighted?
2. Are there particular ecological areas that need focus?
3. Are there unique socioeconomic considerations between the planning areas for which different science attention is warranted?

Table B–1. Listing of science concerns expressed by participants at the technical workshop held at the Alaska Marine Science Symposium on January 21, 2011, in Anchorage, Alaska.

Science concerns	Topic 1: Meteorological-ocean data needs	Topic 2: Monitoring efforts	Topic 3: Scaling issues
Climate down scaling has to be used to develop ranges of parameters not to expect precise results	X		
Distributed Biological Observatory (DBO)	X	X	X
DBO done on an ongoing basis where drilling may take place	X		
Make physical oceanographic models accessible to researchers, public, and oil-spill response. Combine on single interface (Alaska Ocean Observing System site?)	X		
Comprehensive ecological monitoring of subsurface phytoplankton, benthic ecology, substrate, diversity, production, ice seal stock, beluga stock, prey structure, cod, euphausiids, copepods, and identify biology	X	X	
Trace material flow through the ocean, including river melt water and sediment transport	X		
Monitoring for real-time met-ocean data and water-level observations	X		
Make sure ocean circulation data keep up with depth of oil exploration	X		
Ice thickness, scale of measurements needed, scale of time observations, ice gouging, met-forcing affects on ice-floe movement	X		
Understanding of the variations of the ocean from lease block to lease block	X		
Develop an incentive for public data (build and update database), publish raw data as it is collected, up-to-date data in GIS	X	X	
Make sure ocean/atmosphere models account for extreme events	X		
Coast Guard and oversight of spill cleanup	X		
Improve efficiency and collaboration between industry, academia, and government agencies including disciplines not used to collaborating	X	X	
Establish on-going consistent monitoring strategies done in a broad integrated manner that provides ability to quantitatively measure/predict impacts	X	X	X
Interactive online research assets map showing where instruments in field season exists, need to show this same information historically	X		
Determine when equipment cannot be deployed due to wind, waves, fog, cold, darkness	X		
Ranking of environmentally sensitive areas especially nearshore and shoreline, changes to priority protection sites based on projects	X	X	
Trajectory modeling particularly in ice conditions	X		
Physical oceanography effects on infrastructure seasonally and during storm events	X		
High resolution circulation patterns around sensitive areas, subsurface current information, seasonal variability of currents	X		
Greater focus on effects of potential submarine pipelines and onshore support facilities		X	
Fish species lists are slowly being developed, but population, total numbers, distribution, genetics, movement, and ice association are missing		X	
Effects of natural gas/methane on subsurface species		X	
Effects of gas blowout at depth		X	

Table B–1. Listing of science concerns expressed by participants at the technical workshop held at the Alaska Marine Science Symposium on January 21, 2011, in Anchorage, Alaska.—Continued

Science concerns	Topic 1: Meteorological-ocean data needs	Topic 2: Monitoring efforts	Topic 3: Scaling issues
Characterization of biological aspects of Barrow Canyon and other unique features that may be considered exempt from lease sales or need data at a higher resolution	X	X	
What compartment is the Chukchi/Beaufort biomass in during various seasons, years?		X	
National Resource Damage Assessment (NRDA) Process: how does monitoring relate, integration of historical and contemporary data, develop training [Shoreline Cleanup Assessment Technology (SCAT)], subsistence considerations in Bering Sea	X	X	
Conduct experiments including test spill with dye tracer, spill recovery methods, oil in water and oil in ice	X	X	
Consult with Norway and United Kingdom for their risk assessment and safety case planning as well as research on oil/ice interactions	X	X	
Local residents may be interested in working on compromises that determine right time/right place		X	
Use of models and datasets not representative of Arctic conditions may lead to incorrect conclusions and decisions		X	
Increase coordination for planning, lease sales, mitigation measures, permitting, on-going monitoring, and rehabilitation including oil-spill response		X	
Food web cycles are lacking adequate description especially low in food web, annual variability, and potential to disrupt these systems		X	
Develop oil vulnerability index for species in Beaufort/Chukchi		X	
Give emphasis for site-specific studies to sites located in areas likely to be effected, that is, lease areas		X	
Concern for cultural and resource impacts from development, need socio-economic baseline		X	
Better framing in terms of temporal/spatial – percent chance of occurrence		X	
First assess relative abundance/importance then prioritize areas for more in-depth studies		X	
Pair oceanographic observations with biological		X	
Data need for restoration of Arctic Ocean systems and populations		X	
Regular surveying of local communities for changes they are seeing		X	
How will we know the baseline data are representative given the potential changes occurring already due to climate change		X	
Marine mammal range extensions and response to ecosystem variability		X	
Incorporation of Alaska Ocean Observing System data into biological studies, especially for food web/prey structure/energy flow		X	
Continued development of autonomous underwater vehicles (AUVs) and unmanned aircraft, augment acoustic recorders with sensors to capture biological activity and develop new technologies to increase monitoring capabilities	X	X	
How is oil breakdown effected by dispersants in ice and ice-free environments		X	

Table B–1. Listing of science concerns expressed by participants at the technical workshop held at the Alaska Marine Science Symposium on January 21, 2011, in Anchorage, Alaska.—Continued

Science concerns	Topic 1: Meteorological-ocean data needs	Topic 2: Monitoring efforts	Topic 3: Scaling issues
Effects of oil containments and dispersants to the ecosystem, what is the adaptation of organisms to the oil		X	
Long-term carbon assessment in water [for example, chromophoric dissolved organic matter (CDOM)] as baseline assessment, seawater chemistry, locate natural seeps	X	X	
Successful monitoring of Boulder Patch (Beaufort) year-round could be considered for other significant habitats – (Chukchi?)		X	
Community-based monitoring and assessment as a framework for determining current status and future trends, include local communities for on-the-ground response	X	X	
Pre-identify in-state resources with appropriate and current training, publish roster at least within planning, response, and government and industry		X	
Pre-identify mechanisms to distribute response-related research funding		X	
Address unique Arctic logistical issues regarding chain of custody, such as sample storage/handling issues		X	
Pre-identify the process by which monitoring and sampling would be temporarily expanded or initiated		X	
What processes control the marine system, use this to help determine what to measure and monitor		X	
Scale at which things vary on benthos is much shorter than in water column		X	
Consider health impact, assessment and linking (and social parameters) human health with the ecosystem		X	
Necessary to identify what regions of the Arctic are important habitat for particular species		X	
Need migration/movement not just population for risk analysis		X	
More studies needed in microbiology (bacteria), bioremediation		X	X
Consider shifting baselines during monitoring programs and comparison to baselines		X	
Distinguish between monitoring of potential impacts of 'regular' operations versus those from 'spill' scenarios and monitor species recovery after a hydrocarbon release		X	X
Standardized studies need to be done to calculate locally meaningful correction factors for things like marine mammal density estimates.		X	
Gaps are seasonal, lacking early season and over winter so monitoring should include seasonal components, for example, winter oceanographic monitoring for circulation		X	X
Synthesis and integration of existing information including observations, model data, fate and effects of spilled oil, dispersant use, ecological data and baseline data	X	X	X
Under Ice system monitoring (including seasonality) = huge productivity	X	X	
Ice-edge tracking (underway; relationship to ecosystem)		X	
Species adaptation capability/capacity		X	
Expand buoy array		X	X

Table B–1. Listing of science concerns expressed by participants at the technical workshop held at the Alaska Marine Science Symposium on January 21, 2011, in Anchorage, Alaska.—Continued

Science concerns	Topic 1: Meteorological-ocean data needs	Topic 2: Monitoring efforts	Topic 3: Scaling issues
Transparency, quantitative/qualitative		X	
Recognize different monitoring needs/platforms/suitability to meet needs of the questions posed, proactive monitoring design		X	
Need time-sensitive sites (transect) that are spatially placed to capture upstream and downstream work			X
Transport models that incorporate key physical and biological parameters			X
Nested site selection			X
What is the type/discipline of ecosystems data received to understand that ecosystem			X
Longer comparable data sets from existing spatially distributed sampling stations, replicate Outer Continental Shelf Environmental Assessment Program (OCSEAP) studies		X	X
Fisheries—epibenthos abundance and distribution, species composition, ecological process, habitat association			X
Opportunistic opportunities to collect data and explore/analyze existing			X
Broader scope oceanographic understanding is needed for better understanding of smaller scale			X
Tiering of information/studies is an important technique			X
Do more research about planning to respond to oil spills in ice-infested Arctic waters, burning oil in ice, identify areas for pre-positioned protection	X		X
Propagation of sound through oceans			X
Passive acoustic monitors for mining data from other sounds			X
Seismic data – through water column			X
Spatial and temporal variability of ecology			X
Ecological asset inventory			X
Indices for keystone species			X
Model verification – especially validation			X
Process (in addition to coordination) for defining "sufficiency" across spectrum of data/understanding, different for different levels of activity		X	X

Table B–2. Differences in Beaufort and Chukchi Seas as noted by participants at the technical session held at the Alaska Marine Science Symposium on January 21, 2011, in Anchorage, Alaska.

Chukchi Sea
Cumulative impacts – shipping
Less infrastructure in place
Wave height, cold (affects weathering and clean up), visibility, wind driven leads
More complex, topographically, Barrow Canyon
Shoal habitat (Hanna and Harold)
Bering Sea influence; nutrients and carbon
Shallow sea with oil resource far offshore in deep water
Sea bottom very productive, hot spots
More shelf and areas of interest for exploration are ice free longer
Most development areas beyond coastal subsistence use areas
Spring whaling, seal hunting on shear ice, walrus and seal hunting in pack ice
Development farther offshore, greater risk?
More historical and ongoing work
Primarily ship provided transport, shorter transit from south, no road access
Walrus haulouts changing due to changing ice, modeling of walrus distribution
Critical feeding areas for migrating birds
Point Lay, Point Hope – very traditional village lifestyles
Beaufort Sea
Cumulative impacts – oil and gas in Canadian Beaufort
Ice-driven leads, land-fast ice
Current OSC exploration, more infrastructure
Nutrients and carbon from upwelling and shore, more complex circulation
Beaufort gyre influenced, longer sea ice in summer, river influenced
Deep sea with oil resource in shallow water
Flat shelf, sea bottom mostly barren, ice gouging, active gouging zone
Dissolved organic carbon terrestrial carbon utilization
Perhaps more viable, trending towards less ice cover
Lots of overlap between subsistence and development
Fall whaling, cisco/white fish
Importance of cod, 96 percent of fish abundance and biomass, keystone species
Need synthesis of existing data (census of marine life)
Multi-modal, road access to Prudhoe Bay, cargo aircraft, access to small vessels, used to heavy equipment, longer ship transport times
Much more subsistence, but perhaps not as traditional lifestyles

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Appendix C. Structured Decision Making for Energy Exploration and Development Decisions on the Arctic Outer Continental Shelf

By Sarah J. Converse

Background

Decisions facing the Department of the Interior (DOI) on behalf of the Federal Government about whether and where to permit oil and gas exploration and development on the Arctic Outer Continental Shelf (OCS) are challenging. The challenge arises primarily as a function of four characteristics. First, there are complex and potentially competing objectives associated with a diverse stakeholder contingent (for example, energy development, marine mammal protection, oil-spill prevention). Second, there are a wide variety of different decision alternatives available to the decision maker, including many possible combinations of temporal and spatial structures in development permitting. Third, there is an unknown array of decisions required of other agencies resulting from each possible oil and gas development decision alternative that could be selected by the DOI. Fourth, as demonstrated by the analyses outlined in the chapters of this report, there exists a great deal of complex information as well as substantial uncertainty about the potential effects of development on the myriad resources of management interest.

Structured decision making (SDM; sensu Clemen, 1996; Possingham and others, 2001; Williams and others, 2007) is the application of decision science to assist decision makers in the process of making decisions, and is especially important and applicable in the case of decisions that are both important (that is, high stakes) and challenging. SDM rests on the idea that decisions can be made more effectively (that is, more likely to lead to attainment of management objectives) if a structured analysis is conducted. This analysis consists of deconstructing decisions into their component parts, analyzing each part, and synthesizing the parts into a decision framework that can produce direct recommendations to decision makers about which decision is most likely to lead to attainment of management objectives. More generally, engagement in a formal decision-analytic process helps the decision maker to develop the fullest possible understanding of the complexities of the decision, such as decision objectives, tradeoffs, uncertainties, and risks.

Structured decision making is not appropriate in all cases. The use of the process requires that a decision maker can be identified and that the management objectives (potentially multiple and competing) of that decision maker can be articulated. In addition, the set of decision alternatives under consideration must be known or knowable, and there must be an ability to make predictions about how different alternatives would impact the objectives of interest; such predictions can arise from data or from expert judgment and may (and often do) involve substantial uncertainty. Finally, and most generally, the process requires transparency in development of all decision components.

Value of Structured Decision Making

A formal decision-analytic process can help most specifically by producing a recommended course of action most likely to lead to attainment of management objectives. More generally, however, the process is useful for informing a decision maker about the complexities of the decision. For instance, the process is useful in helping the decision maker to develop a clear articulation of the management objectives, to contemplate tradeoffs, to be aware of uncertainty and integrate risk attitudes into the decision (that is, the degree of risk the decision maker is willing to accept in order to obtain some potential benefit), and to develop a sense of what information is available and what uncertainties are relevant. When used appropriately, formal decision processes are designed to lead to decisions that are (Runge and others, 2009):

- Transparent—SDM is designed to produce transparency in the decision-making process, to remove the "black box" aspects of decision making, such that decisions can be understood and communicated.
- Explicit and Able to be Documented—The transparency required by the SDM process results in decision processes that are explicit in their treatment of decision components, which results in decisions that can be effectively documented within an administrative record.
- Deliberative—SDM encourages careful deliberation about the various components of the decision-making process. This is expected to lead to better decision outcomes because deliberation encourages more thorough identification of management objectives and tradeoffs, a wider search for creative decision alternatives, more complete use of scientific information in developing predictions of decision outcomes, and more thorough articulation of important uncertainties and risks in the decision.

- Robust—SDM recognizes that uncertainty and risk influence decision making. As such, SDM is designed to produce decision processes that fully recognize the type and magnitude of uncertainty and risk; such decision processes are designed to produce recommendations that are robust to the uncertainty and risk that exist; that is, decision processes that are most likely to lead to attainment of management objectives.

Stakeholders and Structured Decision Making

Within the public policy realm, consideration of the values of stakeholders is of paramount importance in framing decisions. In the U.S. Department of the Interior Adaptive Management Technical Guide, engagement with stakeholders is identified as the first step of the adaptive management process, which itself is recognized as a structured decision-making process (Williams and others, 2007). Stakeholders have multiple roles in developing decision processes, and should be effectively engaged in the development of each component of the process. Perhaps most critically, the objectives of stakeholders must be understood and integrated. The decision maker, in public policy decisions, has ultimate responsibility for understanding and articulating stakeholder objectives, and for weighing tradeoffs between competing objectives of diverse stakeholder groups. As such, we assume herein that the values of stakeholders are included as they are understood by and embodied in the objectives and tradeoffs of the decision maker.

Components of Structured Decision Making

Structured decision making consists, most basically, of deconstructing decisions into their component parts, analyzing the individual components, and synthesizing the components into an integrated decision framework that is designed to lead to recommended courses of action. As such, decision analysts recognize that every decision involves a consistent set of components (for example, Hammond and others, 1999). These components are:

Decision Problem.—The decision problem is a clear statement of the decision that is to be made. It includes information on the factors prompting the decision, the identity of the decision maker, the particular decision to be made, the spatial and temporal scope of the decision, the timing of the decision, and whether the decision will be repeated through time or is a one-time decision.

Objectives.—The objectives are the things that the decision maker wants to achieve in the context of the particular decision. They are representations of values, policy, and stakeholder objectives guiding the decision maker. In decision analysis, it is often useful to differentiate between fundamental and means objectives. Fundamental objectives reflect ultimate statements of values—in essence, the most basic values of the decision maker. Means objectives, by contrast, are objectives the decision maker would like to achieve because they are themselves means to achieving the fundamental objective(s). For example, if a fundamental objective, in the context of the OCS energy exploration and development decision, is to maintain the tourism value of the Arctic system, a means objective may be to minimize the construction of energy development infrastructure in critical viewsheds.

Alternatives.—The decision alternatives are the comprehensive set of alternative management actions available to the decision maker. The alternatives will depend on the particular decision to be made, and may have many elements (for example, spatial and temporal components).

Model.—The system model and predictions component is the component most familiar to scientists. This component encompasses all information available about the implications of different decision alternatives on the management objectives. That is, science in a decision-making context serves to link our decision alternatives to our objectives, such that we can make predictions of the form, "if we take action 'a', the result in terms of a given management objective will be 'b'." More specifically, we often make such predictions in a probabilistic framework, because we have substantial uncertainty about the functioning of complex systems.

Optimization.—The tradeoffs analysis, or optimization, is the final step necessary in identifying an optimal decision, and involves searching among the proposed set of decision alternatives for the option that is most likely to lead to the attainment of management objectives. In many cases, this means weighing tradeoffs among competing objectives. In addition, some decisions involve an additional component.

Monitoring and Feedback.—Monitoring and feedback are applicable when decisions are repeated through time. In these cases, monitoring data can be used to assess whether management objectives are met, to measure the state of the system for informing state-dependent decisions (that is, where the decision that one takes depends on some aspect of on-the-ground conditions), and to reduce uncertainty about how the system responds to management (Lyons and others, 2008). These monitoring data can then be used to update predictions about system responses to management, thus facilitating improved decision making through time (Nichols and Williams, 2006).

Prototyping of a Decision Framework

With the input of the U.S. Geological Survey (USGS) OCS Team, the broad outline of a decision framework to inform the DOI Arctic OCS energy exploration and development decision was developed. This framework was developed as an example of a more fully articulated framework that could be developed with the input of the decision maker or delegates. That is, this decision framework is both incomplete and not assumed to represent the true aspects of the decision as understood by the decision maker; instead it is intended as an illustration. This simple prototype demonstrates the basic process of SDM and how it could be applied to synthesize and analyze science and policy information to inform Arctic OCS energy exploration and development decisions.

Decision Problem.—The national strategy for energy and economic security defines the intent by the Administration to open certain OCS areas to exploration, set aside those areas deemed inappropriate for development, and increase oil and gas exploration in some frontier areas. The Arctic OCS is identified as one of the most promising frontier areas for consideration because of its high potential of oil and gas resources, a substantial portion of the global potential. This is evidenced by the fact that oil and gas leases already exist in the Arctic OCS. It also is an environment containing substantial ecological and social resources of high spatial and temporal complexity. Within this area, there exist federally mandated conservation requirements within the context of the National Environmental Policy Act, International treaty, and Endangered Species Act regulations. The DOI holds authority for decisions on energy exploration and development in the Arctic OCS.

There are two decisions facing the DOI—one short term and one long term. The short-term decision involves deciding what to do with current Arctic OCS leases that are on hold. The long-term decision involves deciding when and where to permit exploration, development, and production of oil and gas resources in the Arctic OCS; that process is nested within ongoing and repeated revision of the OCS 5-year planning process. There are decisions made at each stage (exploration, development, and production) that can be seen as linked decisions (that is, decisions made at one stage influence the decision alternatives available at the subsequent stage), and there are substantial stakeholder concerns related to the linked nature of these decisions. Concern in the conservation community is based on the perception that once exploration begins, it is inevitable that production will occur; the energy industry is concerned that any one of these linked stages can result in termination of exploration and development prior to production.

There are disparate stakeholders with vested interests and substantial influence through the congressional, judicial, and regulatory processes whose views must be considered and incorporated into the decision. Industry has made significant investments in the Arctic OCS. Other stakeholders include the subsistence community (who have invested generations in the region and whose culture is tied to the marine environment), the general public (who have a stake in the biodiversity, remoteness, the domestic energy resource, and the lease revenue), and the conservation community (who have a stake in the biodiversity and ecological function of the Arctic). Federal agencies with stakes in the decision include the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) (regulatory authority over leases), the National Oceanic and Atmospheric Administration (NOAA) (regulatory authority over listed species), and the Coast Guard (ultimately responsible for spill response and safety).

There is substantial scientific uncertainty about the impacts of energy exploration and development on resources of interest. The DOI has recognized this uncertainty and has tasked the USGS with describing the state of scientific knowledge in order to inform decisions regarding the Arctic OCS; results of the USGS analyses are described in the chapters of this report. In addition, the linked nature of these decisions does have the effect of allowing monitoring data to inform future steps in the decision process, indicating the importance of well-designed and well-executed monitoring plans.

Objectives.—The USGS OCS team developed a draft objectives hierarchy consisting of fundamental objectives grouped in thematic areas, and linked to means objectives. This objectives hierarchy is expected to represent at least some of the objectives of the DOI in the context of the Arctic OCS energy exploration and development decision, but it is not expected to be a complete or necessarily accurate set of the DOI's objectives. The objectives are illustrated graphically in figures C–1 through C–3 and also are provided below. First tier elements are thematic areas (that is, groupings of fundamental objectives). There were three thematic areas identified: human communities, ecosystem values, and economic vitality. Second tier elements are fundamental objectives, of which 10 were identified. Third tier elements are means objectives.

The identified objectives are as follows:

1. Maintain Values of Human Communities
    a. Protect Human Health and Maintain Human Safety
    b. Protect and Maintain Subsistence Communities
        i. Maintain Populations of Subsistence-Hunted Species
        ii. Maintain Culturally Critical Components of Subsistence Hunting
    c. Meet Trust Responsibilities to Native Communities
2. Maintain Ecosystem Values
    a. Protect and Maintain Ecological Function
    b. Protect and Maintain Biological Diversity
        i. Maintain Populations of Endangered Species
        ii. Maintain Populations of Marine Birds
        iii. Maintain Populations of Marine Mammals
        iv. Maintain Populations of Fishes
    c. Protect Wilderness Values and Experience
3. Maintain Economic Vitality of Region
    a. Meet Energy Production Targets
    b. Meet Lease Revenue-Generation Targets
    c. Provide Employment Opportunities
    d. Maintain Tourism Value

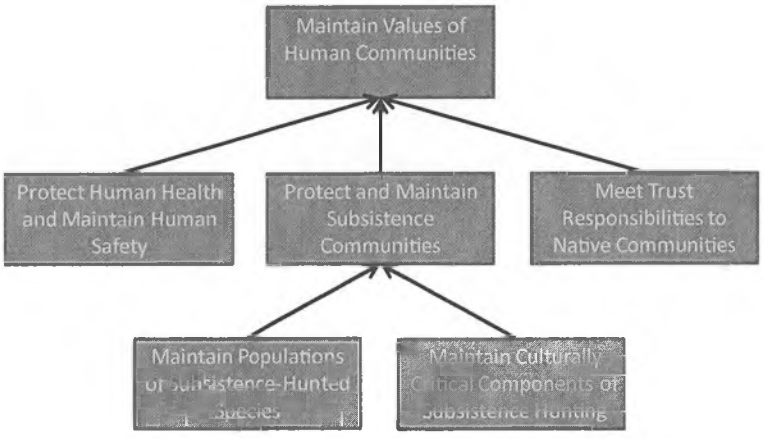

Figure C–1. Objectives hierarchy for the "Maintain Values of Human Communities" theme.

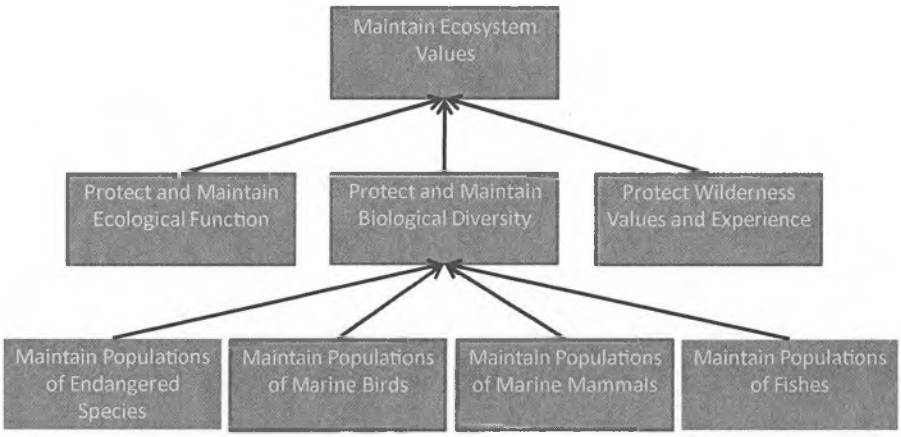

Figure C–2. Objectives hierarchy for the "Maintain Ecosystem Values" theme.

Figure C–3. Objectives hierarchy for the "Maintain Economic Vitality of Region" theme.

Alternatives.—Decision alternatives will involve different spatial and temporal patterns of permitting. Spatial aspects include the particular blocks opened for permitting, such as whether to allow drilling inside the current exclusion area or to expand the exclusion area, and the physical location of permitted sites within permitted blocks, including the allowable proximity to resources of spatial interest. Temporal aspects include the timing of exploration and production activities within a permitted area (for example, drilling could be staggered through time) and whether to impose seasonal constraints on activities. Additional aspects include which mitigation measures to mandate (for example, such as constraints on the density and spacing of drill sites). Decision alternatives will be defined by various combinations of different spatial and temporal patterns of permitting, both with and without mandates for various mitigation measures.

Models.—The modeling stage is the stage during which scientific information is used to develop predictions of the impact of decision alternatives on the various management objectives. We note, however, that building predictive models can only commence after the preceding elements of the decision process are fully understood (that is, the decision problem, objectives, and decision alternatives).

To build predictive models, we would begin by developing conceptual models that link components of the system through logical relationships; these logical relationships are described in narrative form throughout the chapters of this report. Conceptual models must demonstrate links between alternatives and objectives, so the basis for predictions about the impacts of decision alternatives on objectives can be made. Development of conceptual flow diagrams is a useful precursor to development of quantitative predictions. An example can be seen in figure C–4, linking the spatial location of permitted sites to the objective of maintaining populations of marine mammals.

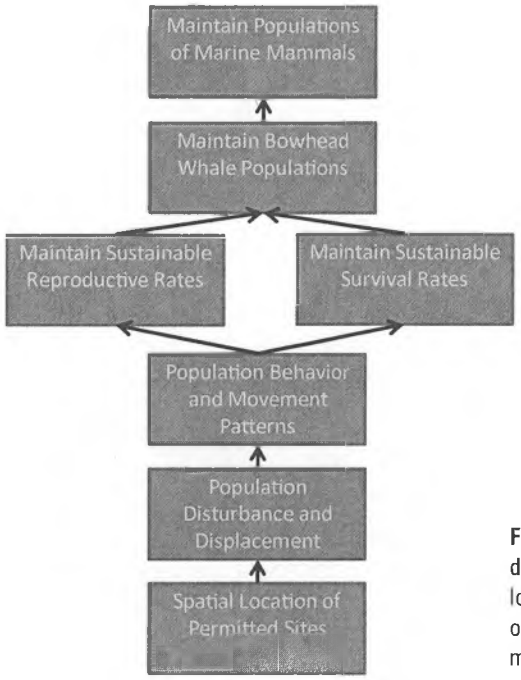

Figure C–4. An example logical flow diagram linking actions (the spatial location of permitted sites) to an objective (maintain populations of marine mammals).

Once such conceptual models are developed, they can be used to form the basis of quantitative predictions. Separate predictive models are needed for each of the fundamental objectives, where outputs of the models will be in units related to the objective (for example, for the objective "maintain populations of marine mammals," models for each species of interest would produce output in the form of numbers of individuals or probability of population viability). These models will make predictions, then, of the impact of each decision alternative on each of the identified management objectives.

One appropriate quantitative modeling tool for at least some of the objectives may be Bayesian Belief Networks (Marcot and others, 2006), which are graphical models that allow for propagation of uncertainty via conditional dependencies between model components. These are probabilistic models that frequently can be developed even with sparse scientific information. Much of the scientific information necessary to build the predictive models of interest may be in the form not of data but of expert knowledge. In this case, techniques for expert elicitation could be used to capture this information in a fashion appropriate for building quantitative models (Meyer and Booker, 1990; Ayyub, 2001).

Optimization.—Once predictions are made about the impact of each decision alternative on each management objective, a wide variety of formal techniques can be used to search among the decision alternatives to identify the optimal decision alternative. Given the complexity and multi-objective nature of the OCS energy exploration decision, it is likely that Multi-Criteria Decision Analysis (MCDA; Keeney and Raiffa, 1976) will be the source of appropriate optimization techniques. In multi-objective decisions, optimization consists of making tradeoffs among multiple objectives. That is, certain alternatives will perform best on some objectives, while different alternatives will perform best on other objectives. The task, then, is to consider these tradeoffs.

A variety of methods are available for tradeoff analysis in MCDA, but frequently the techniques involve developing, in concert with the decision maker or delegates, weights on objectives and then normalizing and summing the predicted outcomes across alternatives to develop "scores" for each alternative, where the alternative with the highest score is identified as the preferred alternative. A necessary final step, then, is sensitivity analysis to evaluate the impact of any uncertainty on the model predictions or the objective weights to inform the decision maker if the decision is highly sensitive to these elements. Sensitivity analyses may suggest places for improvement in the decision framework before final recommendations are developed.

Capacity for Structured Decision Making and Requirements of the Process

Capacity for supporting decision-analytic processes exists both within USGS and in academic and non-profit settings around the United States. Recommendations for conducting decision analysis include:

1. Designate a team coordinator who can act as the decision maker's representative in the decision-analytic process. The team coordinator should have an accurate understanding of the decision maker's objectives (which will integrate the objectives of stakeholders as described above).

2. The team coordinator should work directly with the decision analyst(s) to form a team consisting of experts with relevant knowledge on the different components of the decision, as well as relevant legal and administrative matters.

3. The decision analyst(s) should work with team members in a workshop setting to develop an initial sketch of the elements of the decision (this is known as rapid prototyping the decision framework).

4. Individual team members can then work individually to further develop different components of the decision framework, for example, complete development of relevant predictive models. This individual work should be done in close coordination and with regular input from other members of the team.

5. A final workshop may be held during which the final tradeoffs analysis can be conducted. This, paired with appropriate sensitivity analyses, can be used to complete the report on the decision-analytic process.

Summary Recommendations: Formal decision-analytic methods are useful for supporting decision making in challenging settings with multiple objectives, complex sets of available decision alternatives, and substantial uncertainty and risk. Using the collective knowledge of the USGS OCS team, we developed a Structured Decision Making framework as an example of what could be developed to inform decisions about energy exploration and development in the Arctic OCS. Although development of such a framework would require input of the decision maker or delegates in order to accurately represent management objectives and tradeoffs, we present this example to illustrate the process as well as the potential utility of SDM in this setting, wherein adoption of SDM could facilitate a more robust, transparent, and deliberative decision. We encourage careful consideration of SDM as a useful process in the Arctic Outer Continental Shelf energy exploration decision setting.

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Appendix D. The *Exxon Valdez* Oil Spill Experience: Lessons Learned from a Cold-Water Spill in Sub-Arctic Waters

By Dede Bohn

Background

The March 24, 1989 *Exxon Valdez* Oil Spill (EVOS) was not related to oil and gas development activities, but was the result of the grounding of the tanker *Exxon Valdez* on Bligh Reef in Prince William Sound, Alaska, while outside of normal traffic shipping lanes to avoid icebergs. This accident was the largest oil spill in U.S. waters until the *Deepwater Horizon* spill of 2010. The lessons learned from the spill are included here for the purposes of highlighting Alaska-based experience ranging from spill response through Natural Resource Damage Assessment components that can help inform the U.S. Geological Survey (USGS) Arctic Outer Continental Shelf (OCS) Team assignment.

Most of the oil from the grounding of the *Exxon Valdez* was spilled in the first 6 hours as approximately 10.9 million of the 53 million gallons of North Slope crude oil aboard leaked into the water. Within 2 months, the spread of this oil had impacted more than 1,300 discontinuous miles of the 9,000-mi long coastline in the Prince William Sound and the Gulf of Alaska region (fig. D–1). Less than 1 of the 1,300 mi of oiled beaches was accessible by road (Hunt, 2009). Exxon was not prepared for a spill of this magnitude, nor was its pipeline service company and responder Alyeska, nor the Federal or State governments (Skinner and Reilly, 1989). Efforts were made to remove oil from the water, and included booms to collect oil, test areas of burning, surface dispersants to break up the oil into smaller concentrations, and mechanical skimming to remove oil on the surface. Once the oil had reached shorelines, chemical cleaners, hot water and high pressure, and manual removal by shovels, human hands and absorbent materials were used (Alaska Department of Environmental Conservation, 1993). For the past 20 years, the $900 million in civil settlement funds paid by Exxon have supported restoration, monitoring and research activities in the spill-impacted area (*Exxon Valdez* Oil Spill Trustee Council, 2011b).

The OCS Arctic evaluation and planning effort for oil development can benefit from the EVOS experience through two aspects: (1) improvements in oil-spill prevention and response made as a result of the EVOS, which have enhanced our protection capabilities; and (2) lessons learned from the EVOS, which can inform better preparedness and protection.

Improvements in Spill Prevention and Response Triggered by the EVOS Have Enhanced Our Preparedness

Significant progress has been made in oil-spill prevention and response as a direct consequence of lessons learned from the EVOS, applicable to both its spill area as well as spills elsewhere. Some of these improvements better prepare the OCS Arctic planning effort, and are listed below. The Federal Oil Pollution Act of 1990 (OPA 90), passed by Congress in response to the EVOS, established a procedure for assessing natural resource damages and establishing liability, and designates specific Federal, State and Tribal Government officials to act as trustees on behalf of the public to recover damages from the responsible parties to restore injured, destroyed, or lost natural resources. The OPA 90 also added "oil" to the other hazardous substances covered by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. In the EVOS area itself, specific advances include:

- Alyeska Pipeline Service Company (established in 1970 to oversee the Trans Alaska Pipeline System, and Exxon's first responder to the EVOS), now spends more than $60 million annually under the Ship Escort/Response Vessel System (SERVS) created in 1989, to plan, prepare, and enhance oil-spill prevention and response measures in Prince William Sound.
    - Alyeska oversees oil spill contingency plans such as those required by the State of Alaska for all tankers traveling in Prince William Sound, which must include scenarios for open-water, nearshore, and shoreline responses and support operations.

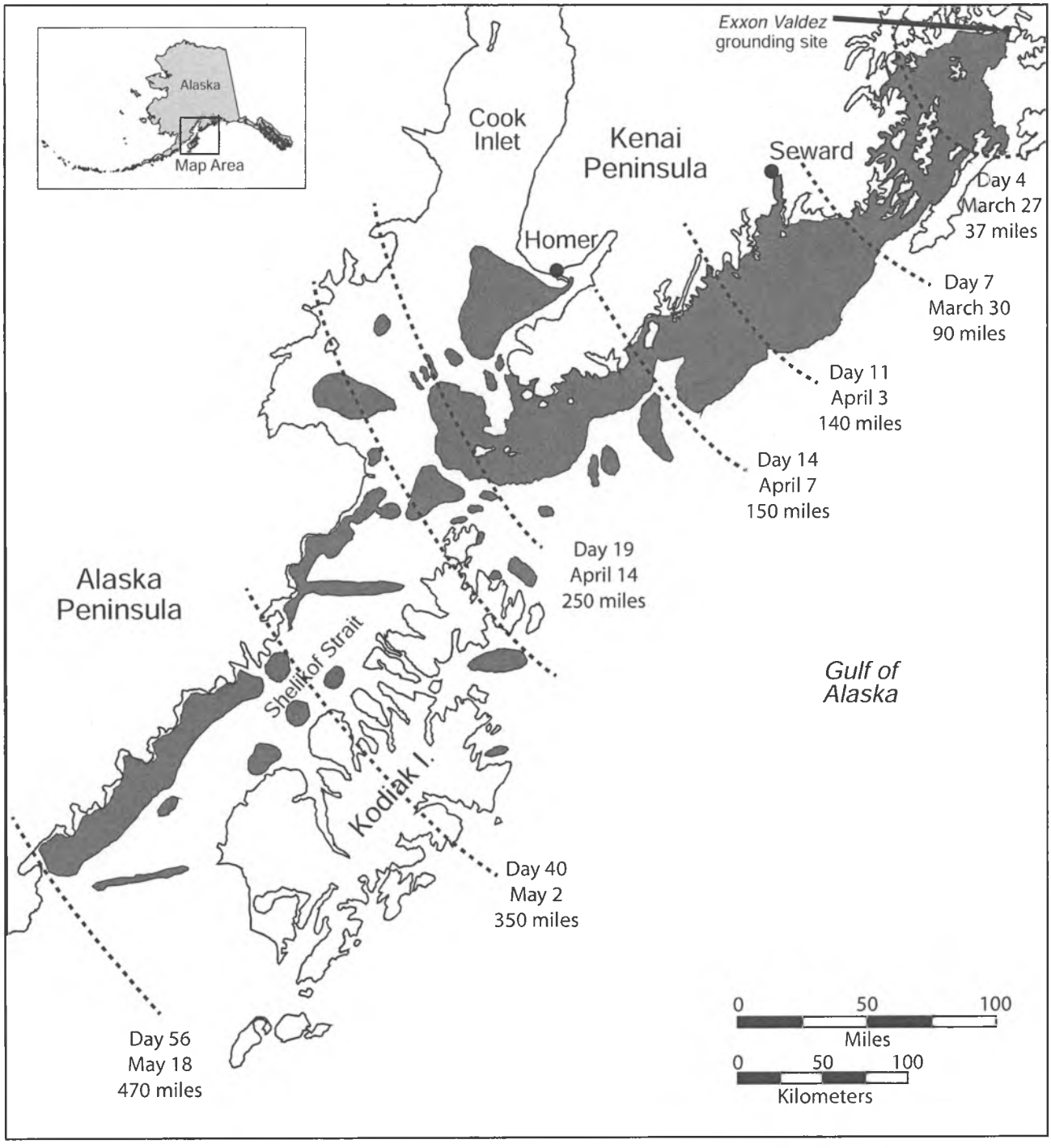

Figure D–1. Within 8 weeks after the spill, wind and currents had distributed the oil from the site of the accident at Bligh Reef in Prince William Sound into the Gulf of Alaska areas of Cook Inlet, Kodiak Island, and the Alaska Peninsula, a maximum distance of 470 miles. Source: 1993 State On-Scene Coordinator's Report (Alaska Department of Environmental Conservation, 1993).

  - Under Aleyska's SERVS program:
    - The design of skimming systems to separate and remove oil from the surface of water has been improved and is now 10 times greater than it was in 1989.
    - Seven barges, capable of holding 818,000 barrels of oil, have been made available in Prince William Sound. At the time of the spill, even if oil could have been collected, there was no holding facility.
    - Forty miles of containment boom is available in Prince William Sound, seven times as much as in 1989.
    - Dispersants are stockpiled for use and application systems via helicopters, airplanes, and boats have been designated.
    - Contingency planning for spills in Prince William Sound, held annually, must include a scenario for a spill of at least 12.6 million gallons.
- The U.S. Coast Guard, via satellite, has expanded the area where it monitors for icebergs and other potential hazards in the paths of tankers transporting oil across Prince William Sound.
- Two, rather than one, escort vessels now accompany and, if needed, assist each tanker while it is in the Sound, as directed by an executive order from the Alaska Governor soon after the EVOS.
- At the State level, a dozen new laws for oil-spill prevention, response, and oversight were passed by the Alaska Legislature between April 1989 and May 1990, including: (1) enlarging the State's emergency oil and hazardous substance response fund to 50 times its previous size; (2) revisions to the oil-spill prevention, response, contingency plan regulations; and (3) increased liabilities and penalties for polluters.
- Congress enacted legislation requiring double hulls on all oil tankers by 2015, including those traveling in Prince William Sound. A U.S. Coast Guard study estimated that, had the *Exxon Valdez* been double-hulled at the time of the spill, the amount of oil spilled would have been reduced by more than one-half (*Exxon Valdez* Oil Spill Trustee Council, 2011b).
- The OPA 90 established two oversight and monitoring programs, one in Prince William Sound, and one in Cook Inlet, to foster partnership of industry, government, and local communities in overseeing the environmental compliance for crude oil terminals (Cook Inlet Regional Citizens Advisory Council, 2011; Prince William Sound Regional Citizens' Advisory Council, 2011).
- The Oil Spill Recovery Institute, established by Congress in the OPA 90 after the spill, is charged with identifying and developing the best available techniques, equipment and materials for responding to oil spills in the Arctic marine environment and to complement Federal and State damage assessment efforts. The Institute is actively conducting research and educational and demonstration projects to carry out its mission, and is mandated through September 2012 (Prince William Sound Science Center Oil Spill Recovery Institute, 2011).

Planning for Preparedness in the Arctic OCS Region: Lessons Learned from the EVOS

Below we list in *italics* some of the lessons learned from the EVOS, which have bearing on the potential strengths and weaknesses of the scientific and technical understanding for Arctic OCS activities. Following each lesson is an explanation of the EVOS activities that comprised it.

Oil-Spill Response

Move quickly and be prepared to contain the oil to keep the situation from worsening.

The extent of injuries to natural resources and services resulting from a spill depends on the circumstances of the incident and the prevailing environmental conditions. Although the weather was calm for the first 3 days after the EVOS, Alyeska Pipeline Company, the designated first responder under the Prince William Sound contingency plan, had few pieces of equipment available and ready for use. In addition to Alyeska's contingency plan, National, regional, and local plans mandated by Federal regulation also had been developed, but the plans were not coordinated, had not established a response command hierarchy for responding to a spill, and lacked specific measures to address such problems as how to address spills in remote areas (Skinner and Reilly, 1989).

- Lightering, the process of unloading the remaining oil from the damaged tanker, took 11 days until the seepage of oil could be stopped. Underwater divers had located holes in 11 of the ship's holding tanks. (Skinner and Reilly, 1989).
- Only two skimmers and little or no containment boom were deployed initially (Skinner and Reilly, 1989).
- A small initial test burn successfully consumed 12,000 to 15,000 gal, but further tests were thwarted due to stormy weather (Skinner and Reilly, 1989).

- There were not enough dispersants available, nor enough vessels and equipment ready to deploy the dispersants. An initial trial application on the first day of the spill failed because of a lack of mixing energy (wind) and a later trial was inconclusive (Skinner and Reilly, 1989).
- A severe winter storm with wind gusts up to 73 mph arrived the evening of March 26 quickly dispersing the oil into patches, which spread to beaches up to 40 mi south of the site of the accident, at the same time temporarily grounding the response vessels.
- Eventually the oil reached as far as 470 mi away, to Chignik, on the Alaska Peninsula. Because the escaped oil was so widespread, it was necessary to continue cleanup efforts for four summers. Some oil lingers today, and cleanup efforts for it remain underway.

Spill response should aim to prevent oil from reaching streams, fine sediment beaches, and estuaries.

- Oil persisted in the sediments of streams, mussel beds, and estuaries, contaminating natal and nursery fish habitats for several years (Moles, 2001).

Damage and Injury Assessment

Fate of the oil, and thus the potential and nature of subsequent environmental effects, depends on a complex interaction of variables at the time of the spill, including chemistry, weather, shoreline characteristics, currents, temperature, and season.

- Estimates on the fate of the spilled oil are (Wolfe and others, 1994):
  - 20 percent evaporated,
  - 50 percent biodegraded either where it was deposited or in the water column,
  - 14 percent was recovered or disposed during the trial burning and dispersant treatments,
  - Less than 1 percent remained in the water column,
  - 2 percent remained on intertidal shorelines, and
  - About 13 percent remained in subtidal sediments, mostly as highly weathered residues.
- Within days, a winter storm had widely dispersed the oil slick both on the surface and subsurface of the seawater; oil droplets in the water column reached depths of at least 75 ft (Short and Harris, 1996); some mousse formed as the oil churned and mixed with water, and some tar balls formed as a result of evaporation (Payne and others, 1996).
- Wind, tide, and currents continued to redistribute the oil for at least 2 months, as shown in figure D–1.
- Spring tides were nearly 18 ft, stranding some oil high on shorelines, giving rise to a "bathtub ring" which was protected from wave action, resulting in no further dispersal (Spies, 2007).
- The total number of animals killed by the spill is unknown. The carcasses of more than 35,000 birds and 1,000 sea otters were found after the spill, but since most carcasses sink, this is a minimum estimate of the actual loss. The EVOS Trustee Council estimates are: 250,000 seabirds, 2,800 sea otters, 300 harbor seals, 250 bald eagles, up to 22 killer whales, and billions of salmon and herring eggs (*Exxon Valdez* Oil Spill Trustee Council, 2011c).
- Biologically, the end of March is particularly stressful for organisms because they have nearly depleted their stored energy and are beginning migration and reproduction cycles and the added impact of being oiled or having oiled prey takes a big toll. The populations of plankton and herring, which form the base of the food chain supporting much of the wildlife, were hard hit because the spring plankton bloom had just begun, and Pacific herring were entering the nearshore habitat of Prince William Sound in order to spawn. All age classes of herring and a significant portion of spawning habitats were contaminated by oil, and subsequently, lesions and elevated hydrocarbon levels were documented in some adult herring (Rice, 2010).

Emphasize preplanning: develop and maintain a regularly updated scientific sampling or biological response plan.

- Develop assessment approaches that do not require extensive baseline data, such as ecosystem models that identify pathways and processes at risk to oil injury; increase the accuracy of these models by running the models with parameters gleaned from pre-spill biological samples so that a baseline condition can be better established, and perturbations tested pre-spill. Monitor populations that can serve as surrogates for others, such as monitoring harlequin ducks as a surrogate for benthic-feeding birds (See, 2001).
- Develop a multi-species integrated approach to test mechanisms limiting recovery; an example in the nearshore environment included a study focused on the invertebrate-feeding sea otter and harlequin duck combined with the fish-feeding river otter and pigeon guillemot seabird (Peterson and Holland-Bartels, 2002).
- Pre-plan coordination and designate trained staff; maintain a scientific sampling or biologic response plan. Otherwise, collections can be haphazard, and data and specimens can be lost and unreported, inaccurate, and incomplete. Plan for a central data clearinghouse (See, 2001).

Obtain a geochemical signature of the spilled oil; not all of the oil encountered on the beaches of the spill area was sourced from the Exxon Valdez accident.

- Some of the oil residues found on some of the Prince William Sound shorelines were chemically distinct from the spilled oil (Kvenvolden, 1993).
- Flattened tar balls found throughout the northern and western parts of the Sound had carbon-isotopic and biomarker signatures of oil products used in Alaska before 1970, and are thought to have been created when storage facilities ruptured during the 1964 Alaska earthquake (Kvenvolden, 1995).

Cleanup

Cleanup was slow to get started, but eventually involved more than 11,000 workers. The combination of the presence of such a large workforce and its supporting infrastructure on sensitive coastal areas, coupled with effects from cleanup approaches, resulted in confounded impacts to the environment.

Detrimental effects of shoreline cleanup methods are complex and sometimes oversimplified.

- High-pressure, hot-water washing of the Prince William Sound shorelines effectively removed stranded oil, but damaged flora and fauna directly and indirectly, and received much public criticism, which caused it to be discontinued. Studies from the EVOS were among the first to document these impacts (Mearns, 1996).
- Response methodologies continue to include the high-pressure, hot-water washing techniques, but the National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration now gives greater weight to evaluating the complexities and competing interests and the environmental tradeoffs before these methodologies are used (National Oceanic and Atmospheric Administration Office of Response and Restoration, 2011).

Restoration

A number of factors affected the ability of agencies to assess damage, define restoration goals, and judge progress towards those goals. Main among these was the lack of pre-spill data for potentially damaged natural resources and (or) the lack of current data. While, for example, significant data were available for seabirds and their prey, such data were collected in the 1970s prior to a decadal oceanic regime shift, which brought in different oceanic temperatures and salinities, resulting in changes to the food web, which triggered restructuring of the biological communities (Anderson and Piatt, 1999). Thus, the use of available pre-spill data such as seabird colony population surveys and demographic information as a pre-spill data set upon which to judge damage or recovery was confounded (Piatt and Anderson, 1996).

The United States Government and the State of Alaska settled their claims against Exxon Shipping Company and Exxon Corporation on October 9, 1991, with a settlement agreement comprised of a criminal plea agreement and fine of $150 million, criminal restitution for injuries to fish, wildlife, and land for $100 million, and a $900 million civil settlement fine. A Memorandum of Agreement between the Federal and State governments established the *Exxon Valdez* Oil Spill Trustee Council to manage the $900 million civil settlement for restoration activities. The Council is comprised of three Federal and three State Trustees.

Define restoration objectives and strategies to achieve the goal of recovering the oil spill area ecosystem.

- Since the EVOS, the OPA 90 Natural Resource Damage Assessment (NRDA) regulations have established that the restoration goal is achieved when the injured natural resources and services have returned to the condition they would have been, had the spill not occurred.
- In the 1994 EVOS Restoration Plan, some recovery objectives specified a return to pre-spill conditions or to stable or increasing population trends, which did not account for stressors other than oil, which became increasingly important as time went by.

Injury assessment of natural resources is complicated by a lack of pre-spill data and compounded by natural variation and will always involve uncertainties.

- In lieu of applicable pre-spill population data, animal carcass counts, a crude and minimal measure, had to be used in order to measure the extent of damages. Actual losses were higher than counted because some carcasses sank or were never discovered. For example, research studies have estimated the actual loss of the seabird murre population at 40 percent of its pre-spill level, or a loss of 250,000 murres, compared with the carcass recovery of 21,000 (Piatt and Ford, 1996). Such extrapolations are highly sensitive to the "observed versus not observed" ratio applied to calculate total loss, which in turn is affected by weather conditions that hamper the ability to make observations.
- Sources of uncertainty in assessing both the short- and long-term damage following a spill include variability in the available population estimates, lack of pre-spill data, ongoing changes to the ecosystem as a result of changing climate and other natural factors, emergence of new effects (for example, new contamination arising from contact with lingering oil), difficulty establishing causation (an unequivocal cause-and-

effect relationship between the biological resource and the oil), and comparing studies of differing spatial and temporal scales (Integral Consulting, Inc., 2006).

- Additional measures and approaches to measure damage in lieu of contemporary pre-spill baselines proved essential to developing an understanding of system recovery. Recovery status has been determined by evaluating the initial magnitude of oil impacts to a population through carcass counts, comparing the population demographics between oiled and unoiled areas, comparing the health of biological community members from oiled and unoiled areas, measuring to determine continued exposure to lingering oil through biomarker or tissue concentrations, establishing the persistence of sublethal or chronic injuries, evaluating the intrinsic ability of the population to recover, and accounting for other stressors from natural or anthropogenic sources (*Exxon Valdex* Oil Spill Trustee Council, 2006).

Track the status of recovery by updating the status of injury through monitoring.

- A list of natural resource and human service injuries caused by the EVOS helped guide the Restoration Plan adopted by the EVOS Trustee Council in 1994. The listings include the recovery status of individual species as well as sediments, subtidal and intertidal communities, commercial fishing, subsistence, recreation and tourism, archeological resources, and designated wilderness areas. The list has been instrumental to the EVOS Trustee Council in prioritizing the expenditure of public restoration funds received from the civil settlement with Exxon, ensuring that money was expended on resources needing attention. As restoration has proceeded and recovery statuses have changed, the list has been updated and re-published in 1996, 1999, 2002, 2006, and 2010. The list serves to track and document the status of recovery of the oil spill area; as of 2010, 2 resources have not recovered (Pacific herring, pigeon guillemots), 10 resources are recovering (Barrow's Goldeneyes, black oystercatchers, clams, designated wilderness areas, harlequin ducks, intertidal communities, killer whales, mussels, sea otters, sediments), 10 resources have recovered (archeological resources, bald eagles, common loons, common murres, cormorants, Dolly Varden fish, harbor seals, pink salmon, river otters, sockeye salmon), 3 resources are very likely recovered (cutthroat trout, rockfish, subtidal communities), and the recovery status of 2 resources (Kittlitz' and Marbled Murrelets) is unknown (*Exxon Valdez* Oil Spill Trustee Council, 1994, 2006, 2010).

Use an ecosystem perspective; examine food chains, and use ecosystem models to pinpoint pathways and processes at risk to oil injury. Do not ignore lower trophic levels.

- Multi-disciplinary, multi-species approaches increased the power to detect and evaluate recovery: the Sound Ecosystem Assessment project evaluated factors affecting productivity of Pacific herring and pink salmon; the Nearshore Vertebrate Predator program addressed factors affecting the recovery of four indicator species; and the Alaska Predator Ecosystem Experiment evaluated the productivity and recovery of seabirds based on the availability of forage fish (*Exxon Valdez* Oil Spill Trustee Council, 2011b). Recovery also will involve complex interactions, such as those associated with the dynamics of both microbial communities and food webs, which will cascade changes up to the largest predator.

Oil can remain toxic in the environment a surprisingly long time; oil degradation rates depend upon localized conditions (Michel and Esler, 2010, and citations therein).

- Some oil has persisted more than 2 decades in unexpected amounts and in toxic relatively unweathered forms, buried in the subsurface intertidal area of approximately 50 discontinuous beach sites, which put together, total a shoreline length of about 1.5 mi.
- The beaches with persistent oil have an upper, highly permeable layer and a lower layer of low permeability where the oil has remained trapped, physically protected from disturbance, oxygenation, and photolysis.
- The oiling history (high, medium, low) of the beaches, surveyed after the spill and again in 2001 and 2008, is one important indicator of predicting where oil persists.
- Biodegradation of the oil has been limited by a low concentration of dissolved oxygen as well as a nutrient concentration too small to sustain oil-consuming microorganisms. Bioremediation projects are being undertaken in 2011, 22 years after the spill.

Some of the lingering oil has been bioavailable to wildlife and has induced chronic exposure in nearshore species (Michel and Esler, 2010, and citations therein).

- Organisms that use the intertidal zone were severely impacted by initial oiling and cleanup and continued to show adverse impacts from continued exposure such as reduced survival rates and diminished populations. Studies have addressed and documented exposure to lingering oil in birds (harlequin ducks, Barrow's Goldeneyes, black oystercatchers, pigeon guillemots), sea otters, and fish (masked greenlings and crescent gunnels).
- Some harlequin ducks and sea otters in the nearshore environment have continued to exhibit signs of exposure to oil through 2006 and 2009, as measured through elevated oil biomarkers in blood and tissues or in gene expression. Studies are ongoing and awaiting the results of laboratory analyses of the most recent harlequin duck samples collected in March 2011 to see if oil exposure continues.

Long-term chronic exposure is now recognized as a major component of injury and may equal or exceed acute effects (Peterson and others, 2003).

- Effects of the EVOS have revised the paradigm for assessing ecological risks of oil in the ocean. Previously, it was assumed that acute mortality is the main impact to a population, but EVOS research has shown that chronic, delayed and indirect long-term risks and impact play a much larger role than previously envisioned. Risk assessment models that project biological injury need to be updated from treating species independently to instead provide for interacting variables.
- A delay in population reduction was caused, for example, by ingestion of oiled prey, by lower survival rates for harlequin ducks in the winters following the spill due to cumulative stress from encountering the lingering oil, and by damage to fish over time through oil exposure which increased embryo mortality and deformity and resulted in poor predator avoidance and low growth rates.
- Recovery was postponed as cascades of indirect effects, such as a food shortage of forage fishes as well as a reduction of high-quality forage fish prey reduced seabird populations of murres, puffins, and pigeon guillemots. Animal communities may experience delayed recovery depending on complex interactions, and communities may not soon return to their original configurations. For example, a loss of experienced breeders in seabird colonies disrupted the phenology of breeding for several years, imperiling late-fledging young, such as murres. On rocky shorelines, indirect interactions resulting from oiling and loss of the ubiquitous rockweed plant cover, as well as grazing and predatory gastropods, are thought to have delayed the recovery process for a decade or more, while opportunistic barnacles colonized the open rock spaces and disrupted the food chain.
- Injury to seabirds, mammals, fish, and invertebrates continues long term through chronic exposure from ingesting contaminated prey and through foraging in oiled sediments, and through disruption of reproduction. Long-term exposure of fish embryos to weathered oil has had population consequences through indirect effects on growth, deformities, and behavior (Rice, 2010, and citations therein).

Oil effects can be subtle, indirect, and long term.

- Long-term monitoring and research have been essential in identifying the full impacts of the spill, as evidenced particularly for sea otters and harlequin ducks. The EVOS Trustee Council has sponsored a multitude of projects to monitor the recovery of injured species, and final reports can be found on their website (*Exxon Valdez* Oil Spill Trustee Council, 2011b) as well as throughout the published literature. Long-term monitoring of the recovery of the nearshore environment, where patches of toxic oil still linger, is one such project which is ongoing, and which is being considered for 5 to 20 additional years of funding by the EVOS Trustee Council at its August 2011 meeting.
- Some injuries cannot be determined until years later, such as the significant long-term biological effects of lingering oil; studies are currently in progress for harlequin ducks and sea otters.
- Delays in the recovery of bird and mammal predators of fish and invertebrates resulted from chronic and indirect effects, such as the loss of their habitat due to oiling or cleanup activities and the subsequent spread of opportunistic species, such as algae or small intertidal fishes, which inhibited the return of the original fish and invertebrate food sources (Peterson, 2000).

- Sublethal exposures to oil caused mortalities due to compromised health, growth, or reproduction; for example, long-term exposure of the black oystercatchers that foraged on heavily oiled shores, documented up to 3 years post-spill, showed reduced breeding and smaller eggs than those that bred in unoiled areas; higher chick mortality occurred in areas where their diet consumption had included oiled mussels; and the oystercatcher parents gathering prey on oiled shores fed chicks more to achieve less growth than those on unoiled shores, at a higher energetic cost (Peterson and others, 2003).
- The acute, initial loss of killer whales following the spill has had a long-term impact on the recovery of the ecosystem because the species is long-lived with low reproductive rates, and, as the predator at the top of the food chain, significantly affects the structure of the ecosystem (Rice, 2010).
- Pacific herring, a primary forage fish for many seabird and marine mammals, still have not recovered. Despite numerous studies, the causes of this phenomenon are not well understood, but appear to include disease, predation, and poor recruitment (the survivability of juveniles) (*Exxon Valdez* Oil Spill Trustee Council, 2010).

Not much real (that is, direct) restoration can be done; so instead the environment must be restored.

- Lost services, such as commercial and sport fishing, recreation and tourism, and subsistence are assumed to be restored when the species upon which they were based are restored (*Exxon Valdez* Oil Spill Trustee Council, 1994).
- To date, because direct restoration opportunities are few, the $900 million civil settlement funds received from Exxon and managed by the EVOS Trustee Council have been allocated 24 percent to research, monitoring, and direct and indirect restoration; 37 percent to habitat protection and acquisition; 22 percent reimbursements for assessments and response; and 17 percent in an investment trust fund to increase the amount of funds available for future studies (*Exxon Valdez* Oil Spill Trustee Council, 2011b).
- Natural recovery was selected under the 1994 EVOS Restoration Plan as the preferred alternative for restoration, and research and monitoring were directed at tracking the status of recovery (*Exxon Valdez* Oil Spill Trustee Council, 1994).
    - Because natural recovery over the past 20 years has failed to remediate the 50 beach segments identified recently with the most significant persistent oil, bioremediation projects using oxygenation and nutrient enrichment techniques are being tested by the EVOS Trustee Council in 2011 as a way to clean up the remaining oil (*Exxon Valdez* Oil Spill Trustee Council, 2011a).
- Habitat acquisition to promote natural recovery of spill-injured resources, especially on lands under imminent threat of development, has been a significant and well-received component of the EVOS restoration program, and could be an effective tool elsewhere. As of 2006, the Council has protected more than 630,000 acres of habitat, including more than 1,400 mi of coastline and more than 300 streams valuable for salmon spawning and rearing (*Exxon Valdez* Oil Spill Trustee Council, 2010).

A Reopener clause, part of the 1991 legal settlement between Exxon and the State and Federal governments, provided for unanticipated injury.

- Some of the long-term injury from the spill was not identifiable initially, but has been established since, under research funded by the EVOS Trustee Council. Under the oil spill Reopener clause in the 1991 litigation settlement with Exxon, on August 31, 2006, the Federal and State governments submitted a demand letter to Exxon to pay up to $100 million for additional restoration work for the recovery of a population, habitat or species suffering a substantial loss or decline from an injury that could not have been known or reasonably anticipated on the date of the settlement. The plan focuses on the restoration of sites where lingering toxic oil persists (U.S. Department of Justice, 2006). Studies assessing the linkage of injury from the lingering oil to damage at the population level, particularly in sea otters and sea ducks, which inhabit the nearshore environment where the lingering oil occurs, are ongoing, and their outcome will help inform the Reopener claim. Trustee Council-sponsored research is underway to continue to identify lingering oil site locations, factors limiting the degradation of the oil, and to test pilot projects to remediate the pockets of lingering oil. Negotiations between the governments and Exxon to address this claim remain underway since September 2006.

Prepare for conflicting studies.

- Exxon Corporation has continued to fund its own damage assessment studies, and the resulting conclusions have consistently contrasted with those funded by the EVOS Trustee Council. The studies have differed in concept, statistical rigor, and choice of study sites and those differences have led to differing conclusions (Spies, 2007; Rice, 2010).

- Sampling design begets conclusions: Despite having common goals, four studies on the impact of the spill on intertidal biota involved different sampling efforts, analytical methodologies, and the choice of biological response variables that led to differing conclusions. Two of the studies were funded by Exxon Corporation, one by the EVOS Trustee Council, and one by the NOAA Hazmat program (Peterson and others, 2001).

Summary Points for the OCS Oil Planning Team Effort

Prevention is the principal defense against oil spills. Preparedness is the next best thing, with the caveat that no two oil spills are the same. Full recovery from the *Exxon Valdez* oil spill has not yet occurred, 22 years later. Keeping oil from reaching shorelines, where it is difficult to treat, may remain in a toxic form in the subsurface for up to 22 years—as in the EVOS—and takes an enormous toll on the food chain, must be a top priority in spill response. Not all species are equally affected, and not all species recover at the same rate. Initial wildlife mortalities from the EVOS were extreme, and likely understated due to lack of pre-spill population data and the difficulty in recovering carcasses. Studies of the long-term environmental and health effects on wildlife of acute and chronic exposure to oil have yielded surprising findings emphasizing the magnitude and complexity of the long-term impact. The effects of chronic oil exposure, delayed impacts, and sub-lethal impacts on growth, development, and reproduction have caused decreases at the population level; this finding is significant. An ecosystem-approach, allowing for the effects of indirect and cascading reactions, is imperative in evaluating restoration.

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Appendix E. Arctic Marine Synthesis—Data Sources and Data Quality

The "Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas" by Audubon Alaska and Oceana (Smith, M.A., 2010, Arctic Marine Synthesis—Atlas of the Chukchi and Beaufort Seas: Audubon Alaska and Oceana, Anchorage) represents an emergent approach about data quality and sufficiency. Before the creation of this effort few others had assembled broad-scale information for this area. This broad synthesis utilizes spatial data from more than 100 sources plus literature and reports from another 400 sources, resulting in 44 thematic maps that cover six categories for the Chukchi and Beaufort Seas: Physical Oceanography, Water Column and Benthic Life, Fish, Birds, Mammals, and People. A listing of maps, data sources, and data quality ratings compiled from this synthesis is shown in table E–1.

Table E–1. Listing of maps, data sources, and data quality ratings as compiled from "The Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas" by Audubon Alaska in partnership with Oceana (Smith, 2010).

[**Good:** provides a complete geographic picture of the resource or species; data are consistent and of decent quality for mapping at the scale used (1:5,000,000); this rating does not indicate that fine-scale, project level data are available; **Fair:** provides a partial geographic picture of the resource or species; data are variable, some portions of the map are represented by reliable, high-quality data and data for other portions of the map are outdated, opinion-based, or missing data altogether; some key features, such as concentrations areas, may be missing. **Poor**: provides an incomplete geographic picture of the resource or species; information is missing, outdated, or deficient, but it is the best known data available (Smith, M.A., 2010, Arctic Marine Synthesis—Atlas of the Chukchi and Beaufort Seas: Audubon Alaska and Oceana, Anchorage)]

Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Physical Oceanography		
Project Area	Good	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Alaska State Geospatial Data Clearinghouse. 2008. Base data. GIS shapefiles. <http://www.asgdc.state.ak.us/>. Accessed June 2008. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Johnson, G.W., A.G. Gaylord, J.J. Brady, M. Dover, D. Garcia-Lavigne, W.F. Manley, R. Score, and C.E. Tweedie. 2009. Arctic Research Mapping Application (ARMAP). CH2M HILL Polar Services, Englewood, Colorado. <http://www.armap.org>. Accessed January 2010.
Bathymetry	Good	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Alaska State Geospatial Data Clearinghouse. 2008. Base data. GIS shapefiles. <http://www.asgdc.state.ak.us/>. Accessed June 2008. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Chukchi Sea shoals. GIS feature class (based on AOOS 2009).
Ecoregions	Good	Piatt, J.F., and A.M. Springer. 2007. Marine ecoregions of Alaska. Pages 522–526 in Long term ecological change in the Northern Gulf of Alaska. R. Spies, editor. Elsevier, Amsterdam. <http:/www.absc.usgs.gov/research/NPPSD/marine_ecoregions.htm>. Accessed July 2008. Nowacki, G., P. Spencer, T. Brock, M. Fleming, and T. Jorgenson. 2001. Ecoregions of Alaska. GIS shapefile. USGS, Reston, Virginia. World Wildlife Fund. 2009. Terrestrial ecoregions. GIS shapefile. <http://www.worldwildlife.org/science/ecoregions/item1267.html>. Accessed November 2009.
Ocean Circulation	Fair	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Ocean circulation. GIS feature class (based on Weingartner et al. 2005; Weingartner 2006; MMS 2007; University of Alaska Fairbanks, Institute of Marine Science 2009). MMS (Minerals Management Service). 2007. Chukchi Sea Planning Area, Oil and Gas Lease Sale 193 and seismic surveying activities in the Chukchi Sea final environmental impact statement. U.S. Department of the Interior, MMS, Alaska OCS Region, Anchorage, Alaska. University of Alaska Fairbanks, Institute of Marine Science. 2009. Chukchi Sea circulation. Digital map. <http://www.ims.uaf.edu/chukchi/>. Accessed March 2009. Weingartner, T. 2006. Circulation, thermohaline structure, and cross-shelf transport in the Alaskan Beaufort Sea. Report OCS Study MMS 2006-031. MMS. Weingartner, T., K. Aagaard, R. Woodgate, S. Danielson, Y. Sasaki, and D. Cavalieri. 2005. Circulation on the north central Chukchi Sea shelf. Deep Sea Research Part II: Topical Studies in Oceanography 52:3150-3174.

Table E–1. Listing of maps, data sources, and data quality ratings as compiled from "The Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas" by Audubon Alaska in partnership with Oceana (Smith, 2010)—Continued

[**Good:** provides a complete geographic picture of the resource or species; data are consistent and of decent quality for mapping at the scale used (1:5,000,000); this rating does not indicate that fine-scale, project level data are available; **Fair:** provides a partial geographic picture of the resource or species; data are variable, some portions of the map are represented by reliable, high-quality data and data for other portions of the map are outdated, opinion-based, or missing data altogether; some key features, such as concentrations areas, may be missing. **Poor**: provides an incomplete geographic picture of the resource or species; information is missing, outdated, or deficient, but it is the best known data available (Smith, M.A., 2010, Arctic Marine Synthesis—Atlas of the Chukchi and Beaufort Seas: Audubon Alaska and Oceana, Anchorage)]

Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Physical Oceanography—Continued		
Sea Ice Dynamics	Fair	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Chukchi Sea shoals. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Landfast ice (≥3 months per year). GIS feature class (based on National Ice Center 2008). Audubon Alaska. 2009. Monthly sea ice concentration (≥50 percent based on monthly median from 2003–2007). GIS raster dataset (based on National Ice Center 2008). Audubon Alaska. 2009. Recurring leads and polynyas. GIS feature class (based on Stringer and Groves 1991; USFWS 1995; Carmack and MacDonald 2002; Eicken et al. 2005). Carmack, E.C., and R. MacDonald. 2002. Oceanography of the Canadian shelf of the Beaufort Sea: a setting for marine life. Arctic 55:29-45. Eicken, H., L.H. Shapiro, A.G. Gaylord, A. Mahoney, and P.W. Cotter. 2005. Mapping and characterization of recurring spring leads and landfast ice in the Beaufort and Chukchi seas. OCS Study MMS 2005-068. MMS, Anchorage, Alaska. Hearon, G., D. Dickins, K. Ambrosius, and K. Morris. 2009. Mapping sea ice overflood using remote sensing: Smith Bay to Camden Bay. Report prepared by DF Dickins Associates, Coastal Frontiers Corporation, Aerometric, and University of Alaska, The Geophysical Institute, for U.S. Department of Interior, MMS, Alaska OCS Region. National Ice Center. 2008. National Ice Center Arctic sea ice charts and climatologies in gridded format. GIS datasets. F. Fetterer and C. Fowler, editors. National Snow and Ice Data Center, Boulder, Colorado. National Snow and Ice Data Center. 2010. Monthly sea ice extent. GIS shapefile. <ftp://sidadscolorado.edu/DATASETS/NOAA/G02135 shapefiles/>. Accessed January 2010. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. Stringer, W.J., and J.E. Groves. 1991. Location and areal extent of polynyas in the Bering and Chukchi seas. Arctic 44, Supplement 1:164-171. USFWS. 1995. Habitat conservation strategy for polar bears in Alaska. USFWS, Anchorage, Alaska.
Sea Floor Substrate	Poor	Carmack, E.C., and R. MacDonald. 2002. Oceanography of the Canadian shelf of the Beaufort Sea: a setting for marine life. Arctic 55:29-45. Dunton, K.H., E. Reimnitz, and S. Schonberg. 1982. An Arctic kelp community in the Alaskan Beaufort Sea. Arctic 35(4):465-484. Horowitz, W.L. 2002. Evaluation of sub-sea physical environmental data for the Beaufort Sea OCS and incorporation into a geographic information system (GIS) database. OCS Study MMS 2002 017. <http://www.mms.gov/itd>. Accessed June 2009. Mohr, J.L., N.J. Wilimovsky, and E.Y. Dawson. 1957. An Arctic Alaskan kelp bed. Arctic 19:45-54. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington.

Table E–1. Listing of maps, data sources, and data quality ratings as compiled from "The Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas" by Audubon Alaska in partnership with Oceana (Smith, 2010)—Continued

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Physical Oceanography—Continued		
Sea Surface Temperature	Good	Audubon Alaska. 2009. Average yearly mean sea surface temperature, May–October, 2004–2008 GIS raster dataset (based on Feldman and McClain 2009). Feldman, G.C., and C.R. McClain. 2009. Ocean color web, aqua MODIS, NASA Goddard Space Flight Center. N. Kuring, S. Bailey, and W. April, editors. <http://oceancolor.gsfc.nasa.gov/>. Accessed June 2009.
Observed Climate Change	Good	Halpern, B., S. Walbridge, K. Selkoe, C. Kappel, F. Micheli, C. D'Agrosa, et al. 2008. A global map of human impact on marine ecosystems. Science 319:948-952. National Snow and Ice Data Center. 2010. Monthly sea ice extent. GIS shapefile. <ftp://sidadscolorado.edu/DATASETS/NOAA/G02135 shapefiles/>. Accessed January 2010.
Water Column and Benthic Life		
Chlorophyll-*A*	Good	Audubon Alaska. 2009. Average seasonal mean chlorophyll-a, May–October, 2004–2008. GIS raster dataset (based on Feldman and McClain 2009). Feldman, G.C., and C.R. McClain. 2009. Ocean color web, aqua MODIS, NASA Goddard Space Flight Center. N. Kuring, S. Bailey, and W. April, editors. <http://oceancolor.gsfc.nasa.gov/>. Accessed June 2009.
Net Primary Productivity	Good	Audubon Alaska. 2009. Mean yearly sum of net primary productivity, 2003–2007. GIS raster dataset (based on Behrenfeld and Falkowski 1997; Oregon State University 2009). Behrenfeld, M.J., and P.G. Falkowski. 1997. Photosynthetic rates derived from satellite-based chlorophyll concentration. Limnology and Oceanography 42:1-20. Oregon State University. 2009. Ocean productivity. GIS datasets. <http://www.science.oregonstate.edu/ocean.productivity/index.php>. Accessed April 2009.
Zooplankton	Poor	NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
Benthic Biomass	Fair	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Benthic biomass. GIS raster dataset (based on Grebmeier et al. 2006; Shelf Basin Interaction 2008). Grebmeier, J.M., L.W. Cooper, H.M. Feder, and B.I. Sirenko. 2006. Ecosystem dynamics of the Pacific-influenced northern Bering and Chukchi seas in the Amerasian Arctic. Progress in Oceanography 71:331-361. Shelf Basin Interaction. 2008. Benthic samples. Microsoft Access database. <http://www.eol.ucar.edu/projects/sbi/all_data.shtml>. Accessed July 2008.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Water Column and Benthic Life—Continued		
Opilio (Tanner or Snow Crab)	Poor	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Opilio crab. GIS feature class (based on NOAA 1988; Paul and Paul 1997; NOAA and MMS 2008). NMFS (National Fisheries Management Service). 2005. Final environmental impact statement for essential fish habitat identification and conservation in Alaska. NOAA National Marine Fisheries Service, Alaska Region, Anchorage. NOAA (National Oceanic and Atmospheric Administration) and MMS. 2008. Cruise report for the 2008 Beaufort Sea Survey, July 27–August 30, 2008. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. Paul, J.M., and A.J. Paul. 1997. Reproductive biology and distribution of the snow crab from the northeastern Chukchi Sea. American Fisheries Society Symposium 19:287-294.
Fish		
Capelin	Poor	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Johnson, S. 2008. Capelin counts from beach seine surveys near Barrow, 2004–2008. Excel spreadsheet. NOAA, Juneau, Alaska. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
Pacific Herring	Poor	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
Saffron Cod	Poor	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Saffron cod. GIS feature class (based on NOAA 1988; NOAA and MMS 2008; Wilson 2009) Geological Survey of Canada. In review. Environmental atlas of the Beaufort coastlands. <http:/gsc.nrcan.gc.ca/beaufort/fisheries_e.php>. Accessed January 2010. NOAA (National Oceanic and Atmospheric Administration) and MMS. 2008. Cruise report for the 2008 Beaufort Sea Survey, July 27–August 30, 2008 NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NMFS (National Fisheries Management Service). 2005. Final environmental impact statement for essential fish habitat identification and conservation in Alaska. NOAA National Marine Fisheries Service, Alaska Region, Anchorage. Wilson, Bill, NOAA. 2009. Personal communication with Melanie Smith, Audubon Alaska. 25 June.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Fish—Continued		
Pink Salmon	Poor	ADFG. 2009. Anadramous waters catalog. GIS shapefile. AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
Chum Salmon	Poor	ADFG. 2009. Anadramous waters catalog. GIS shapefile. AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
Birds		
Yellow-Billed Loon	Fair	Audubon Alaska. 2009. Yellow-billed Loon. GIS feature class (based on USFWS 1992-2008; Schmutz 2002-09; Drew and Piatt 2003; Fair, 2009; Schmutz 2009). BirdLife International. 2009. Important Bird Areas. GIS feature class Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Fair, J. 2009. Personal communication with M. Smith/Audubon Alaska. 18 December. Schmutz, J. 2009. Yellow-billed Loon satellite telemetry locations 2002-09. Alaska Science Center, USGS, Anchorage. Schmutz, J./USGS. 2009. Personal communication with M. Smith/Audubon Alaska. June. USFWS. 1992–2005. Density polygons (based on USFWS Eider breeding population survey and USFWS Arctic Coastal Plain aerial breeding pair survey). USFWS. 1992–2006. Eider breeding population survey. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey. USFWS. 1998–2003. Arctic Coastal Plain molting sea duck survey. USFWS. 1999–2001. Beaufort Sea nearshore and offshore waterbird aerial survey. USFWS. 1999–2007. Common Eider survey. USFWS. 2003–2004. Arctic Coastal Plain Yellow-billed Loon survey. USFWS. 2005–2007. Western Alaska Yellow-billed Loon survey. USFWS. 2007. Yellow-billed Loon (Gavia adamsii) fact sheet. May. USFWS, Alaska Region, Anchorage.

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Birds—Continued		
Red-Throated Loon	Fair	Audubon Alaska. 2009. Red-throated Loon. GIS feature class (based on Portenko 1981; Flint et al. 1984; USFWS 1992-2008; Barr et al. 2000; Schmutz 2000-09; Drew and Piatt 2003; Ridgely et al. 2007; Schmutz 2009). Barr, J.F., C. Eberl, and J.W. Mcintyre. 2000. Red-throated Loon (Gavia stellata). In The birds of North America Online. A. Poole, editor. Cornell Lab of Ornithology, Ithaca, New York. <http://bna.birds.cornell.edu/bna/species/513>. Accessed June 2009. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Flint, V.E., R.L. Boehme, Y.V. Kostin, and A.A. Kuznetsov. 1984. A field guide to birds of the USSR. NJ: Princeton University Press, Princeton, New Jersey. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington. Portenko, L.A. 1981. Birds of the Chukchi Peninsula and Wrangel Island (translated from Russian). Published for the Smithsonian Institution and the National Science Foundation, Washington, D.C. Amerind, Springfield, Virginia. Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, et al. 2007. Digital distribution maps of the birds of the Western Hemisphere. version 3.0. NatureServe, Arlington, Virginia. Schmutz, J. 2009. Red-throated Loon satellite telemetry locations, 2002-09. Alaska Science Center, USGS, Anchorage. Schmutz, J./USGS. 2009. Personal communication with M. Smith/Audubon Alaska. June. USFWS. 1992–2005. Density polygons (based on USFWS Eider breeding population survey and USFWS Arctic Coastal Plain aerial breeding pair survey). USFWS. 1992–2006. Eider breeding population survey. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey. USFWS. 1998–2003. Arctic Coastal Plain molting sea duck survey. USFWS. 1999–2001. Beaufort Sea nearshore and offshore waterbird aerial survey. USFWS. 1999–2007. Common Eider survey. USFWS. 2003–2004. Arctic Coastal Plain Yellow-billed Loon survey. USFWS. 2005–2007. Western Alaska Yellow-billed Loon survey.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Birds—Continued		
Spectacled Eider	Fair	Audubon Alaska. 2009. Important Bird Areas. GIS feature class. Audubon Alaska. 2009. Spectacled Eider. GIS feature class (based on USFWS 1992-2008; Larned et al. 1995; Larned and Tiplady 1997; Larned 1999; Petersen et al. 1999; Petersen et al. 2000; Drew and Piatt 2003; Petersen 2009). BirdLife International. 2009. Important Bird Areas. GIS feature class. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Larned, W.W. 1999. Ledyard Bay survey. August. USFWS, Anchorage, Alaska. Larned, W.W., and T. Tiplady. 1997. Late winter population and distribution of Spectacled Eiders (Somateria fischeri) in the Bering Sea, 1996–97. October. USFWS, Anchorage, Alaska. Larned, W.W., G.R. Balogh, and M.R. Petersen. 1995a. Distribution and abundance of Spectacled Eiders (Somateria fischeri) in Ledyard Bay, Alaska, September 1995. November. USFWS, Anchorage, Alaska. Larned, W.W., G.R. Balogh, and M.R. Petersen. 1995b. Late winter distribution of Spectacled Eiders (Somateria fischeri) in the Bering Sea, 1995. September. USFWS, Anchorage, Alaska. Larned, W.W., J.I. Hodges, and M.R. Petersen. 1995c. Distribution and abundance of Spectacled Eiders (Somateria fischeri) in Mechigmenskiya Bay, Chukotka, Russia, September 1995. November. USFWS, Anchorage, Alaska. Larned, W.W., M.R. Petersen, K. Laing, R. Platte, and J.L. Hodges. 1995d. Progress report: location and characteristics or Spectacled Eider molting and wintering areas, 1993-94. February. USFWS, Anchorage, Alaska. Petersen, M./USGS. 2009. Personal communication with M. Smith/Audubon Alaska. July. Petersen, M.R., J.B Grand, and C.P. Dau. 2000. Spectacled Eider (Somateria fischeri). In The birds of North America online. A. Poole, editor. Cornell Lab of Ornithology, Ithaca, New York. <http:/bna.birds.cornell.edu/bna/species/547/articles/introduction>. Accessed June 2009. Petersen, M.R., W.W. Larned, and D.C. Douglas. 1999. At-sea distribution of spectacled eiders: A 120-year-old mystery resolved. Auk 116:1009-1020. USFWS. 1992–2005. Density polygons (based on USFWS Eider breeding population survey and USFWS Arctic Coastal Plain aerial breeding pair survey) USFWS. 1992–2006. Eider breeding population survey. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey. USFWS. 1999–2007. Common Eider survey. USFWS. 2008. Critical Habitat portal: Spectacled Eider Critical Habitat. GIS shapefile. <http://criticalhabitat.fws.gov/crithab/>. Accessed August 2008.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Birds—Continued		
Steller's Eider	Fair	Audubon Alaska. 2009. Steller's Eider. GIS feature class (based on USFWS 1992-2008; Fredrickson 2001; Drew and Piatt 2003; Ridgely et al. 2007; Martin 2009). BirdLife International. 2009. Important Bird Areas. GIS feature class. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Fredrickson, L.H. 2001. Steller's Eider (Polysticta stelleri). In The Birds of North America online. A. Poole, editor. Cornell Lab of Ornithology, Ithaca, New York. <http://bna.birds.cornell.edu/bna/species/571>. Accessed February 2009. Martin, P. 2009. Steller's Eider satellite telemetry locations 2000-02. USFWS, Fairbanks, Alaska. Martin, P./USFWS. 2009. Personal communication with M. Smith/Audubon Alaska. June. Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, et al. 2007. Digital distribution maps of the birds of the Western Hemisphere, version 3.0. NatureServe, Arlington, Virginia. USFWS. 1992–2006. Eider breeding population survey. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey. USFWS. 1998–2003. Arctic Coastal Plain molting sea duck survey. USFWS. 1999–2007. Common Eider survey.

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Birds—Continued		
King Eider	Fair	Audubon Alaska. 2009. King Eider. GIS feature class (based on NOAA 1988; USFWS 1992-2008; Larned et al. 1995; Dickson et al. 1997; Larned 1999; Dickson and Gilchrist 2002; Drew and Piatt 2003; Ridgely et al. 2007: Oppel 2008; Oppel 2009; Oppel et al. 2009). Audubon Alaska. 2009. Important Bird Areas. GIS feature class. Dickson, D.L., and H.G. Gilchrist. 2002. Status of marine birds of the southeastern Beaufort Sea. Arctic 55. Supplement 1:46-58. Dickson, D.L., R.C. Cotter, J.E. Hines, and M.F. Kay. 1997. Distribution and abundance of King Eiders in the western Canadian Arctic. In Occasional paper number 94. D.L. Dickson, editor. Canadian Wildlife Service, Edmonton, Alberta. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Larned, W.W. 1999. Ledyard Bay survey. August. USFWS, Anchorage, Alaska. Larned, W.W., G.R. Balogh, and M.R. Petersen. 1995a. Distribution and abundance of Spectacled Eiders (Somateria fischeri) in Ledyard Bay, Alaska, September 1995. November. USFWS, Anchorage, Alaska. Larned, W.W., G.R. Balogh, and M.R. Petersen. 1995b. Late winter distribution of Spectacled Eiders (Somateria fischeri) in the Bering Sea, 1995. September. USFWS, Anchorage, Alaska. Larned, W.W., M.R. Petersen, K. Laing, R. Platte, and J.L. Hodges. 1995d. Progress report: location and characteristics or Spectacled Eider molting and wintering areas, 1993-94. February. USFWS, Anchorage, Alaska. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. Oppel, S. 2008. King Eider migration and seasonal interactions at the individual level. Dissertation, University of Alaska Fairbanks, Fairbanks, Alaska. Oppel, S./University of Alaska Fairbanks. 2009. Personal communication with M. Smith/Audubon Alaska. September. Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, et al. 2007. Digital distribution maps of the birds of the Western Hemisphere, version 3.0. NatureServe, Arlington, Virginia. USFWS. 1992–2005. Density polygons (based on USFWS Eider breeding population survey and USFWS Arctic Coastal Plain aerial breeding pair survey). USFWS. 1992–2006. Eider breeding population survey. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey. USFWS. 1998–2003. Arctic Coastal Plain molting sea duck survey. USFWS. 1999–2001. Beaufort Sea nearshore and offshore waterbird aerial survey. USFWS. 1999–2007. Common Eider survey.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Birds—Continued		
Common Eider	Fair	Audubon Alaska. 2009. Common Eider. GIS feature class (based on Drew and Piatt 2003; USFWS 1992–2008; NOAA 1988; Kendall 2005). Audubon Alaska. 2009. Important Bird Areas. GIS feature class. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Kendall, S.J. 2005. Surveys of breeding birds on barrier islands in the Arctic National Wildlife Refuge, 2003–2004. USFWS, Arctic National Wildlife Refuge, Fairbanks, Alaska. Larned, W.W., M.R. Petersen, K. Laing, R. Platte, and J.L. Hodges. 1995d. Progress report: location and characteristics or Spectacled Eider molting and wintering areas, 1993-94. February. USFWS, Anchorage, Alaska. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey. USFWS. 1998–2003. Arctic Coastal Plain molting sea duck survey. USFWS. 1999–2001. Beaufort Sea nearshore and offshore waterbird aerial survey. USFWS. 1999–2007. Common Eider survey. USFWS. 2005–2007. Western Alaska Yellow-billed Loon survey. USFWS. 2008. Beringian seabird colony catalog. Microsoft Excel spreadsheet.
Long-Tailed Duck	Fair	Alexander, S.A., D.L. Dickson, and S.E. Westover. 1997. Spring migration of eiders and other waterbirds in offshore areas of the western Arctic. In King and Common eiders of the western Canadian Arctic. D.L. Dickson, editor. Occasional Paper Number 94. Canadian Wildlife Service, Edmonton, Alberta. Audubon Alaska. 2009. Important Bird Areas. GIS feature class. BirdLife International. 2009. Important Bird Areas. GIS feature class. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington. Portenko, L.A. 1981. Birds of the Chukchi Peninsula and Wrangel Island (translated from Russian). Published for the Smithsonian Institution and the National Science Foundation, Washington, D.C. Amerind, Springfield, Virginia. USFWS. 1992–2005. Density polygons (based on USFWS Eider breeding population survey and USFWS Arctic Coastal Plain aerial breeding pair survey). USFWS. 1992–2006. Eider breeding population survey. USFWS. 1992–2008. Arctic Coastal Plain aerial breeding pair survey.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Birds—Continued		
Ivory Gull	Poor	Audubon Alaska. 2009. Ivory Gull. GIS feature class (based on Portenko 1981; Benter 2009). Benter, B./USFWS. 2009. Personal communication with M. Smith/Audubon Alaska. 21 August. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Mallory, M.L., I.J. Stenhouse, G. Gilchrist, G. Robertson, J.C. Haney, and S.D. Macdonald. 2008. Ivory Gull (Pagophila eburnea). In The birds of North America Online. A. Poole, editor. Cornell Lab of Ornithology, Ithaca, New York. <http://bna.birds.cornell.edu/bna/species/175>. Accessed June 2009. Portenko, L.A. 1981. Birds of the Chukchi Peninsula and Wrangel Island (translated from Russian). Published for the Smithsonian Institution and the National Science Foundation, Washington, D.C. Amerind, Springfield, Virginia.
Kittlitz's Murrelet	Poor	Arctic Ocean Diversity. 2009. Kittlitz's Murrelet known nest locations in Alaska (based on Day et al. 1999). <http://www.arcodiv.org/Database/Birds_datasets.html>. Accessed June 2009. Audubon Alaska. 2009. Important Bird Areas. GIS feature class. Day, R.H., K.J. Kuletz, and D.A. Nigro. 1999. Kittlitz's Murrelet (Brachyramphus brevirostris). In The birds of North America online. A. Poole, editor. Cornell Lab of Ornithology, Ithaca, New York.<http://bns.birds.cornell.edu/bna/species/435>. Accessed January 2010. Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, et al. 2007. Digital distribution maps of the birds of the Western Hemisphere, version 3.0. NatureServe, Arlington, Virginia. USFWS. 2009. Kittlitz's Murrelet nesting areas. USFWS, Anchorage Field Office.
Northern Fulmar	Fair	Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. USFWS. 2008. Beringian seabird colony catalog. Microsoft Excel spreadsheet.
Short-Tailed Shearwater	Fair	Drew, G.S., and J.F. Piatt. 2003. North Pacific pelagic seabird database, version 1.0. Alaska Science Center, USGS, Anchorage. Larned, W.W. 1999. Ledyard Bay survey. August. USFWS, Anchorage, Alaska. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
Seabird Colonies	Fair	USFWS. 2008. Beringian seabird colony catalog. Microsoft Excel spreadsheet.
Important Bird Areas	Fair	Audubon Alaska. 2009. Important Bird Areas. GIS feature class. BirdLife International. 2009. Important Bird Areas. GIS feature class. Bird Studies Canada and Canadian Nature Federation. 2004. Important Bird Areas of Canada database. Bird Studies Canada, Port Rowan, Ontario.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Mammals		
Polar Bear	Fair	ADFG. 1997. Most Environmentally Sensitive Area (MESA) Data. GIS shapefiles. Habitat and Restoration Division. Amstrup, S.C., G.M. Durner, I. Stirling, and T.L. McDonald. 2005. Allocating harvests among polar bear stocks in the Beaufort Sea. Arctic 58:247-259. Kalxdorff. S. 1997. Collection of local knowledge regarding polar bear habitat use in Alaska. Technical report MMM 97-2. USFWS, Marine Mammal Management, Anchorage, Alaska. Kochnev, A.A., V.M. Etylin, V.I. Kavry, E.B. Siv-Siv, and I.V. Tanko. 2003. Traditional knowledge of Chukotka Native peoples regarding polar bear habitat use. Prepared for U.S. National Park Service by The Chukotka Association of Traditional Marine Mammal Hunters, The Alaska Nanuuq Commission, The Pacific Fisheries Research Center (Chukotka Branch). McDonald, L.L., and D.G. Robertson. 2000. Polar bear maternity den surveys in the Russian Arctic: development of protocols and standard operating procedures. Western EcoSystem Technologies, Cheyenne, Wyoming. MMS. 2008. Bowhead whale aerial survey program. Microsoft Access database. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington. North Slope Science Initiative. 2008. Polar bear locations. GIS shapefile. <http://www.gina.alaska.edu/projects/nssi-catalog>. Accessed October 2008. Stishov, M.S. 1991. Results of aerial counts of the polar bear dens on the Arctic coasts of the extreme Northeast Asia. In Polar bears: proceedings of the tenth working meeting of the IUCN/SSC Polar Bear Specialist Group. S.C. Amstrup and O. Wiig, editors. October 25-29. Sochi, USSR. USFWS. 2009. Polar bear proposed critical habitat. GIS shapefiles. USFWS (U.S. Fish and Wildlife Service) and MMS. 1994. Conservation plan for the polar bear in Alaska. June. USFWS, Anchorage, Alaska. USGS (U.S. Geological Survey). 2002. Confirmed polar bear den locations, 1919-2002. GIS shapefile. Biological Resources Division.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Mammals—Continued		
Arctic Fox	Poor	Audubon Alaska. 2009. Arctic fox. GIS feature class (based on Pelletier 2000; Nowacki et al. 2001; Patterson et al. 2007; Pamperin 2008; Northwest Territories Environment and Natural Resources Wildlife Division 2009; IUCN 2009). IUCN (International Union for Conservation of Nature). 2009. Arctic fox (Alopex lagopus) range map. Species Survival Commission Canid Specialist Group.<http://www.canids.org/species/Alopex_lagopus.htm>. Accessed June 2009. Northwest Territories Environment and Natural Resources Wildlife Division. 2009. Arctic fox distribution. Digital map. <http://www.nwtwildlife.com/NWTwildlife/foxes/arcticfox/distribution.htm>. Accessed June 2009. Nowacki, G., P. Spencer, T. Brock, M. Fleming, and T. Jorgenson. 2001. Ecoregions of Alaska. GIS shapefile. USGS, Reston, Virginia. Pamperin, N.J. 2008. Winter movements of Arctic foxes in northern Alaska measured by satellite telemetry. University of Alaska Fairbanks. Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, et al. 2007. Digital distribution maps of the mammals of the Western Hemisphere, version 3.0. NatureServe, Arlington, Virginia. Pelletier, B.R. 2000. Environmental atlas of the Beaufort coastlands. Geological Survey of Canada. <http://gsc.nrcan.gc.ca/beaufort index_ephp>. Accessed June 2009.
Pacific Walrus	Fair	ADFG (Alaska Department of Fish and Game). 1986. Alaska habitat management guide. Division of Habitat, Juneau, Alaska. AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Chukchi Sea shoals. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Pacific walrus. GIS feature class (based on NOAA 1988; MMS 2008). MMS. 2008. Bowhead whale aerial survey program. Microsoft Access database. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. Robards, M., A. Kochnev, and S. Deming. 2007. Sharing knowledge about Pacific walrus. Published map.
Ribbon Seal	Fair	AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Angliss, R.P., and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce. Report Technical Memo NMFS-AFSC-180. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Boveng, P.L., J.L. Bengtson, T.W. Buckley, M.F. Cameron, S.P. Dahle, B.A. Megrey, J.E. Overland, and N.J. Williamson. 2008. Status review of the ribbon seal (Histriophoca fasciata). U.S. Department of Commerce, NOAA. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Mammals—Continued		
Spotted Seal	Fair	ADFG. 1997. Most Environmentally Sensitive Area (MESA) Data. GIS shapefiles. Habitat and Restoration Division. AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Angliss, R.P., and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce. Report Technical Memo NMFS-AFSC-180. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Spotted seal. GIS feature class (based on NOAA 1988; ADFG 1997; Rugh et al. 1997; Lowry et al. 1998; Eningowuk 2002; NOAA 2002; Oceana 2008). Eningowuk, J. 2002. Spotted seal (based on local and traditional knowledge). Lowry, L.F., K.J. Frost, R. Davis, D.P. DeMaster, and R.S. Suydam. 1998. Movements and behavior of satellite-tagged spotted seals (Phoca largha) in the Bering and Chukchi seas. Polar Biology 19:221-230. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington. Oceana. 2008. Spotted seal. GIS feature class (based on local and traditional knowledge). Rugh, D.J., K.E.W. Shelden, and D.E. Withrow. 1997. Spotted seals, Phoca largha, in Alaska. Marine Fisheries Review 59:1-18.
Ringed Seal	Fair	ADFG (Alaska Department of Fish and Game). 1986. Alaska habitat management guide. Division of Habitat, Juneau, Alaska. Angliss, R.P., and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce. Report Technical Memo NMFS-AFSC-180. AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Ringed seal. GIS feature class (based on NOAA 1988; Harwood and Stirling 1992; MMS 2008). Bengtson, J.L., L.M. Hiruki-Raring, M.A. Simpkins, and P.L. Boveng. 2005. Ringed and bearded seal densities in the eastern Chukchi Sea, 1999–2000. Polar Biology 28:833-845. Frost, K./Retired biologist. 2010. Personal communication with M. Smith/Audubon Alaska. 3 January. Harwood, L.A., and I. Stirling. 1992. Distribution of ringed seals in the southeastern Beaufort Sea during late summer. Canadian Journal of Zoology 70:891-900. MMS. 2008. Bowhead whale aerial survey program. Microsoft Access database. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Mammals—Continued		
Bearded Seal	Fair	Angliss, R.P., and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce. Report Technical Memo NMFS-AFSC-180. AOOS. 2009. 1 km topographic/bathymetric map of Alaska. Raster dataset. <http://ak.aoos.org/aoos/tools.htm>. Accessed February 2009. Audubon Alaska. 2009. Bathymetric contour lines. GIS feature class (based on AOOS 2009). Audubon Alaska. 2009. Bearded Seal. GIS feature class (based on NOAA 1988; Bengtson et al. 2005; Angliss and Outlaw 2008; MMS 2008; Boveng 2009). Audubon Alaska. 2009. Chukchi Sea shoals. GIS feature class (based on AOOS 2009). Bengtson, J.L., L.M. Hiruki-Raring, M.A. Simpkins, and P.L. Boveng. 2005. Ringed and bearded seal densities in the eastern Chukchi Sea, 1999–2000. Polar Biology 28:833-845. Boveng, P./NOAA Alaska Fisheries Science Center. 2009. Personal communication with M. Smith/Audubon Alaska. June. Frost, K./Retired biologist. 2010. Personal communication with M. Smith/Audubon Alaska. 3 January. MMS. 2008. Bowhead whale aerial survey program. Microsoft Access database. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington.
Bowhead Whale	Fair	ADFG. 2009. Summary maps of fall movements of bowhead whales in the Chukchi Sea. <http://www.adfg.alaska.gov/static/home/about/management/wildlife/management/marinemammals/pdfs/bow_move_chukchi_sea.pdf>. Accessed February 2009. Audubon Alaska. 2009. Bowhead whale. GIS feature class (based on North Slope Borough 2003; ADFG 2009; Quakenbush 2009). Moore, S.E., and K.L. Laidre. 2006. Trends in sea ice cover within habitats used by bowhead whales in the Western Arctic. Ecological Applications 16(3):932-944. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington. Noongwook, G., H.P. Huntington, and J.C. George. 2007. Traditional knowledge of the bowhead whale (Balaena mysticetus) around St. Lawrence Island, Alaska. Arctic 60:47-54. North Slope Borough. 2003. Bowhead whale subsistence sensitivity. (The map incorporates data from Moore and Reeves 1993 and Richardson 1999.) In Barrow, Alaska: North Slope Borough. Department of Planning and Community Services, Geographic Information Systems Division. Oceana. 2008. Bowhead whale. GIS feature class (based on local and traditional knowledge). Quakenbush, L./ADFG. 2009. Personal communication with M. Smith/Audubon Alaska. February.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
Mammals—Continued		
Beluga Whale	Fair	ADFG. 1997. Most Environmentally Sensitive Area (MESA) Data. GIS shapefiles. Habitat and Restoration Division. Angliss, R.P., and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce. Report Technical Memo NMFS-AFSC-180. Huntington, H. P., and the communities of Buckland, Koyuk, Point Lay, and Shaktoolik. 1999. Traditional knowledge of the ecology of beluga whales (*Delphinapterus leucas*) in the eastern Chukchi and northern Bering seas, Alaska. Arctic 52:49-61. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas. NOAA. 2002. Environmental sensitivity index, version 3.0. NOAA, Seattle, Washington. Suydam, R., and ADFG. 2004. Bowhead whale feeding areas. *In* North Slope Borough. 2006. North Slope Borough Area Wide Comprehensive Plan. Barrow, Alaska.
Gray Whale	Fair	Angliss, R.P., and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce. Report Technical Memo NMFS-AFSC-180. Audubon Alaska. 2009. Gray whale. GIS feature class (based on NOAA 1988; MMS 2008). MMS. 2008. Bowhead whale aerial survey program. Microsoft Access database. NOAA. 1988. Bering, Chukchi, and Beaufort seas coastal and ocean zones strategic assessment data atlas.
People		
Energy Development and Protected Areas	Good	Alaska Center for the Environment. 2009. Oil and gas infrastructure. GIS geodatabase. Alaska Department of Natural Resources. 2008. Surface holes. GIS shapefile. Alaska Department of Natural Resources. 2009. Oil and gas leases. GIS shapefile. Alaska Oil and Gas Conservation Commission. 2009. Oil and gas wells. GIS shapefile. Alaska State Geospatial Data Clearinghouse. 2008. Base data. GIS shapefiles. <http://www.asgdc.state.ak.us/>. Accessed June 2008. Audubon Alaska. 2009. MMS program areas, 2010–2015. GIS feature class (based on MMS 2009). BLM. 2008. Oil and gas infrastructure. GIS shapefiles. ESRI. 2009. StreetMap premium: North America. GIS feature class. MMS. 2009. Draft proposed Outer Continental Shelf (OCS) oil and gas leasing program, 2010–2015. January. World Wildlife Fund. 2009. Arctic-wide human infrastructure. GIS geodatabase. World Wildlife Fund. 2010. Protected areas in eastern Russia. GIS shapefile.
Human Impact	Good	Alaska Department of Natural Resources. 2008. Surface holes. GIS shapefile. Halpern, B., S. Walbridge, K. Selkoe, C. Kappel, F. Micheli, C. D'Agrosa, et al. 2008. A global map of human impact on marine ecosystems. Science 319:948-952.

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Map title	Data quality rating (Good, Fair, Poor)	Data sources for individual maps
People—Continued		
Predicted Climate Change	Fair	Audubon Alaska. 2009. Predicted climate change: increase in air temperature at surface, mean for June - August, 2000–2009 versus 2090 2099. GIS raster dataset (based on NCAR 2009; SNAP 2009). NCAR (National Center for Atmospheric Research). 2009. Global CCSM data: Scenario A1B –ensemble average for air temperature at surface. GIS shapefile. Geographic Information Systems (GIS) Initiative. <http://www.gisclimatechange.org/CCSMDownloadWizard.htm>.Accessed March 2009. SNAP (Scenarios Network for Alaska Planning). 2009. A1B GCM dataset: air temperature – 5-model composite. GIS raster dataset. <http://www.snap.uaf.edu/downloads/alaska-climate-datasets>. Accessed March 2009.

For more information, contact:

Energy Resources Program Coordinator
U.S. Geological Survey, MS 915A
Reston, VA 20192

Regional Executive, Alaska
U.S. Geological Survey
4210 University Drive
Anchorage, AK 99508

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Other Organizations Documents and Information

G.

Alaska Marine Policy Forum, Summary of Wed. May 25, 2011 Teleconference

AOOS
Alaska Ocean Observing System

Sea Grant
Alaska

Alaska Marine Policy Forum

Summary of Wednesday, May 25, 2011 call
Host: Molly McCammon mccammon@aoos.org

Alaska Marine Policy Forum: A bimonthly teleconference for Alaskans to network and share information about marine policy, budgets, and legislation at state, national, and international levels, sponsored by Alaska Sea Grant and the Alaska Ocean Observing System.

NOTES FROM THE May 25 CALL

Cheryl Rosa and John Farrell, Arctic Research Commission
As part of the National Ocean Council development of a National Ocean Policy, the Arctic Research Commission is co-lead with the Navy in developing an Arctic Strategic Action Plan (SAP). They have been working since February, and the draft outline will be public on June 1 (at www.whitehouse.gov/administration/eop/oceans/sap). The National Ocean Policy has 9 priority areas that include environmental response, ocean observing and coordination of data. The Arctic is the only geographic region called out for its own SAP. Two listening sessions will be held in Alaska: one in Barrow on June 9th at City Hall, and the other in Anchorage on June 10th at the Loussac Library (both 4-9 pm).

Arne Fuglvog, staff to AK Senator Lisa Murkowski
Senator Murkowski was very happy with her trip to Nuuk for the Arctic Council meeting with Secs. Clinton and Salazar. She is impressed with the administration's willingness to step up for Arctic issues, showing that the Arctic has reached a new level of priority. The new Search and Rescue (SAR) binding agreement is important and they now are moving toward an agreement on oil spill response.

Arne noted that more and more Arctic issues are coming up at the national level. Sen. Murkowksi gave a floor speech last week on the Arctic. She and Sen. Begich still want to see movement on the Law of the Sea Treaty. It needs 67 votes to pass the Senate, and it will probably take 7-8 days of "floor time" to get the vote scheduled.

Lawson Brigham suggested that the Arctic Council's oil spill response plan be written more openly using public and industry input, unlike how the SAR agreement was reached. Bob Pawlowski asked about the deep water port charrette in Anchorage last week. Arne mentioned that currently the US doesn't have any plans to build an Arctic port,, but with about 800 ongoing projects in the Arctic, that might make sense. He mentioned that the state and industry need to engage in the discussions about a deep water port. The fundamental question is "Is it in the nation's best interest to have a deep water port in the Arctic?"

Re: Budget – The House is marking up bills; the Senate is more focused on debt ceiling and isn't likely to mark up any individual bills this summer. It's possible that individual budget bills get passed, or that

there is an omnibus bill, or there could be another continuing resolution. Unfortunately, if a continuing resolution is passed late in the year, summer construction projects in Alaska get delayed.

Christine Hess, Staff to AK Legislature Rep. Reggie Joule (D-Kotzebue)
Re: the Alaska Coastal Management Program (ACMP) – the Alaska State Senate says that they have the votes to agree to come back for a special session for probably 2 days to address the Alaska Coastal Management Program. Senator Begich sent a letter to the governor which was very helpful. A 2/3 vote of the House is required for the Legislature to call itself into special session. The issues on the table are the inclusion of local and traditional knowledge in decision making, and 'removal for cause' from the Board. NOTE: Since the Marine Policy Forum teleconference, the Legislature decided not to hold the special session since they were not able to reach agreement on the legislation.

The Northern Waters Task Force will meet in Kotzebue on July 5 and 6, followed by Nome on July 7 and 8. The Task Force will take field trips to Red Dog Mine on the 6th, and to Wales, Diomede, and potential port sites, on the 9th. The Kotzebue visit will be concurrent with the local trade fair festival. Other trips on the docket include:

- Unalaska: Aug 24-26th
- September: potentially an additional meeting to wrap up loose ends or hear from presenters not available at other meetings, especially the Bethel meeting that was cancelled.

Cheryl Rosa, USARC (continued)
The Interagency Arctic Policy Committee (IARPC), part of the White House Office of Science and Technology Policy, has hired Alaskan Brendan Kelly for about 45% of his time. They are working on budget cross-cut planning for federal Arctic research which will allow them to get a handle on what is being spent on the Arctic. This cross cut has the support of OMB, and will be part of the 2014 budget. In the 5-year plan that IARPC is crafting, there is emphasis on collaboration, sustainability, and improved coordination.

Amy Holman, NOAA
Check the Federal Register for notification about a public hearing by the International Whaling Commission in Anchorage June 14. Also, NOAA and BOEMRE have developed an MOU so that they can work more closely together.

Ian Dutton, Alaska SeaLife Center
Several Alaskans recently attended the International Marine Conservation Congress in Victoria, BC. Ian can provide information if you are interested. June 8th is World Oceans Day and there will be two new statues unveiled at the ASLC, as well as 2 new exhibits. Tickets to the evening party are $20 (5-7pm on the 8th).

Cdr. Mark Everitt, USCG
USCG Rear Admiral Tom Ostebo was recently appointed Commander of the 17th USCG District replacing Chris Colvin. The Coast Guard will do a search and rescue exercise in Barrow next week. They will also do a towing experiment in the Bering Strait this summer, as well resume Arctic overflights. If you are interested in coming along on a flight, contact Shane Montoya or Mark Everitt at the USCG. Additionally, the Healy leaves Seattle next week, will stop in Hawaii, and then continue on to the Arctic until Dec 30th.

Kris Holdereid, Kachemak Bay NERR and Gary Freitag, Alaska Sea Grant MAP

Harmful algal blooms in Ketchikan and Juneau are significant right now. Gary noted that these are Alexandruim cells, so PSP and not domoic acid. Three very sick people have gone to the hospital in Ketchikan for digging clams on local beaches. He noted that with warm, sunny weather, conditions are just right.

Upcoming Events

June 8	World Ocean Day, events at the Alaska Sea Life Center
June 9	National Ocean Policy Listening Session, Barrow
June 10	National Ocean Policy Listening Session, Anchorage
June 11	Copper River Nouveau, Cordova
June 13	Cryosphere Hazards in Alaska workshop, Anchorage
June 14	NOAA Deputy Undersecretary Monica Medina has ocean observing discussion at AOOS
June 19-21	Arctic Imperatives conference, Girdwood, sponsored by Aspen Institute & AK Dispatch
June 20-25	"4th Symposium on Impacts of Ice Diminishing Arctic on Naval and Maritime Operations (Washington DC)
June 21-23:	National Ocean Policy's national CMSP meeting. Reps from Alaska are six fed agencies points of contact, Mark Robbins from the Governor's office, and some invitees from the Alaska Native community. Washington DC. (June 21st is open to public; the rest is invite-only.) Washington DC
June 26-29:	Solutions to Coastal Disasters national conference, Anchorage
July 18-22	Coastal Zone 2011 national conference, Chicago

Next Meetings

Dates for next two calls:

Wednesday July 20th, 1 pm Alaska time
Wednesday, September 21, 1 pm Alaska time

AOOS
www.aoos.org

Alaska Ocean Observing System

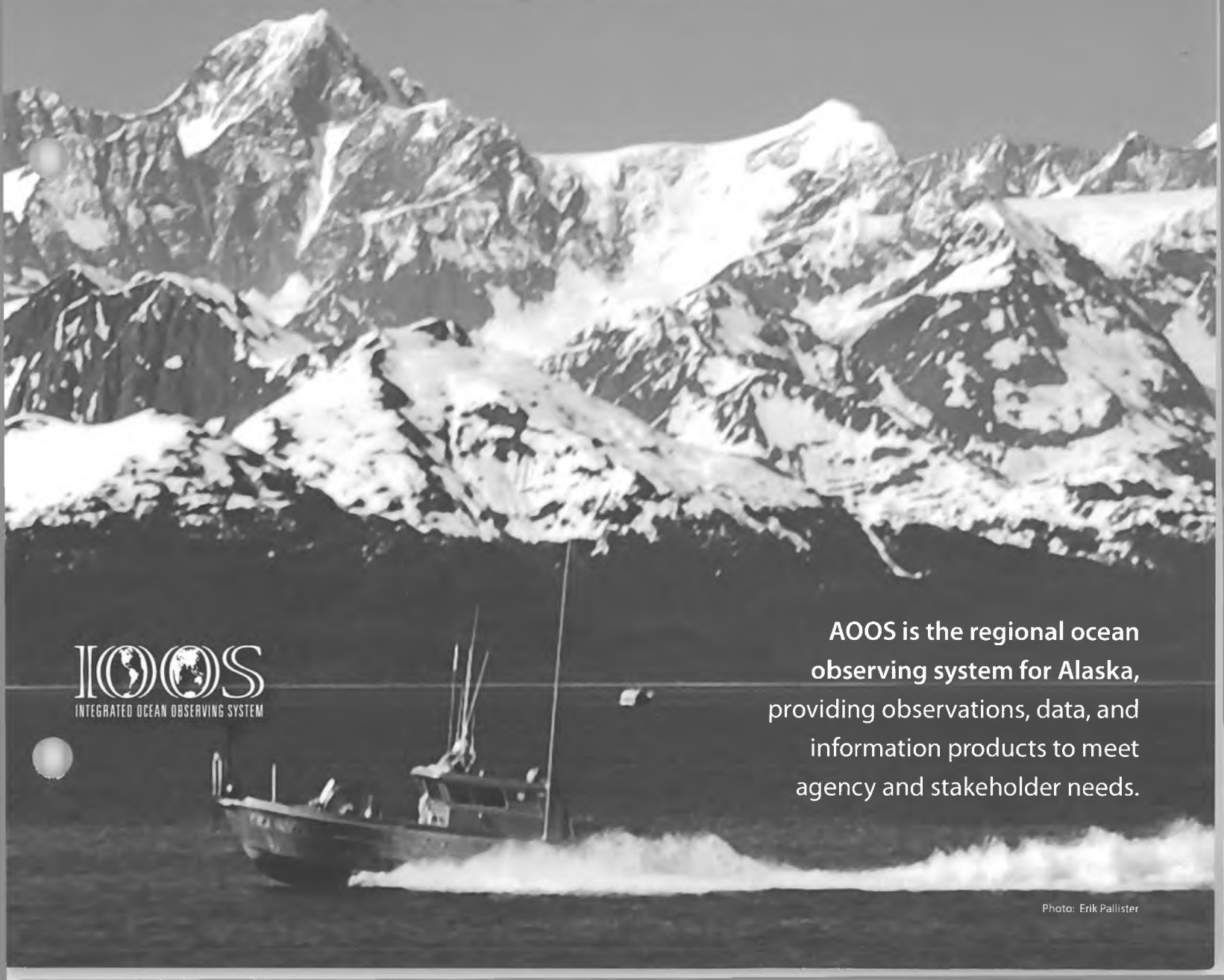
The eye on Alaska's coasts and oceans

We help improve

SAFETY: By ensuring the safety and security of Alaskans

ECONOMY: By helping unlock economic benefits of the ocean

ENVIRONMENT: By protecting our marine resources



IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

AOOS is the regional ocean observing system for Alaska, providing observations, data, and information products to meet agency and stakeholder needs.

Photo: Erik Pallister

A tool for tracking, predicting, managing, and adapting to changes in our marine environment

AOOS

AOOS Members

State agencies
- Alaska Dept. of Environmental Conservation
- Alaska Dept. of Fish and Game
- Alaska Dept. of Natural Resources

Federal agencies
- Bureau of Ocean Energy Management, Regulation and Enforcement
- NOAA
- U.S. Coast Guard
- U.S. Geological Survey

State/federal entities
- Alaska Sea Grant Program

Research entities
- Alaska SeaLife Center
- Barrow Arctic Science Consortium
- NOAA Alaska Fisheries Science Center
- North Pacific Research Board
- Prince William Sound Science Center/ Oil Spill Recovery Institute
- University of Alaska
- U.S. Arctic Research Commission

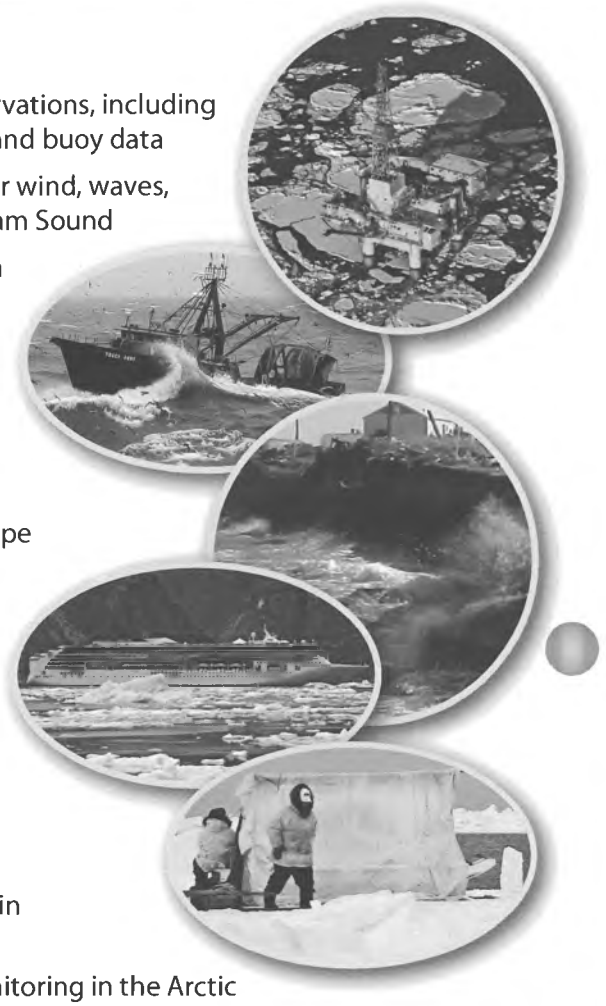
Non-profit NGO
- Marine Exchange of Alaska

AOOS Board Officers
- ***Chair: Denby Lloyd,*** Alaska Dept. of Fish and Game
- ***Vice Chair: Glenn Sheehan,*** Barrow Arctic Science Consortium
- ***Secretary: Ed Page,*** Marine Exchange of Alaska
- ***Treasurer: Doug DeMaster,*** NOAA Alaska Fisheries Science Center

AOOS Staff
- ***Molly McCammon,*** Executive Director
- ***Darcy Dugan,*** Program Manager for Partnerships and Outreach
- ***Rob Bochenek,*** Data Manager

What we do

- Give access to real-time observations, including web cams, weather stations, and buoy data
- Produce data and forecasts for wind, waves, and circulation in Prince William Sound
- Monitor ocean acidification in the northern Gulf of Alaska and Arctic
- Support glider observations in the Arctic to monitor climate change
- Support the Alaska Harbor Observation Network prototype system in Seward
- Track agency and industry research assets in the Arctic



Coming soon

- More wind, wave, and ocean circulation forecasts in Southcentral Alaska
- Real-time wave observations in Lower Cook Inlet
- More ocean acidification monitoring in the Arctic
- An annual ***State of Alaska's Oceans and Coasts*** **report**
- Water level sensors and wave buoys in western Alaska
- Marine forecasts and real-time data to vessels using Automatic Identification System (AIS) tracking
- An electronic Sea Ice Atlas for shippers and forecasters

With more funding, we would

- Improve storm surge forecasts for western Alaska statewide
- Develop coastal climate change monitoring program
- Expand an ocean acidification monitoring system statewide
- Expand glider observing program
- Expand real-time wind, water level and wave observations and forecasts

AOOS is part of national and global networks of ocean observing.

1007 W 3RD AVENUE, SUITE 100 • ANCHORAGE, AK 99501 • 907-644-6703 • WWW.AOOS.ORG

H.

Arctic Energy Network

INSTITUTE OF THE NORTH

The Arctic Energy Network

The Arctic Energy Network (AEN) is a community of interest focused on exploring policy and practice related to the Arctic's unique energy resources as well as the energy needs of arctic communities. Hosted by the Institute of the North, the AEN brings together stakeholders from across the Arctic to learn, teach and collaborate on arctic energy issues.

Vision

The exchange of knowledge results in the responsible development of Arctic energy resources and support and improve the economic, social and environmental conditions of Arctic communities, states and nations.

Mission

The AEN connects stakeholders in Arctic energy issues, building bridges and creating opportunities to learn, teach and collaborate on shaping the emerging and best practices in Arctic energy policies, technology, infrastructure and security.

The AEN meets its mission through:

- ⇨ Hosting networking and learning opportunities
- ⇨ Educating policy makers and administrators
- ⇨ Seeking out and sharing best practices
- ⇨ Supporting collaborative research opportunities
- ⇨ Convening around emerging energy issues
- ⇨ Conducting research projects
- ⇨ Encouraging groundbreaking thinking

As a part of its mission based activities, the AEN hosts a website that serves as an interactive forum to:

- Convene members & facilitate around specific topics.
- Create an archive of essential ideas, programming, speeches, reviews, and action plans that result from AEN functions.
- Promote collaborative research opportunities.
- Share upcoming events on a calendar dedicated to Arctic energy conferences, workshops, and presentations.
- Connect members to projects across the Arctic.

Membership

Membership is open to all stakeholders and parties interested in Arctic energy issues including private sector, indigenous groups, government agencies, non-governmental organizations, local, state & national governments, policy makers, energy experts and research institutions who share the following values:

1. Energy should be affordable, reliable and accessible.
2. Energy wealth should be invested to support community and economic development.
3. A balance of non-renewable and renewable energy sources is necessary.
4. Wise energy development is the cornerstone to economic sustainability in the Arctic.

Membership Benefits

The AEN offers the following benefits to all of its members:

- ⇨ Invitations to join educational technology and policy tours of neighboring nations, states, and provinces.
- ⇨ E-newsletter on energy news from across the Arctic.
- ⇨ Case studies of energy projects across the Arctic.
- ⇨ Chance to engage in cross-industry collaborations.
- ⇨ Coordination of fellowships and professional exchanges.
- ⇨ Opportunities to participate in AEN programs and initiatives.
- ⇨ Promotion of member's events in the shared-event calendar.
- ⇨ Access to the "Member's Only" section of the AEN website.
- ⇨ Membership directory.
- ⇨ Invitations to annual Arctic Energy Policy Forum.
- ⇨ Biannual Arctic Energy Summit.

The Arctic is in a state of change and there are great opportunities as well as challenges that face, collectively, Arctic communities. AEN member organizations work to address these challenges and develop opportunities by sharing expertise, experience and knowledge.

Membership Dues & Additional Benefits:

- Individual: $100
- Basic Organization: $250
- Supporting Organization: $1000
  - Discounts on registration for events such as policy tours and Arctic Energy Summit
- Sponsoring Organization: $5000
  - Discounts on registration for events such as policy tours and Arctic Energy Summit
  - Logo on AEN website & newsletters
  - Invitation to VIP receptions
  - Observer status on the Advisory Council

Member organizations may become sustaining member with an additional gift on top of dues. The additional contributions of sustaining members support the biannual conference and other networking and educational events throughout the year.

Governance

The AEN is led by an Advisory Council reflective the diversity of the membership of the AEN and diversity of the Arctic. Advisory Council members are responsible for evaluating new programs and initiatives, contributing their expertise to the current and future work of the AEN, providing leadership in the planning of the biannual Arctic Energy Summit and general guidance on the direction of the AEN. All Advisory Council meetings are open to the general membership.

Membership on the Advisory Council

Each of the eight Arctic nation governments may appoint one representative to the Advisory Council. Additional seats to the Advisory Council are elected from the membership and apportioned to ensure diverse experience and knowledge is contributed. Elected seats are apportioned as follows:

- Indigenous Organization (2)
- Resource Development (2)
- Energy Research (2)
- Non-governmental Organization (2)

Each of the elected members serves a two year term. Elections are held at the biannual Arctic Energy Summit and each member of the AEN has an equal vote. Select sponsors are also invited to participate in a non-voting Observer role.

Special Committees

The Advisory Council may elect to form special committees. The Chair of a committee shall be an advisory council member but other members of the AEN as well as subject matter experts may be invited to serve on committees.

Lead Organization

The AEN is hosted by the Institute of the North, and qualifies as a 501 (c)(3) organization under its umbrella. As a lead organization the ION houses AEN staff and administers the AEN's finances.

The Institute's mission and vision are strongly aligned with the work of the AEN. Governor Walter J. Hickel, founder of the Institute of the North, believed strongly that we must understand the reality, the richness and the responsibility of the North. Today, the Institute works to share that vision, specializing in how to utilize and care for the resource-rich commons for the benefit of those living in and on the commons. Areas of special study include Alaska, the many regions of the Arctic and other areas of the world that are wealthy in both human cultures and natural resources. The Institute has gained a wide reputation as a center for the study of commonly-owned lands, seas and resources using Alaska as a model.

Appendix A

Members of the AEN have indicated recommended the following areas of work for the Arctic Energy Network to focus their energy and attention on. The AEN Advisory Council will assist in prioritizing the most cutting edge issues, developing projects and promoting opportunities for members to engage each other, exchanging knowledge and pioneering new thoughts on these and many other critical arctic energy issues.

COMMUNITY ENERGY ISSUES

Arctic communities are consumers of energy that is not often affordable, reliable or accessible to them, greatly impacting their sustainability. In finding community energy solutions, topics of interest include improving the transportation, storage and transmission of energy, developing stranded renewable resources, improving energy efficiency, improving and developing new technology for community energy projects, financing research for development, testing and implementation of new technology, creating viable energy markets in remote and rural locations, reducing diesel consumption, and enhancing leadership development and training opportunities for local people to administer, develop and improve on community energy solutions.

RESOURCE DEVELOPMENT

Responsible development of extractive and renewable energy resources is a challenge and an opportunity in the Arctic. It is estimated that 25% of the undiscovered global oil and gas resources are in the Arctic as well as bountiful supply of renewable resources including bio-mass, wind and geothermal energy. Creating infrastructure to develop and transport these resources, addressing indigenous and other community concerns with resource development, the security of the projects being developed, evaluating new technologies that are being deployed, sharing best practices for development in sensitive Arctic environments, promoting technology exchange between the renewable and extractive energy sectors, and strengthening trust and facilitating better relationships are among the hot topics that the members of the AEN are interested in.

PUBLIC POLICY

Public policy for the Arctic has not necessarily kept pace with the changes in the Arctic. While Arctic environment has been the subject of much hotly contested policy work, the Arctic as a global commons, indigenous rights, stewardship, local, national and international standards for development, improvements in regulatory structures, disaster mitigation, public-private partnerships, projected increases in Arctic development particularly by non-Arctic nations, sovereign wealth funds, sustainability of communities, the effects of climate change, reducing black carbon, and other unique Arctic issues have received less attention.

DATA COLLECTION

Significant gaps still exist in the Arctic knowledge base that can be filled by the AEN from creating a comprehensive database of expertise, knowledge, best practices and current projects in the Arctic, to mapping energy use in the Arctic and proving assessments of resource wealth and renewable energy resources.

INSTITUTE OF THE NORTH
509 WEST THIRD AVENUE, SUITE 107
ANCHORAGE, ALASKA 99501
Phone: (907) 771-2444
Fax: (907) 771-2466
www.institutenorth.org

Reference Material (File 1)

<TARGET><BILL></BILL><SUBJECT>Reference Material (File 1)</SUBJECT><COMM>ANW27</COMM></TARGET>

1.

Introductory Materials & Reference Materials Index

http://www.housemajority.org/coms/index.php?c=104

NORTHERN WATERS TASK FORCE REFERENCE MATERIALS INDEX

Tab 1: Introductory Materials

Alaska State Legislature Legislative Resolve 54: Establishing and Relating to the Alaska Northern Waters Task Force

Arctic Policy, Indigenous and Research Groups: An Annotated List

Abbreviations and Acronyms

Tab 2: Summary of proposed federal legislation

Senator Begich Inuvikput Package Summary

Senator Murkowski's Arctic Bills Summary August 5, 2010

Tab 3: United States Arctic Policy

National Security Presidential Directive/NSPD 66 and Homeland Security Presidential Directive/HSPD-25

Tab 4: Information on the Interagency Ocean Policy Task Force

White House Interagency Ocean Policy Task Force Press Release

Summary of Executive Order: Stewardship of the Ocean, Our Coasts, and the Great Lakes and the Final Recommendations of the Interagency Policy Task Force, August 4, 2010

White House Council on Environmental Quality: Final Recommendations of the Interagency Ocean Policy Task Force July 19, 2010

Tab 5: Information on the National Ocean Council

Executive Order: Stewardship of the Ocean, Our Coasts, and the Great Lakes, July 19, 2010 (creates National Ocean Council)

VanNess Feldman: Issue Alert July 22, 2010 Obama Administration Establishes National Policy to Protect Oceans, Coasts, and Great Lakes and Creates National Ocean Council to Oversee and Implement New Policy

Tab 6: Information on the Climate Change Adaptation Task Force

White House Climate Change Adaptation Task Force

Progress Report on the Interagency Climate Change Adaptation Task Force March 16, 2010

Tab 7: Information on the Arctic Marine Shipping Assessment

Arctic Council: Arctic Marine Shipping Assessment Executive Summary With Recommendations

Arctic Council: Arctic Marine Shipping Assessment 2009 Report

UAF News Release: Next Steps in Arctic Shipping Policies, September 15, 2010

Considering a Roadmap Forward: The Arctic marine Shipping Assessment Workshop Report, Oct. 22-24, 2009

United Nations Convention Law of the Sea Overview and Other Summary Information

Tab 8: United States Arctic Research Commission Report

United States Arctic Commission: Report on Goals and Objectives for Arctic Research 2009-2010

Tab 9: National Oceanic and Atmospheric Administration Report

National Oceanic and Atmospheric Administration: Arctic Vision and Strategy, April 2010

Tab 10: Arctic Report Card

Arctic Report Card: Update for 2009 Tracking Recent Environmental Changes

Tab 11: Arctic Impact Assessment

Arctic Impact Assessment Policy Document issued by the Arctic Council Ministerial Meeting Reykjavik, November 24, 2004

Tab 12: U.S. Navy report

U.S. Navy Arctic Road Map, October 2009

Tab 13: United States Coast Guard Power Point Presentation on the Arctic

United States Coast Guard: The Emerging Arctic A New Maritime Frontier

Tab 14: Alaska Climate Change Executive Roundtable Power Point Presentation

Alaska Climate Change Executive Roundtable: State of the Arctic March 18, 2010, Miami Florida

Tab 15: Governor's Subcabinet on Climate Change Reports:

Adaptation Advisory Group: Alaska's Climate Change Strategy: Addressing Impacts in Alaska Executive Summary

Immediate Action Workgroup: Recommendations to the Governor's Subcabinet on Climate Change, March 2009

Research Needs Work Group: Recommendations on Research Needs Necessary to Implement an Alaska Climate Change Strategy

Tab 16: Press Releases

Press Releases of Interest

Other publications of interest can be found at:

From the United Nations website the full text of the Laws of the Sea can be found at:
http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

The Arctic Council's Arctic Climate Impact Assessment full report can be found at:
http://www.acia.uaf.edu/

The Governor's Climate Change Subcabinet complete documents can be found at:
http://www.climatechange.alaska.gov/

From the Inuit Circumpolar Council website additional documents of interest can be found at:
http://www.inuit.org/

The Arctic Council's Arctic Human Development Report can be found at:
http://www.svs.is/AHDR/AHDR%20chapters/English%20version/Chapters%20PDF.htm

The Aspen Institute Report can be found at:
http://www.aspeninstitute.org/policy-work/energy-environment/our-policy-work/dialogue-commission-arctic-climate-change.

NORTHERN WATERS TASK FORCE
MEMBER ROSTER:

LEGISLATIVE MEMBERS:

Representative Reggie Joule, District 40, Kotzebue, Chair

Email: representative_reggie_joule@legis.state.ak.us
Phone: 350-5057 (cell)
Address: State Capitol Bldg. Room 410
Juneau, AK. 99801

Staff: Christine Hess 465-4942/957-2276 (cell) Christine_hess@legis.state.ak.us
Elizabeth Hensley 442-3800/317-5781(cell) elizabeth_hensley@legis.state.ak.us

Senator Bert Stedman, District A, Vice-Chair

Email: senator_bert_stedman@legis.state.ak.us
Phone: 465-3873/738-8905 (cell)
Address: State Capitol Bldg. Room 516
Juneau, AK. 99801

Staff: Linda Hay 465-2138/321-1249(cell) linda_hay@legis.state.ak.us Julie Isom 225-8088 julie_isom@legis.state.ak.us

Representative Bob Herron, District 38 , Bethel

Email: representative_bob_herron@legis.state.ak.us
Phone: 545-0848/ 209-4774 (cell)
Address: Bethel LIO Box 886
Bethel, AK. 99559-0886

Staff: Rob Earl at 269-0126/ 952-1810 (cell) rob_earl@legis.state.ak.us Elizabeth Clement from Nov. 22nd 465-6576/957-2721 (cell) liz_clement@legis.state.ak.us

Representative Bryce Edgmon, District 39, Dillingham (alt.)

Email: representative_bryce_edgmon@legis.state.ak.us
Phone: 842-1729/632-3001
Address: P.O. Box 84
Dillingham, AK. 99576

Staff: Tim Clark 465-4451 timothy_clark@legis.state.ak.us and Adam Berg 269-0275 adam_berg@legis.state.ak.us

Senator Lyman Hoffman, District S, Bethel

Email: senator_lyman_hoffman@legis.state.ak.us
Phone: 465-4453
Address: State Capitol Bldg. Room 518
Juneau, AK. 99801

Staff: Pat Walker 465-5047/723-6767(cell) patricia_walker@legis.state.ak.us

Senator Donald Olson, District T (alt.)

Email: senator_donny_olson@legis.state.ak.us
Phone: 465-3707/240-3795
Address: State Capitol Bldg. Room 508
Juneau, AK. 99801

Staff: Christina Apathy 465-3707 christina_apathy@legis.state.ak.us

PUBLIC MEMBERS:

***Chris Hladick, City Manager, Unalaska*:**

Email: chladick@ci.unlaska.ak.us
Phone: 581-7733 (work)
359-6837 (cell Unalaska)

830-0824 (cell Alaska)
581-6563 (home phone)

Address: PO Box 584
Unalaska, AK. 99685

Assistant: Joy Collins at 581-7733

Larry Hartig, Commissioner, Department of Environmental Conservation:

Email: Larry.hartig@alaska.gov
Phone: 465-5065/ 301-5914 cell
Address: P.O. Box 111800
Juneau, AK. 99811-1800

Assistant: Claire Fishwick Claire_fishwick@alaska.gov at 465-5065

Mayor Edward Itta, North Slope Borough

Email: Edward.Itta@north-slope.org or esitta@gci.net
Phone: 852-0455/227-0751
Address: Mayor's Office
P.O. Box 69
Barrow, AK. 99723

Assistant: Karen Crain at 646-8210/ Karin.Crain@north-slope.org/

Mayor Denise Michels, Nome

Email: mayor@ci.nome.ak.us
Phone: 443-4251 (work)/ 360-0491 (cell)

Address: City of Nome
P.O. Box 281
Nome, AK. 99762

Chuck Greene, Vice President NANA Development Corporation

Email: Chuck.Greene@nana.com
Phone: 442-3301/351-4351 (cell)
Address: P.O. Box 49
Kotzebue, AK. 99752

Dave Kubiak, Alaska Marine Conservation Council

Email: mythos1@starband.net
Phone: 277-5357 (Anch) /486-5536 (Kodiak)/539-8256 (cell)
Address: Box 193
Kodiak, AK, 99615

Cora Campbell, Governor's Office, Special Assistant (State alt.)

Email: cora.campbell@alaska.gov
Phone: 465-3938 (office)/ 209-1842 (cell)
Address: 1840 Wickersham Ave.,
Juneau, AK. 99801

Assistant: Forrest Wolfe forrest.wolfe@alaska.gov (907) 465-3500

Rear Admiral Colvin, Commander, 17th Coast Guard District, Liaison

Phone: 463-2029
Email: christopher.c.colvin@uscg.mil
Address: United States Coast Guard
17th CG District
Commander (D)
P.O. Box 5517
Juneau, AK. 99502-5517

Assistant: Debra Cruz debra.m.cruz@uscg.mil (907) 463-2025/norman.l.custard@uscg.mil

Introduction to Northern Waters Task Force

- The NWTF was created by HCR 22 during the 2010 legislative session.

- Warming trends have caused the perennial Arctic sea ice to be depleted by 9% per decade, scientist predict that the Arctic could be ice free in 20 to 30 years, which will open up a vast array of new challenges and opportunities for the communities that live along the seas, for the state, for the nation and the entire globe

- During the last legislature, Representative Alan Austerman from Kodiak brought to a group of legislators' attention something that had been bobbing around in the ether for some time: that the Alaska legislature lacks meaningful involvement in addressing issues related to the changing Arctic seas. After some discussion, what most of us knew but had not acted on was that the federal government and independent organizations are taking action to address the opportunities and challenges that are coming before us as the Arctic ice melts. We felt it was time to get involved, so together, we pushed to create the Task Force.

- During the course of our meetings in Juneau, we heard discussion of an Arctic waters commission being formed at the federal level. We felt that since the only reason the U.S. borders the Arctic is because of Alaska, Alaskans should have input in creating the body that the federal government planned to set up, so that our state and communities' interests would be adequately represented.

- This federal body has been created, so our thinking was timely. On July 19, 2010 President Obama signed an Executive Order establishing the first ever National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes, which adopts the Final Recommendations of the Interagency Ocean Policy Task Force and directs federal agencies to implement these recommendations.

- A high level National Ocean Council has been created to coordinate

federal agencies to implement the National Policy and to strengthen ocean governance. It will establish a Governance Coordinating Committee to formally engage with states, tribes and local governments. The Committee will consist of 18 members, including one designated seat for an Alaskan representative chosen in consultation with the governor. There may be other opportunities for Alaska representation, as there is a seat for one member of a state legislature, three tribal representatives, and three local government representatives.

- The National Ocean Council will immediately begin coastal and marine spacial planning to analyze current and anticipated uses of ocean and coastal areas. The NOC has created 9 regional planning bodies to develop the coastal and marine spacial plans. Alaska is a region unto itself.

- According to the resolution creating our Task Force, the duties of the task force are to:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;
(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;
(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and
(4) conduct hearings in the Northern region of the state to fulfill its purpose;

The task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration.

- I thank you for taking time out of your extremely busy schedules to be part of this Task Force.

During Session:
Alaska State Capitol
Juneau, Alaska 99801-1182
(907) 465-4833
Fax (907) 465-4586
1-800-782-4833
Representative_Reggie_Joule@legis.state.ak.us

During Interim:
P.O. Box 673
Kotzebue, Alaska 99752
(907) 442-3880
Fax (907) 442-3022

Alaska State Legislature
REPRESENTATIVE REGGIE JOULE

To: Senator Stevens, Senate President
Representative Chenault, Speaker of the House

From: Representative Reggie Joule

Date: September 9, 2010

Re: Northern Waters Task Force

Thank you for your recent appointments to the Northern Waters Task Force. Recently, my fellow legislators have selected me to chair the task force. Our first hearing is tentatively scheduled for October 1st in Anchorage. As the chair, I am now seeking authority to spend the funds designated for the task force so that we can carry out the mission outlined in Legislative Resolve 54. Attached with this letter is a list of the members of the task force with their contact information so that the accounting department can assist us with arranging travel and reimbursing members for their expenses. By your signatures above you will authorize the chair to expend the funds for the task force. Thank you for your attention to this matter.

WORKING AGENDA

1. Welcome and organization 8-8:45 a.m.

   Introduce members
   Overview of task force and task force mission
   Travel and accounting procedures
   Possible schedules for future hearings and sites:

   - Alaska Federation of Natives (Oct. 20-22nd)
   - Nov. 15-18th Kotzebue and Nome
   - Dec. 1-2 Barrow with PNWER
   - End of Jan. Bethel

15 min. Break

2. Introduction and overview 9-9:15 a.m. (CLH)

Molly McCammon 644-6703/227-7643 (confirmed)
Director
Alaska Ocean Observing Systems

3. Science of the warming waters 9:15-10 am (CLH)

   Kate Moran 202-841-1566/ 202-456-6079
   kmoran@ostp.eop.gov
   Hajo Eicken 474-7280
   Hajo.eicken@gi.alaska.edu
   Mike Castellano

Break 10-10:15 am

4. NOAA/and what the feds are doing 10:15 to 11 am (CLH)

   Amy Holman NOAA 271-5334 call out

5. Overview of what the state is doing and the state federal executive roundtable (LH) 11-11:45 Commissioner Hartig 465-5065

15 min break to get food

12 to 1 p.m. International Lunchtime Panel: (EH)

Alaska Federation of Natives/ISER

United States Arctic Commission, Cheryl Rosa, Deputy Director

Consulate of Canada, Jennifer Loten

ICC

6. US Coast Guard/Marine Shipping 1:15 to 2pm (RE)

   Rear Admiral Christopher Colvin
   Michael.cerne@usdg.mil
   Capt. Carl Uchytil 463-2226/lead for Arctic

   Mike Straga/Lawson Bringham

7. United States Arctic Commission Report 2-2:45 pm (EH)(confirmed)

   Cheryl Rosa

Deputy Director of USARC and Anchorage Director,
Buck Sharpton

15 min break

8. Oil and Gas 3-3:45 (Linda Hay)

Marilyn Crockett/Judy Brady/ Shell/Jason Brune

4:15 to 5 pm wrap up

Video conferencing Rob

Other ideas:

Barrow

AK Clean Seas – Ron Morris 644-2603

Army Corps – chief engineer AK district – port development challenges or siting.

Someone from Crowley Marine

Contact for Northern Waters Task Force:

Jackie Poston 317-4667 (cell) DEC/EPA

Cora Campbell cora.campbell@alaska.gov 465-3938

Molly McCammon, Director
Alaska Ocean Observing System
McCammon@aoos.org 644-6703/227-7634 (cell)

Coast Guard

Captain Carl Uchytil 463-2226 (planning/coordination in Arctic)
Norman Custard "Buddy" 463-2025
Norman.l.custard@uscg.mil

Possible testifiers for hearings:

1. National Ocean Policies and the Interagency Ocean Policy Task Force and NOAA's Arctic Vision:

Amy Holman, NOAA Alaska Regional Coordinator
Marcia Combes, AK Regional Director, EPA
Pat Pourchot, AK Regional Special Assistant for Dept of Interior

2. Federal Arctic Research Policy Committee:

Kate Moran (202) 841-1566 – Mobile (202) 456-6079 – Work
White House Office of Science Technology and Policy

3. Marine Shipping Issues:

Lawson Brigham, UAF
Mike Sfraga/UAF

4. US Arctic Research Commission:

Mary Pete
Cheryl Rosa
Dr. Buck Sharpton/UAF

5. Fed-State Climate Change Executive roundtable on collaborative efforts:

George Haskett, Chair and Regional Director US Fish and Wildlife Services
907-786-3542 Geoff_Haskett@fws.gov

6. Collaborative Efforts on environmental and science research and monitoring to meet stakeholders needs:

North Slope Science Initiative/John Payne Exec. Director
Molly McCammon, Alaska Ocean Observing Systems
Jackie Menge/Arctic report Card

7. Coast Guard:

Captain Carl Uchytil 463-2226 Carl.J.Uchytil@uscg.mil
Christopher Colvin, 17th District Commander for the Arctic
Mike Cerne co-chairing strategy development for the National Ocean policy Michael.Cerne@uscg.mil

8. States efforts: Governor's Climate change Subcabinet and four working groups and other state efforts:

Commissioner Hartig

9. Other possible for first hearing but not for village travel:

John Madden, DMVA abd HS&ER (increased capacity for emerging emergency needs in the Arctic)
Mike Coffey, AK DOT (transportation needs in the Arctic)
Mike Brubaker ANTHC (changing climate and health)
Phil Martine, USFWS, (coordinating Arctic landscape conservation cooperative)

STATE OF ALASKA
THE LEGISLATURE

2010

Source
CSHCR 22(FIN)

Legislative Resolve No.
54

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of the interaction among the ice, oceans, and atmosphere; and

WHEREAS rapidly retreating sea ice is altering fish and wildlife habitats and affecting the accessibility and viability of certain species on which many local communities rely for nutritional and cultural purposes; and

WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deepwater port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of 11 members as follows:

(1) two senators appointed by the President of the Senate;

(2) two representatives appointed by the Speaker of the House of Representatives; and

(3) seven members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) five public members, three of whom reside in coastal areas of the state;

(B) one member representing the executive branch of state government;

(C) one member representing the federal government; and be it

FURTHER RESOLVED that a vacancy on the task force shall be filled in the manner of the original appointment; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves, and the chair may assign staff to provide support to the task force; and be it

FURTHER RESOLVED that the public members, and, if the member does not receive reimbursement for expenses from the federal government, the federal government member of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions, and the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

Russian Assn of Indigenous Peoples of the North (RAIPON) www.raipon.org

III. RESEARCH AND ACADEMIC ORGANIZATIONS

A. State of Alaska and US Federal Research

Interagency Arctic Research Policy Committee (IARPC)
www.nsf.gov/od/opp/arctic/iarpc/start.jsp
IARPC consists of fifteen-plus agencies, departments, and offices across the US Federal government and is chaired by the National Science Foundation.
IARPIC Departments:

the National Science Foundation www.nsf.gov
- **Office of Polar Programs** (OPP) www.nsf.gov/dir/index.jsp?org=OPP
  The key funder of Arctic and Antarctic research in the U.S.

the Department of Commerce
- **NOAA's National Marine Fisheries Service** (NMFS) www.nmfs.noaa.gov
- **NOAA's Office of Oceanic and Atmospheric Research** (OAR) www.oar.noaa.gov provides the research foundation for understanding the complex systems that support our planet. NOAA Research provides better forecasts, earlier warnings for natural disasters and a greater understanding of the Earth. Their role is to provide unbiased science to better manage the environment, nationally and globally.

the Department of Defense
- **US Army Cold Regions Research & Engineering Laboratory** **www.crrel.usace.army.mi**

the Department of State www.state.gov
the Department of Health and Human Services
- **National Institutes of Health** www.nih.gov/index.html
- **Indian Health Service** www.ihs.gov

the Department of Homeland Security
- **US Coast Guard** www.uscg.mil
- **US Coast Guard Research & Development Center** www.uscg.mil/acquisition/rdc/rdc.asp

the Office of Science and Technology Policy
www.whitehouse.gov/administration/eop/ostp
- **National Science and Technology Council**: This Cabinet-level Council is the principal means within the executive branch to coordinate science and technology policy across the diverse federal entities. By July 22, 2010 Presidential Memorandum, the NSTC now coordinates some IARPIC activities.

the Department of Agriculture www.usda.gov
the Department of Energy www.energy.gov
- **National Renewable Energy Lab** (NREL) www.nrel.gov

the Department of the Interior www.doi.gov
- **Bureau of Indian Affairs** www.bia.gov
- **US Fish & Wildlife Service** www.fws.gov

- **US Geological Survey** www.usgs.gov
- **Bureau of Ocean Energy Management** www.boemre.gov
  On May 19, 2010, Secretary Salazar began splitting the MMS into three bureaus: the Bureau of Ocean Energy Management, the Bureau of Safety and Environmental Enforcement, and the Office of Natural Resources Revenue.

the Department of Transportation www.dot.gov
- Maritime Administration: www.marad.dot.gov
- Federal Aviation Administration www.faa.gov

the National Aeronautics and Space Administration www.nasa.gov
the Environmental Protection Agency www.epa.gov
- Office of Research & development www.epa.gov/ORD

the Smithsonian Institution www.si.edu
the National Endowment for the Humanities www.neh.gov

United States Arctic Research Commission (USARC) www.arctic.gov
The Commission's main purpose is to establish the national policy, priorities, and goals necessary to construct a federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences and to recommend Arctic research policy, and to communicate our research and policy recommendations to the President and the Congress.

Arctic Research Consortium of the United States (ARCUS) www.arcus.org
The Arctic Research Consortium of the United States was formed in 1988 to identify and bring together the human and facilities resources of the Arctic research community in the United States. ARCUS is a non-profit corporation consisting of institutions organized and operated for educational, professional, or scientific purposes. The ARCUS headquarters and staff are located in Fairbanks, Alaska.

Alaska Fisheries Science Center (AFSC) www.afsc.noaa.gov
Barrow Arctic Science Consortium (BASC) www.arcticscience.org
North Slope Science Initiative (NSSI) www.northslope.org
US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) www.crrel.usace.army.mil
Office of Naval Research (ONR) www.onr.navy.mil
National Research Council (NRC) http://nationalacademies.org/nrc
Provides independent, expert advice to the Congress, Administration and public. Three boards of relevance: Polar Research Board; Marine Board; and Ocean Studies Board.

B. International Research

International Arctic Science Committee http://web.arcticportal.org/iasc
Comprised of national science organizations covering all fields of Arctic research, the International Arctic Science Committee (IASC) was established in 1990, began operations in 1991 and today involves 18 member countries. The IASC's mission is to encourage and facilitate cooperation in all aspects of Arctic research throughout the

region. Although IASC is not a funding agency, it supports science development by providing scientific advice as well as seed money. In general, IASC-supported activities are international or circumpolar in nature and thus of interest to several member countries. The organizational needs of IASC are served by a secretariat located in Stockholm. IASC is an international associate of the International Council for Science, and has observer status on the Arctic Council.

The International Union for Circumpolar Health http://iuch.net
Formally established in 1981, the International Union for Circumpolar Health (IUCH) is a non-governmental organization with members, adhering bodies and affiliates throughout the circumpolar region. Its focus is the health problems and needs of northern peoples. Its functions include disseminating medical knowledge, research findings and demonstrated solutions to the general and specific medical and health problems of Arctic communities. To support its members and affiliates, and the scientific and indigenous communities at large, the IUCH has established working groups that concentrate on specific health problems of importance to circumpolar populations, maintains several publications, and supports international efforts in telemedicine and health informatics.

International Polar Year 2007-2008 (IPY) www.ipy.org
The International Polar Year is a large scientific program focused on the Arctic and the Antarctic. An important aspect of its activities is the legacy of information and organization that it will leave in the polar regions. One of the most significant efforts in this regard is concerned with the creation of a Sustained Arctic Observation Network to meet scientific and societal needs.

Arctic Human Health Initiative (AHHI) www.arctichealth.org/ahhi (Arctic Council)
International Arctic Research Center (IARC) www.iarc.uaf.edu
International Study of Arctic Change (ISAC) www.arcticchange.org

C. Universities, Colleges, Institutes, Non-Profits and Think Tanks

University of the Arctic www.uarctic.org
The University of the Arctic is a cooperative network of universities, colleges and other organizations committed to higher education and research in the North.
Institute of Arctic Studies (Dartmouth)
http://dickey.dartmouth.edu/initiatives/arctic-studies
Scott Polar Research Institute (Cambridge) www.spri.cam.ac.uk
Institute of Arctic & Alpine Research University of Colorado
http://instaar.colorado.edu
North Pacific Research Board (NPRB) www.nprb.org
Institute of the North www.institutenorth.org
Anchorage-based think tank on Arctic and other issues. Worked on **the Arctic Marine Shipping Assessment**: www.institutenorth.org/servlet/content/maritime_news.html
The Northern Forum www.northernforum.org
The Northern Forum is a non-profit, international organization composed of sub-national or regional governments from eight northern countries.

Int'l Arctic Social Sciences Assn. www.iassa.org
Cold Climate Housing Research Center (CCHRC) www.cchrc.org (Non-profit)
International Arctic Research Center, UAF www.iarc.uaf.edu
Geophysical Institute, UAF www.gi.alaska.edu
Center for Alaska Native Health Research (CANHR) canhr.uaf.edu
University of Alaska Geography Program www.geographyua.org
Arctic policy studies and workshops
Institute for Social and Economic Research, UAA (ISER) www.iser.uaa.alaska.edu
School of Fisheries and Ocean Sciences, UAF www.sfos.uaf.edu
Institute of Arctic Biology, UAF www.iab.uaf.edu

Abbreviations and Acronyms:

AAAS.....American Association for the Advancement of Science, http://www.aaas.org
ACF.....Administration for Children and Families, http://www.acf.hhs.gov
ADEC.....Alaska Department of Environmental Conservation, http://www.dec.state.ak.us
ADVANCE.....Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383
AFSC.....Alaska Fisheries Science Center, http://www.afsc.noaa.gov
AHHI.....Arctic Human Health Initiative, http://www.arctichealth.org/ahhi
AMAP.....Arctic Monitoring and Assessment Program of the Arctic Council, http://www.amap.no
AMRAP.....Alaska Mineral Resource Assessment Program
AMSA.....*Arctic Marine Shipping Assessment*, http://www.arctic.gov/publications/AMSA_2009_Report_2nd_print.pdf
ANILCA.....Alaska National Interest Lands Conservation Act of 1980
ANSC.....Alaska Native Science Commission, http://www.nativescience.org
ANSEP.....Alaska Native Science and Engineering Program, http://ansep.uaa.alaska.edu
ANTHC.....Alaska Native Tribal Health Consortium, http://www.anthc.org
AON.....Arctic Observing Network, http://www.nsf.gov/news/news_summ.jsp?cntn_id=109687
AOOS.....Alaska Ocean Observing System, http://www.aoos.org
APECS.....Association of Polar Early Career Scientists, http://apecs.is
ARCUS.....Arctic Research Consortium of the United States, http://www.arcus.org
ARPA.....Arctic Research and Policy Act of 1984, as amended, http://www.nsf.gov/od/opp/arctic/iarpc/arc_res_pol_act.jsp
ARRA.....American Recovery and Reinvestment Act
BASC.....Barrow Arctic Science Consortium, http://www.arcticscience.org
BEO.....Barrow Environmental Observatory, http://www.arcticscience.org/researchBases.php
BEST-BSIERP.....Bering Sea Ecosystem Study (NSF)-Bering Sea Integrated Ecosystem Research Program (NPRB), http://bsierp.nprb.org
BIA.....Bureau of Indian Affairs, http://www.bia.gov
BIAWG.....Bering Sea Interagency Working Group
BLM.....Bureau of Land Management, http://www.blm.gov
CANHR.....Center for Alaska Native Health Research, http://canhr.uaf.edu
CCHRC.....Cold Climate Housing Research Center, http://www.cchrc.org
CCSP.....US Climate Change Science Program, http://www.climatescience.gov
CDC.....Center for Disease Control and Prevention, http://www.cdc.gov
CDQ.....Community Development Quota
CEQ.....Council on Environmental Quality, http://www.ceq.gov
CIMES.....Center for Island, Maritime, and Extreme Environment Security, http://cimes.hawaii.edu
COMPETES.....America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science
COSEE.....Centers for Ocean Science Education Excellence, http://www.cosee.net
CRRC.....Coastal Response Research Center, http://www.crrc.unh.edu
CRREL.....US Army Corps of Engineers Cold Regions Research and Engineering Laboratory, http://www.crrel.usace.army.mil
DHHS.....Department of Health and Human Services, http://www.hhs.gov
DHS.....Department of Homeland Security, http://www.dhs.gov
DNA.....Deoxyribonucleic acid
DOC.....Department of Commerce, http://www.doc.gov
DOD.....Department of Defense, http://www.defense.gov
DOE.....Department of Energy, http://www.doe.gov
DOI.....Department of the Interior, http://www.doi.gov
DOS.....Department of State, http://www.dos.gov
DOT.....Department of Transportation, http://www.dot.gov
ECS.....Federal Interagency Extended Continental Shelf Task Force, http://continentalshelf.gov
ED.....US Department of Education, http://www.ed.gov
EEZ.....Exclusive Economic Zone
EPA.....Environmental Protection Agency, http://www.epa.gov
FAA.....Federal Aviation Administration, http://www.faa.gov
FDA.....Food and Drug Administration, http://www.fda.gov
FIC.....Fogarty International Center, http://www.fic.nih.gov

GEOSS.....Global Earth Observing System of Systems, http://www.earthobservations.org
HIPAS.....High Power Auroral Stimulation
HUD.....Department of Housing and Urban Development, http://www.hud.gov
IARC.....International Arctic Research Center, http://www.iarc.uaf.edu
IARPC.....Interagency Arctic Research and Policy Committee, http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp
IASC.....International Arctic Science Committee, http://www.arcticportal.org/iasc
ICCOPR.....Interagency Coordinating Committee on Oil Pollution Research, see Title VII at http://www.epw.senate.gov/opa90.pdf
IHS.....Indian Health Service, http://www.ihs.gov
IODP.....Integrated Ocean Drilling Program, http://www.iodp.org
IPCC.....United Nation's Intergovernmental Panel on Climate Change, http://www.ipcc.ch
IPY.....International Polar Year, http://www.ipy.org
ISAC.....International Study of Arctic Change, http://www.arcticchange.org
IUCH.....International Union for Circumpolar Health, http://iuch.net
LOSI.....Loss of Sea Ice, http://www.afsc.noaa.gov/Publications/ProcRpt/PR2007-05.pdf
MARAD.....Department of Transportation/Maritime Administration, http://www.marad.dot.gov
MEDEA.....Measurements of Earth Data for Environmental Analysis
MMS.....Minerals Management Service, http://www.mms.gov
MOU.....Memorandum of Understanding
NASA.....National Aeronautics and Space Administration, http://www.nasa.gov
Navy SupSalv.....Naval Sea System Command Supervisor of Salvage and Diving, http://www.supsalv.org
NCMHD.....National Center on Minority Health and Disparities, http://www.ncmhd.nih.gov
NCRR.....National Center for Research Resources, http://www.ncrr.nih.gov
NEH.....National Endowment for the Humanities, http://www.neh.gov
NGA.....National Geospatial-Intelligence Agency, http://www.nga.mil
NIAAA.....National Institute on Alcohol Abuse and Alcoholism, http://www.niaaa.nih.gov
NICHD.....National Institute on Child Health and Development, http://www.nichd.nih.gov
NIH.....National Institutes of Health, http://www.nih.gov
NIMH.....National Institute of Mental Health, http://www.nimh.nih.gov
NIST.....National Institute of Standards and Technology, http://www.nist.gov
NMFS.....National Marine Fisheries Service, http://www.nmfs.noaa.gov
NOAA.....National Oceanographic and Atmospheric Administration, http://www.noaa.gov
NPCREP.....North Pacific Climate Regimes and Ecosystem Productivity, http://www.pmel.noaa.gov/foci/NPCREP
NPFMC.....North Pacific Fisheries Management Council, http://www.alaskafisheries.noaa.gov/npfmc
NPRB.....North Pacific Research Board, http://www.nprb.org
NRC.....National Research Council, http://nationalacademies.org/nrc
NREL.....National Renewable Energy Lab, http://www.nrel.gov
NSF.....National Science Foundation, http://www.nsf.gov
NSSI.....North Slope Science Initiative, http://www.northslope.org
NSTC.....National Science and Technology Council, http://www.ostp.gov/cs/nstc
ONR.....Office of Naval Research, http://www.onr.navy.mil
OPA90.....Oil Pollution Act of 1990
OSRI.....Oil Spill Recovery Institute, http://www.pws-osri.org
OSTP.....Office of Science and Technology Policy, http://www.ostp.gov
PICES.....North Pacific Marine Science Organization, http://www.pices.int
PMEL.....Pacific Marine Environmental Laboratory, http://www.pmel.noaa.gov
RUSALCA.....Russian-American Long-term Census of the Arctic, http://www.arctic.noaa.gov/aro/russian-american
SAMHSA.....Substance Abuse and Mental Health Services Administration, http://www.samhsa.gov
SAON.....Sustaining Arctic Observing Networks, http://www.arcticobserving.org
SBIR.....Small Business Innovation Research, http://www.sbir.gov
SCICEX.....The Scientific Ice Exercises Program, http://www.scicex.org
SDMI.....Statewide Digital Mapping Initiative, http://www.alaskamapped.org
SEARCH.....Study of Environmental ARctic CHange, http://www.arcus.org/search/index.php
SFOS.....UAF's School of Fisheries and Ocean Sciences, http://www.sfos.uaf.edu
SI.....Smithsonian Institution, http://www.si.edu
SINTEF (Norwegian).....Stiftelsen for industriell og teknisk forskning, http://www.sintef.no/Home
TEK.....Traditional Ecological (or Environmental) Knowledge
UAF.....University of Alaska Fairbanks, http://www.uaf.edu
UNCLOS.....United Nations Convention on the Law of the Sea, http://www.un.org/Depts/los/index.htm
UNESCO.....United Nations Educational Scientific and Cultural Organization, http://portal.unesco.org
USACE.....US Army Corp of Engineers, http://www.usace.army.mil
USARC.....US Arctic Research Commission, http://www.arctic.gov
USCG.....US Coast Guard, http://www.uscg.mil
USDA.....US Department of Agriculture, http://www.usda.gov
USFWS.....US Fish and Wildlife Service, http://www.fws.gov
USGS.....US Geological Survey, http://www.usgs.gov

Source: U.S. Arctic Commission, Goals and Objectives for Arctic Research, 2009-2010

2.

Summary of Proposed Federal Legislation

Senator Begich - Inuvikput Package

Introduced August 3, 2009, the *Inuvikput Package* consists of seven pieces of legislation:

S.1560 Arctic OCS Revenue Sharing Act - Alaska Natives who have subsisted on marine mammals and other arctic resources for thousands of years would bear the direct risks of increased commercial activity in their waters. This bill directs a portion of federal revenues from offshore oil and gas development - the same share Louisiana receives from drilling in the adjacent Gulf of Mexico - to the State of Alaska with a percentage of those funds directed to those most affected.

S.1561 Arctic Marine Shipping Assessment Implementation Act - As the polar icecap recedes, the Arctic region is increasingly accessible to shipping and tourism. This bill is designed to ensure safe and reliable maritime transportation in the Arctic and protect its waters. It would boost the nation's investment in needed infrastructure, including replacement of America's aging fleet of icebreakers and building new forward operating air bases for the Coast Guard to assert our national interest in the region.

S.1562 Arctic Science, Coordination and Integration Act - Numerous scientists and agencies conduct important and needed research into various aspects of the Arctic but concerns remain that these efforts are not well coordinated and leave gaps in our understanding of Arctic issues. This bill calls on the National Research Council to undertake a study toward a comprehensive strategy to coordinate Arctic research and make recommendations to Congress on a long-term Arctic Ocean research plan.

S.1563 Arctic Ambassador Act - Russia, Canada, Norway and other Arctic nations are represented at the ambassadorial level before the Arctic Council and U.S. interests would benefit from an enhanced diplomatic presence in Arctic matters. This bill is intended to strengthen U.S. representation before the Arctic Council and other international forums by appointment of a U.S. ambassador to the Arctic.

S.1564 Arctic Oil Spill Research and Recovery Act - Vast energy reserves are believed to lie beneath Arctic waters and it is vital that any development of such resources be conducted in a responsible manner that protects the environment upon which residents of the region depend. This bill directs the Secretary of Commerce to conduct research to improve oil spill prevention, response and recovery in Arctic conditions and requires the Coast Guard to assess and reduce risk from such development.

S.1565 Arctic Health Research Act - People of the Arctic suffer from increased rates of alcohol abuse, diabetes, high blood pressure, and death from injury and suicide. This act would initiate a study into the mental, behavioral and physical health problems in the Arctic, institute an Arctic health assessment program at the Centers for Disease Control and create an "Arctic desk" at the National Institute of Health that was called for in 1984 but has never been established.

S.1566 Arctic Climate Change Adaptation Act - Alaska villages and public infrastructure are already suffering from coastal erosion, flooding, permafrost melting and other impacts of climate change. This bill would help the State of Alaska, Alaska Native organizations, affected Arctic communities and the private sector adapt to the impacts of climate change and assist in dealing with habitat restoration, clean energy development and other economic development activities.

Senator Murkowski's Arctic Bills - August 5, 2010

Sen. Murkowski has introduced three Arctic bills in the 111th Congress. None are expected to move this Congress. According to her staff, she awaits a Coast Guard report due out in December to begin pushing these bills forward.

Senator Murkowski's website provides, "One [piece of legislation] would implement some of the recommendations of the Arctic Marine Shipping Assessment, including the authorization of a study to determine and develop the necessary infrastructure to support increased Arctic maritime transportation. The legislation also authorizes the construction of two new heavy icebreakers to replace the aging Polar Sea and Polar Star.

A second bill would amend the Hydrographic Services Improvement Act to authorize funding to get data and services to the Arctic for safe navigation, delineate the U.S. extended continental shelf and monitor coastal changes.

The third bill would direct the Department of Defense and the Department of Homeland Security to study the feasibility, location and resource needs for an Arctic deep water port. This study would determine whether it is in the strategic interest of the United States to build a port and where it might be located. A deep water port would not only serve our military and Coast Guard needs, but as we develop our offshore oil and gas reserves and see more shipping, tourism and vessel traffic in the Arctic, a deep water port could provide a crucial base of operations.

Sen. Murkowski is also a strong proponent of ratification of the United Nations Convention on the Law of the Sea, believing that it is crucial for the United States to be a party to this Treaty and be a player in the process, rather than an outsider hoping our interests are not damaged. As the only Arctic nation not a party to the treaty, failure to ratify continues to keep the United States at a disadvantage internationally and outside the process, without a seat at the table."

http://murkowski.senate.gov/public/index.cfm?p=Arctic

3.

United States Arctic Policy

NSPD-66 / HSPD-25

The White House
President George W. Bush

National Security Presidential Directive and Homeland Security Presidential Directive

January 9, 2009

NATIONAL SECURITY PRESIDENTIAL DIRECTIVE/NSPD -- 66
HOMELAND SECURITY PRESIDENTIAL DIRECTIVE/HSPD -- 25

MEMORANDUM FOR THE VICE PRESIDENT
THE SECRETARY OF STATE
THE SECRETARY OF THE TREASURY
THE SECRETARY OF DEFENSE
THE ATTORNEY GENERAL
THE SECRETARY OF THE INTERIOR
THE SECRETARY OF COMMERCE
THE SECRETARY OF HEALTH AND HUMAN SERVICES
THE SECRETARY OF TRANSPORTATION
THE SECRETARY OF ENERGY
THE SECRETARY OF HOMELAND SECURITY
ASSISTANT TO THE PRESIDENT AND CHIEF OF STAFF
ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY
DIRECTOR OF THE OFFICE OF MANAGEMENT AND BUDGET
DIRECTOR OF NATIONAL INTELLIGENCE
ASSISTANT TO THE PRESIDENT FOR NATIONAL SECURITY AFFAIRS
COUNSEL TO THE PRESIDENT
ASSISTANT TO THE PRESIDENT AND DEPUTY NATIONAL SECURITY ADVISOR FOR INTERNATIONAL ECONOMIC AFFAIRS
ASSISTANT TO THE PRESIDENT FOR HOMELAND SECURITY AND COUNTERTERRORISM
CHAIRMAN, COUNCIL ON ENVIRONMENTAL QUALITY
DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
COMMANDANT, U.S. COAST GUARD
DIRECTOR, NATIONAL SCIENCE FOUNDATION

SUBJECT: Arctic Region Policy

I. PURPOSE

A. This directive establishes the policy of the United States with respect to the Arctic region and directs related implementation actions. This directive supersedes Presidential Decision Directive/NSC-26 (PDD-26; issued 1994) with respect to Arctic policy but not Antarctic policy; PDD-26 remains in effect for Antarctic policy only.

B. This directive shall be implemented in a manner consistent with the Constitution and laws of the United States, with the obligations of the United States under the treaties and other international agreements to which the United States is a party, and with customary international law as recognized by the United States, including with respect to the law of the sea.

II. BACKGROUND

A. The United States is an Arctic nation, with varied and compelling interests in that region. This directive takes into account several developments, including, among others:

1. Altered national policies on homeland security and defense;

2. The effects of climate change and increasing human activity in the Arctic region;

3. The establishment and ongoing work of the Arctic Council; and

4. A growing awareness that the Arctic region is both fragile and rich in resources.

III. POLICY

A. It is the policy of the United States to:

1. Meet national security and homeland security needs relevant to the Arctic region;

2. Protect the Arctic environment and conserve its biological resources;

3. Ensure that natural resource management and economic development in the region are environmentally sustainable;

4. Strengthen institutions for cooperation among the eight Arctic nations (the United States, Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, and Sweden);

5. Involve the Arctic's indigenous communities in decisions that affect them; and

6. Enhance scientific monitoring and research into local, regional, and global environmental issues.

B. **National Security and Homeland Security Interests in the Arctic**

1. The United States has broad and fundamental national security interests in the Arctic region and is prepared to operate either independently or in conjunction with other states to safeguard these interests. These interests include such matters as missile defense and early warning; deployment of sea and air systems for strategic sealift, strategic deterrence, maritime presence, and maritime security operations; and ensuring freedom of navigation and overflight.

2. The United States also has fundamental homeland security interests in preventing terrorist attacks and mitigating those criminal or hostile acts that could increase the United States vulnerability to terrorism in the Arctic region.

3. The Arctic region is primarily a maritime domain; as such, existing policies and authorities relating to maritime areas continue to apply, including those relating to law enforcement.[1] Human activity in the Arctic region is increasing and is projected to increase further in coming years. This requires the United States to assert a more active and influential national presence to protect its Arctic interests and to project sea power throughout the region.

4. The United States exercises authority in accordance with lawful claims of United States sovereignty, sovereign rights, and jurisdiction in the Arctic region, including sovereignty within the territorial sea, sovereign rights and jurisdiction within the United States exclusive economic zone and on the continental shelf, and appropriate control in the United States contiguous zone.

5. Freedom of the seas is a top national priority. The Northwest Passage is a strait used for international navigation, and the Northern Sea Route includes straits used for international navigation; the regime of transit passage applies to passage through those straits. Preserving the rights and duties relating to navigation and overflight in the Arctic region supports our ability to exercise these rights throughout the world, including through strategic straits.

6. Implementation: In carrying out this policy as it relates to national security and homeland security interests in the Arctic, the Secretaries of State, Defense, and Homeland Security, in coordination with heads of other relevant executive departments and agencies, shall:

a. Develop greater capabilities and capacity, as necessary, to protect United States air, land, and sea borders in the Arctic region;

b. Increase Arctic maritime domain awareness in order to protect maritime commerce, critical infrastructure, and key resources;

c. Preserve the global mobility of United States military and civilian vessels and aircraft throughout the Arctic region;

d. Project a sovereign United States maritime presence in the Arctic in support of essential United States interests; and

e. Encourage the peaceful resolution of disputes in the Arctic region.

C. **International Governance**

1. The United States participates in a variety of fora, international organizations, and bilateral contacts that promote United States interests in the Arctic. These include the Arctic Council, the International Maritime Organization (IMO), wildlife conservation and management agreements, and many other mechanisms. As the Arctic changes and human activity in the region increases, the United States and other governments should consider, as appropriate, new international arrangements or enhancements to existing arrangements.

2. The Arctic Council has produced positive results for the United States by working within its limited mandate of environmental protection and sustainable development. Its subsidiary bodies, with help from many United States agencies, have developed and undertaken projects on a wide range of topics. The Council also provides a beneficial venue for interaction with indigenous groups. It is the position of the United States that the Arctic Council should remain a high-level forum devoted to issues within its current mandate and not be transformed into a formal international organization, particularly one with assessed contributions. The United States is nevertheless open to updating the structure of the Council, including consolidation of, or making operational changes to, its subsidiary bodies, to the extent such changes can clearly improve the Council's work and are consistent with the general mandate of the Council.

3. The geopolitical circumstances of the Arctic region differ sufficiently from those of the Antarctic region such that an "Arctic Treaty" of broad scope -- along the lines of the Antarctic Treaty -- is not appropriate or necessary.

4. The Senate should act favorably on U.S. accession to the U.N. Convention on the Law of the Sea promptly, to protect and advance U.S. interests, including with respect to the Arctic. Joining will serve the national security interests of the United States, including the maritime mobility of our Armed Forces worldwide. It will secure U.S. sovereign rights over extensive marine areas, including the valuable natural resources they contain. Accession will promote U.S. interests in the environmental health of the oceans. And it will give the United States a seat at the table when the rights that are vital to our interests are debated and interpreted.

5. Implementation: In carrying out this policy as it relates to international governance, the Secretary of State, in coordination with heads of other relevant executive departments and agencies, shall:

   a. Continue to cooperate with other countries on Arctic issues through the United Nations (U.N.) and its specialized agencies, as well as through treaties such as the U.N. Framework Convention on Climate Change, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention on Long Range Transboundary Air Pollution and its protocols, and the Montreal Protocol on Substances that Deplete the Ozone Layer;

   b. Consider, as appropriate, new or enhanced international arrangements for the Arctic to address issues likely to arise from expected increases in human activity in that region, including shipping, local development and subsistence, exploitation of living marine resources, development of energy and other resources, and tourism;

   c. Review Arctic Council policy recommendations developed within the ambit of the Council's scientific reviews and ensure the policy recommendations are subject to review by Arctic governments; and

   d. Continue to seek advice and consent of the United States Senate to accede to the 1982 Law of the Sea Convention.

D. **Extended Continental Shelf and Boundary Issues**

1. Defining with certainty the area of the Arctic seabed and subsoil in which the United States may exercise its sovereign rights over natural resources such as oil, natural gas, methane hydrates, minerals, and living marine species is critical to our national interests in energy security, resource management, and environmental protection. The most effective way to achieve international recognition and legal certainty for our extended continental shelf is through the procedure available to States Parties to the U.N. Convention on the Law of the Sea.

2. The United States and Canada have an unresolved boundary in the Beaufort Sea. United States policy recognizes a boundary in this area based on equidistance. The United States recognizes that the boundary area may contain oil, natural gas, and other resources.

3. The United States and Russia are abiding by the terms of a maritime boundary treaty concluded in 1990, pending its entry into force. The United States is prepared to enter the agreement into force once ratified by the Russian Federation.

4. Implementation: In carrying out this policy as it relates to extended continental shelf and boundary issues, the Secretary of State, in coordination with heads of other relevant executive departments and agencies, shall:

   a. Take all actions necessary to establish the outer limit of the continental shelf appertaining to the United States, in the Arctic and in other regions, to the fullest extent permitted under international law;

   b. Consider the conservation and management of natural resources during the process of delimiting the extended continental shelf; and

   c. Continue to urge the Russian Federation to ratify the 1990 United States-Russia maritime boundary agreement.

E. **Promoting International Scientific Cooperation**

1. Scientific research is vital for the promotion of United States interests in the Arctic region. Successful conduct of U.S. research in the Arctic region requires access throughout the Arctic Ocean and to terrestrial sites, as well as viable international mechanisms for sharing access to research platforms and timely exchange of samples, data, and analyses. Better coordination with the Russian Federation, facilitating access to its domain, is particularly important.

2. The United States promotes the sharing of Arctic research platforms with other countries in support of collaborative research that advances fundamental understanding of the Arctic region in general and potential Arctic change in particular. This could include collaboration with bodies such as the Nordic Council and the European Polar Consortium, as well as with individual nations.

3. Accurate prediction of future environmental and climate change on a regional basis, and the delivery of near real-time information to end-users, requires obtaining, analyzing, and disseminating accurate data from the entire Arctic region, including both paleoclimatic data and observational data. The United States has made significant investments in the infrastructure needed to collect environmental data in the Arctic region, including the establishment of portions of an Arctic circumpolar observing network through a partnership among United States agencies, academic collaborators, and Arctic residents. The United States promotes active involvement of all Arctic nations in these efforts in order to advance scientific understanding that could provide the basis for assessing future impacts and proposed response strategies.

4. United States platforms capable of supporting forefront research in the Arctic Ocean, including portions expected to be ice-covered for the foreseeable future, as well as seasonally ice-free regions, should work with those of other nations through the establishment of an Arctic circumpolar observing network. All Arctic nations are members of the Group on Earth Observations partnership, which provides a framework for organizing an international approach to environmental observations in the region. In addition, the United States recognizes that academic and research institutions are vital partners in promoting and conducting Arctic research.

5. Implementation: In carrying out this policy as it relates to promoting scientific international cooperation, the Secretaries of State, the Interior, and Commerce and the Director of the National Science Foundation, in coordination with heads of other relevant executive departments and agencies, shall:

a. Continue to play a leadership role in research throughout the Arctic region;

b. Actively promote full and appropriate access by scientists to Arctic research sites through bilateral and multilateral measures and by other means;

c. Lead the effort to establish an effective Arctic circumpolar observing network with broad partnership from other relevant nations;

d. Promote regular meetings of Arctic science ministers or research council heads to share information concerning scientific research opportunities and to improve coordination of international Arctic research programs;

e. Work with the Interagency Arctic Research Policy Committee (IARPC) to promote research that is strategically linked to U.S. policies articulated in this directive, with input from the Arctic Research Commission; and

f. Strengthen partnerships with academic and research institutions and build upon the relationships these institutions have with their counterparts in other nations.

F. **Maritime Transportation in the Arctic Region**

1. The United States priorities for maritime transportation in the Arctic region are:

   a. To facilitate safe, secure, and reliable navigation;

   b. To protect maritime commerce; and

   c. To protect the environment.

2. Safe, secure, and environmentally sound maritime commerce in the Arctic region depends on infrastructure to support shipping activity, search and rescue capabilities, short- and long-range aids to navigation, high-risk area vessel-traffic management, iceberg warnings and other sea ice information, effective shipping standards, and measures to protect the marine environment. In addition, effective search and rescue in the Arctic will require local, State, Federal, tribal, commercial, volunteer, scientific, and multinational cooperation.

3. Working through the International Maritime Organization (IMO), the United States promotes strengthening existing measures and, as necessary, developing new measures to improve the safety and security of maritime transportation, as well as to protect the marine environment in the Arctic region. These measures may include ship routing and reporting systems, such as traffic separation and vessel traffic management schemes in Arctic chokepoints; updating and strengthening of the Guidelines for Ships Operating in Arctic Ice-Covered Waters; underwater noise standards for commercial shipping; a review of shipping insurance issues; oil and other hazardous material pollution response agreements; and environmental standards.

4. Implementation: In carrying out this policy as it relates to maritime transportation in the Arctic region, the Secretaries of State, Defense, Transportation, Commerce, and Homeland Security, in coordination with heads of other relevant executive departments and agencies, shall:

   a. Develop additional measures, in cooperation with other nations, to address issues that are likely to arise from expected increases in shipping into, out of, and through the Arctic region;

   b. Commensurate with the level of human activity in the region, establish a risk-based capability to address hazards in the Arctic environment. Such efforts shall advance work on pollution prevention and response standards; determine basing and logistics support requirements, including necessary airlift and icebreaking capabilities; and improve plans and cooperative agreements for search and rescue;

   c. Develop Arctic waterways management regimes in accordance with accepted international standards, including vessel traffic-monitoring and routing; safe navigation standards; accurate and standardized charts; and accurate and timely environmental and navigational information; and

   d. Evaluate the feasibility of using access through the Arctic for strategic sealift and humanitarian aid and disaster relief.

G. **Economic Issues, Including Energy**

1. Sustainable development in the Arctic region poses particular challenges. Stakeholder input will inform key decisions as the United States seeks to promote economic and energy security. Climate change and other factors are significantly affecting the lives of Arctic inhabitants, particularly indigenous communities. The United States affirms the importance to Arctic communities of adapting to climate change, given their particular vulnerabilities.

2. Energy development in the Arctic region will play an important role in meeting growing global energy demand as the area is thought to contain a substantial portion of the world's undiscovered energy resources. The United States seeks to ensure that energy development throughout the Arctic occurs in an environmentally sound manner, taking into account the interests of indigenous and local communities, as well as open and transparent market principles. The United States seeks to balance access to, and development of, energy and other natural resources with the protection of the Arctic environment by ensuring that continental shelf resources are managed in a responsible manner and by continuing to work closely with other Arctic nations.

3. The United States recognizes the value and effectiveness of existing fora, such as the Arctic Council, the International Regulators Forum, and the International Standards Organization.

4. Implementation: In carrying out this policy as it relates to economic issues, including energy, the Secretaries of State, the Interior, Commerce, and Energy, in coordination with heads of other relevant executive departments and agencies, shall:

   a. Seek to increase efforts, including those in the Arctic Council, to study changing climate conditions, with a view to preserving and enhancing economic opportunity in the Arctic region. Such efforts shall include inventories and assessments of villages, indigenous communities, subsistence opportunities, public facilities, infrastructure, oil and gas development projects, alternative energy development opportunities, forestry, cultural and other sites, living marine resources, and other elements of the Arctic's socioeconomic composition;

   b. Work with other Arctic nations to ensure that hydrocarbon and other development in the Arctic region is carried out in accordance with accepted best practices and internationally recognized standards and the 2006 Group of Eight (G-8) Global Energy Security Principles;

   c. Consult with other Arctic nations to discuss issues related to exploration, production, environmental and socioeconomic impacts, including drilling conduct, facility sharing, the sharing of environmental data, impact assessments, compatible monitoring programs, and reservoir management in areas with potentially shared resources;

   d. Protect United States interests with respect to hydrocarbon reservoirs that may overlap boundaries to mitigate adverse environmental and economic consequences related to their development;

   e. Identify opportunities for international cooperation on methane hydrate issues, North Slope hydrology, and other matters;

   f. Explore whether there is a need for additional fora for informing decisions on hydrocarbon leasing, exploration, development, production, and transportation, as well as shared support activities, including infrastructure projects; and

   g. Continue to emphasize cooperative mechanisms with nations operating in the region to address shared concerns, recognizing that most known Arctic oil and gas resources are located outside of United States jurisdiction.

H. **Environmental Protection and Conservation of Natural Resources**

1. The Arctic environment is unique and changing. Increased human activity is expected to bring additional stressors to the Arctic environment, with potentially serious consequences for Arctic communities and ecosystems.

2. Despite a growing body of research, the Arctic environment remains poorly understood. Sea ice and glaciers are in retreat. Permafrost is thawing and coasts are eroding. Pollutants from within and outside the Arctic are contaminating the region. Basic data are lacking in many fields. High levels of uncertainty remain concerning the effects of climate change and increased human activity in the Arctic. Given the need for decisions to be based on sound scientific and socioeconomic information, Arctic environmental

research, monitoring, and vulnerability assessments are top priorities. For example, an understanding of the probable consequences of global climate variability and change on Arctic ecosystems is essential to guide the effective long-term management of Arctic natural resources and to address socioeconomic impacts of changing patterns in the use of natural resources.

3. Taking into account the limitations in existing data, United States efforts to protect the Arctic environment and to conserve its natural resources must be risk-based and proceed on the basis of the best available information.

4. The United States supports the application in the Arctic region of the general principles of international fisheries management outlined in the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of December 10, 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks and similar instruments. The United States endorses the protection of vulnerable marine ecosystems in the Arctic from destructive fishing practices and seeks to ensure an adequate enforcement presence to safeguard Arctic living marine resources.

5. With temperature increases in the Arctic region, contaminants currently locked in the ice and soils will be released into the air, water, and land. This trend, along with increased human activity within and below the Arctic, will result in increased introduction of contaminants into the Arctic, including both persistent pollutants (e.g., persistent organic pollutants and mercury) and airborne pollutants (e.g., soot).

6. Implementation: In carrying out this policy as it relates to environmental protection and conservation of natural resources, the Secretaries of State, the Interior, Commerce, and Homeland Security and the Administrator of the Environmental Protection Agency, in coordination with heads of other relevant executive departments and agencies, shall:

   a. In cooperation with other nations, respond effectively to increased pollutants and other environmental challenges;

   b. Continue to identify ways to conserve, protect, and sustainably manage Arctic species and ensure adequate enforcement presence to safeguard living marine resources, taking account of the changing ranges or distribution of some species in the Arctic. For species whose range includes areas both within and beyond United States jurisdiction, the United States shall continue to collaborate with other governments to ensure effective conservation and management;

   c. Seek to develop ways to address changing and expanding commercial fisheries in the Arctic, including through consideration of international agreements or organizations to govern future Arctic fisheries;

   d. Pursue marine ecosystem-based management in the Arctic; and

   e. Intensify efforts to develop scientific information on the adverse effects of pollutants on human health and the environment and work with other nations to reduce the introduction of key pollutants into the Arctic.

IV. Resources and Assets

A. Implementing a number of the policy elements directed above will require appropriate resources and assets. These elements shall be implemented consistent with applicable law and authorities of agencies, or heads of agencies, vested by law, and subject to the availability of appropriations. The heads of executive departments and agencies with responsibilities relating to the Arctic region shall work to identify future budget, administrative, personnel, or legislative proposal requirements to implement the elements of this directive.

GEORGE W. BUSH

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[1] These policies and authorities include Freedom of Navigation (PDD/NSC-32), the U.S. Policy on Protecting the Ocean Environment (PDD/NSC-36), Maritime Security Policy (NSPD-41/HSPD-13), and the National Strategy for Maritime Security (NSMS).

Source: The White House

4.

Information on the Interagency Ocean Policy Task Force

White House Interagency Ocean Policy Task Force

On June 12, 2009, President Obama sent a memorandum to the heads of executive departments and federal agencies establishing an Interagency Ocean Policy Task Force, led by the White House Council on Environmental Quality. The Task Force is charged with developing a recommendation for a national policy that ensures protection, maintenance, and restoration of oceans, our coasts and the Great Lakes. It will also recommend a framework for improved stewardship, and effective coastal and marine spatial planning.

The oceans, our coasts, and the Great Lakes provide jobs, food, energy resources, ecological services, recreation, and tourism opportunities, and play critical roles in our Nation's transportation, economy, and trade, as well as the global mobility of our Armed Forces and the maintenance of international peace and security," President Obama wrote in the memorandum. "We have a stewardship responsibility to maintain healthy, resilient, and sustainable oceans, coasts and Great Lakes resources for the benefit of this and future generations."

"The challenges our oceans, coasts, and Great Lakes are facing are complex, and to meet these challenges we must have the participation of a wide spectrum of views from within the federal government," said Nancy Sutley, Chair of the White House Council on Environmental Quality. "The Task Force has a wealth of opportunity to make our oceans, coasts and Great Lakes healthier - both environmentally and economically."

The recommendations and frameworks developed by the Task Force will be cost effective and improve coordination across federal agencies. The Chair will terminate the Task Force upon the completion of its duties.

The time period to submit comments to the Task Force has closed, but you can read comments from others. The Task Force's Interim Framework is open for comment through Friday, February 12, 2010.

Read the President's Proclamation on National Oceans Month

Summary of Executive Order - Stewardship of the Ocean, Our Coasts, and the Great Lakes - and the Final Recommendations of the Interagency Ocean Policy Task Force

Distributed by Representative Joule - August 4, 2010

On July 19, 2010, President Obama signed an Executive Order establishing the first ever National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes ("National Policy"). The Order adopts the Final Recommendations of the Interagency Ocean Policy Task Force ("OPTF") and directs federal agencies to implement them. The Final Recommendations of the Task Force include:

1. Strengthening ocean governance and coordination, and establishing principles for ocean management.

2. Creation of a National Ocean Council to coordinate federal agencies to implement the National Policy and to strengthen ocean governance. It will hold its first meeting in late summer 2010. Co-chairs are chair of the Council on Environmental Quality and Director of the Office of Science and Technology Policy. Members are nine Secretaries; Attorney General; Administrators of EPA, OMB, NOAA, and NASA; Directors of National Intelligence and NSF; Chairman of the Joint Chiefs of Staff; National Security Advisor; Assistants to the President for Homeland Security, Domestic Policy, Energy and Climate Change, and Economic Policy; and a federal employee designated by the Vice President.

3. An implementation strategy with nine priority objectives for U.S. action. Within them, there are five Areas of Special Emphasis for implementing the National Policy, including "Changing Conditions in the Arctic: Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes. The National Ocean Council is responsible for developing and overseeing a strategic action plan for each priority within 6-12 months of its establishment.

4. An ecosystem-based framework for coastal and marine special planning ("CMSP") to address conservation, economic activity, user conflict and sustainable use. CMSP is "a comprehensive, adaptive, integrated, ecosystem-based, and transparent spacial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas." Nine regional planning bodies consisting of federal, state, tribal and other representatives will develop the CMSPs. Alaska is a region unto itself. The National Oceans Council will commence the CMSP process immediately.

5. Establishment of a Governance Coordinating Committee to formally engage with states, tribes and local governments. It will consist of 18 members, including one designated seat for an Alaskan representative chosen in consultation with the Governor. There may be other opportunities for Alaska representation, as there is a seat for one member of a state legislature, three tribal representatives, and three local government representatives.

The Interagency Ocean Policy Task Force, formed in June 2009 at the President's request, included 24 senior policy officials from across the federal government and was led by the White House Council on Environmental Quality. The OPTF found that the complexity of the oceans governance structure, which included hundreds of domestic policies, laws & regulations, was leaving gaps in governance. Thus, it recommended the National Policy.

The National Policy does not establish new regulations or restrict any uses. It does not require new legislation in order to be implemented. The Policy is intended to provide a stronger framework from applying existing laws and agency authorities, but does not supersede them or alter their authorities.

To come to its recommendations, the OPTF reviewed federal, state and foreign policies, past and pending legislation, recommendations in two earlier Ocean Commission reports, and public comments through a robust public process (38 expert roundtables, 6 regional public meetings - in Anchorage on August 21, 2009 - and a website to accept public comments). It received over 5,000 public comments. The key themes the Task Force incorporated in the Final Recommendations are: the importance of science-based decision making, improved transparency and public participation, avoiding new layers and bureaucracy and unnecessary costs, and funding to implement the policy adequately.

The President has requested funding for the 2011 fiscal year: $12 million for CMSP and geospatial modernization, $20 million for regional ocean partnership grants, and $5 million for integrated ecosystem assessments. His budget requests also include investments across agencies to implement the National Policy.

See
http://www.whitehouse.gov/administration/eop/ceq/initiatives/oceans for more information.

THE WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY

Final Recommendations Of The Interagency Ocean Policy Task Force July 19, 2010

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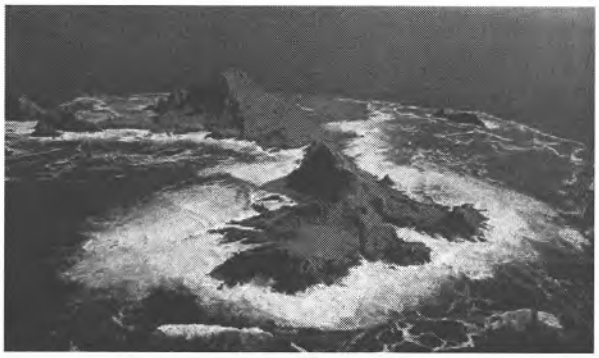
EXECUTIVE SUMMARY

I. Introduction



In order to better meet our Nation's stewardship responsibilities for the ocean, our coasts, and the Great Lakes, President Obama established the Interagency Ocean Policy Task Force (Task Force) on June 12, 2009. The Task Force is composed of 24 senior-level officials from executive departments, agencies, and offices across the Federal government and led by the Chair of the Council on Environmental Quality (CEQ). The President charged the Task Force with developing recommendations to enhance our ability to maintain healthy, resilient, and sustainable ocean, coasts, and Great Lakes resources for the benefit of present and future generations.

The Deepwater Horizon-BP oil spill in the Gulf of Mexico and resulting environmental crisis is a stark reminder of how vulnerable our marine environments are, and how much communities and our Nation rely on healthy and resilient ocean and coastal ecosystems. The ocean, our coasts, and the Great Lakes deeply impact the lives of all Americans, whether we live and work in the country's heartland or along its shores. America's rich and productive coastal regions and waters support tens of millions of jobs and contribute trillions of dollars to the national economy each year. They also host a growing number of important activities, including recreation, science, commerce, transportation, energy development, and national security and they provide a wealth of natural resources and ecological benefits.

Nearly half of the country's population lives in coastal counties, and millions of visitors enjoy our Nation's seashores each year. The ocean, our coasts, and the Great Lakes are vital places for recreation, including boating, fishing, swimming, nature watching, and diving. These activities not only help fuel our economy, but also are critical to the social and cultural fabric of our country. In addition, coastal ecosystems provide essential ecological services. Barrier islands, coral reefs, mangroves, and coastal wetlands help to protect our coastal communities from damaging floods and storms. Coastal wetlands shelter recreational and commercial fish species, provide critical habitat for migratory birds and mammals, and serve as a natural filter to help keep our waters clean.

Despite the critical importance of these areas to our health and well-being, the ocean, coasts and Great Lakes face a wide range of threats from human activities. Overfishing, pollution, coastal development and the impacts of climate change are altering ecosystems, reducing biological diversity, and

placing more stress on wildlife and natural resources, as well as on people and coastal communities. Compounding these threats, human uses of the ocean, coasts, and Great Lakes are expanding at a rate that challenges our ability to plan and manage significant and often competing demands. Demands for energy development, shipping, aquaculture, emerging security requirements and other new and existing uses are expected to grow. Overlapping uses and differing views about which activities should occur where can generate conflicts and misunderstandings. As we work to accommodate these multiple uses, we must also ensure continued public access for recreation and other pursuits, and sustain and preserve the abundant marine resources and healthy ecosystems that are critical to the well-being and prosperity of our Nation.

The challenges we face in the stewardship of the ocean, our coasts, and the Great Lakes lie not only within the ecosystems themselves, but also in the laws, authorities, and governance structures intended to manage our use and conservation of them. United States governance and management of these areas span hundreds of domestic policies, laws, and regulations covering international, Federal, State, tribal, and local interests. Challenges and gaps arise from the complexity and structure of this regime.

The time has come for a comprehensive national policy for the stewardship of the ocean, our coasts, and the Great Lakes. Today, as never before, we better comprehend the links among land, air, fresh water, ocean, ice, and human activities. Advances in science and technology provide better and timelier information to guide decision-making. By applying the principles of ecosystem-based management (which integrates ecological, social, economic, commerce, health, and security goals, and which recognizes both that humans are key components of ecosystems and also that healthy ecosystems are essential to human welfare) and of adaptive management (which calls for routine reassessment of management actions to allow for better informed and improved future decisions) in a coordinated and collaborative approach, the Nation will more effectively address the challenges facing the ocean, our coasts, and the Great Lakes and ensure their continued health for this and future generations.

II. Summary of the Final Recommendations of the Task Force

To develop its recommendations, the Task Force reviewed Federal, State, and foreign policies and models, past and pending legislation, the recommendations contained in the two earlier Ocean Commissions' reports, and public comments.

The Task Force also initiated a robust public engagement process to receive input from a diversity of voices across the country. On behalf of the Task Force, CEQ hosted 38 expert roundtables to hear from a broad range of stakeholder groups. The Task Force also hosted six regional public meetings, and created a website to accept public comments through CEQ. The Task Force received more than 5,000 public comments, with many of the groups commenting representing constituencies of hundreds or thousands of members.

The Task Force recommendations set a new direction for improved stewardship of the ocean, our coasts, and the Great Lakes. They provide: (1) our Nation's first ever *National Policy for the Stewardship of the*

Ocean, Our Coasts, and the Great Lakes (National Policy); (2) a strengthened governance structure to provide sustained, high-level, and coordinated attention to ocean, coastal, and Great Lakes issues; (3) a targeted implementation strategy that identifies and prioritizes nine categories for action that the United States should pursue; and (4) a framework for effective coastal and marine spatial planning (CMSP) that establishes a comprehensive, integrated, ecosystem-based approach to address conservation, economic activity, user conflict, and sustainable use of ocean, coastal, and Great Lakes resources.

National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes

It is the Policy of the United States to:

- Protect, maintain, and restore the health and biological diversity of ocean, coastal, and Great Lakes ecosystems and resources;
- Improve the resiliency of ocean, coastal, and Great Lakes ecosystems, communities, and economies;
- Bolster the conservation and sustainable uses of land in ways that will improve the health of ocean, coastal, and Great Lakes ecosystems;
- Use the best available science and knowledge to inform decisions affecting the ocean, our coasts, and the Great Lakes, and enhance humanity's capacity to understand, respond, and adapt to a changing global environment;
- Support sustainable, safe, secure, and productive access to, and uses of the ocean, our coasts, and the Great Lakes;
- Respect and preserve our Nation's maritime heritage, including our social, cultural, recreational, and historical values;
- Exercise rights and jurisdiction and perform duties in accordance with applicable international law, including respect for and preservation of navigational rights and freedoms, which are essential for the global economy and international peace and security;
- Increase scientific understanding of ocean, coastal, and Great Lakes ecosystems as part of the global interconnected systems of air, land, ice, and water, including their relationships to humans and their activities;
- Improve our understanding and awareness of changing environmental conditions, trends, and their causes, and of human activities taking place in ocean, coastal, and Great Lakes waters; and
- Foster a public understanding of the value of the ocean, our coasts, and the Great Lakes to build a foundation for improved stewardship.

The recommended National Policy establishes a comprehensive national approach to uphold our stewardship responsibilities; ensures accountability for our actions; and serves as a model of balanced,

productive, efficient, sustainable, and informed ocean, coastal, and Great Lakes use, management, and conservation within the global community. The National Policy recognizes that America's stewardship of the ocean, our coasts, and the Great Lakes is intrinsically and intimately linked to environmental sustainability, human health and well-being, national prosperity, adaptation to climate and other environmental change, social justice, foreign policy, and national and homeland security. It sets forth overarching guiding principles for United States management decisions and actions affecting the ocean, our coasts, and the Great Lakes.

Policy Coordination Framework to Improve the Stewardship of the Ocean, Our Coasts, and the Great Lakes

No single agency can successfully resolve the complex and pressing problems facing the ocean, our coasts, and the Great Lakes. Successful stewardship will require an effective governance structure with sustained leadership and broad interagency coordination to effectively manage the many uses of these resources. A coordinated Federal effort, proactively guided by a senior-level interagency body, will ensure that the hundreds of domestic policies, laws, and regulations governing the management of the ocean, our coasts, and the Great Lakes are implemented in a meaningful way.

The Task Force recommends a combination of modifications to the structure of the existing Committee on Ocean Policy[1], a stronger mandate and direction, and renewed and sustained high-level engagement. Subject to later refinements, the Task Force recommends:

1. Establishing a new National Ocean Council (NOC) which consolidates and strengthens the Principal- and Deputy-level components of the existing Committee on Ocean Policy within a single structure;

2. Strengthening the decision-making and dispute-resolution processes by defining clear roles for the NOC and the NOC leadership;

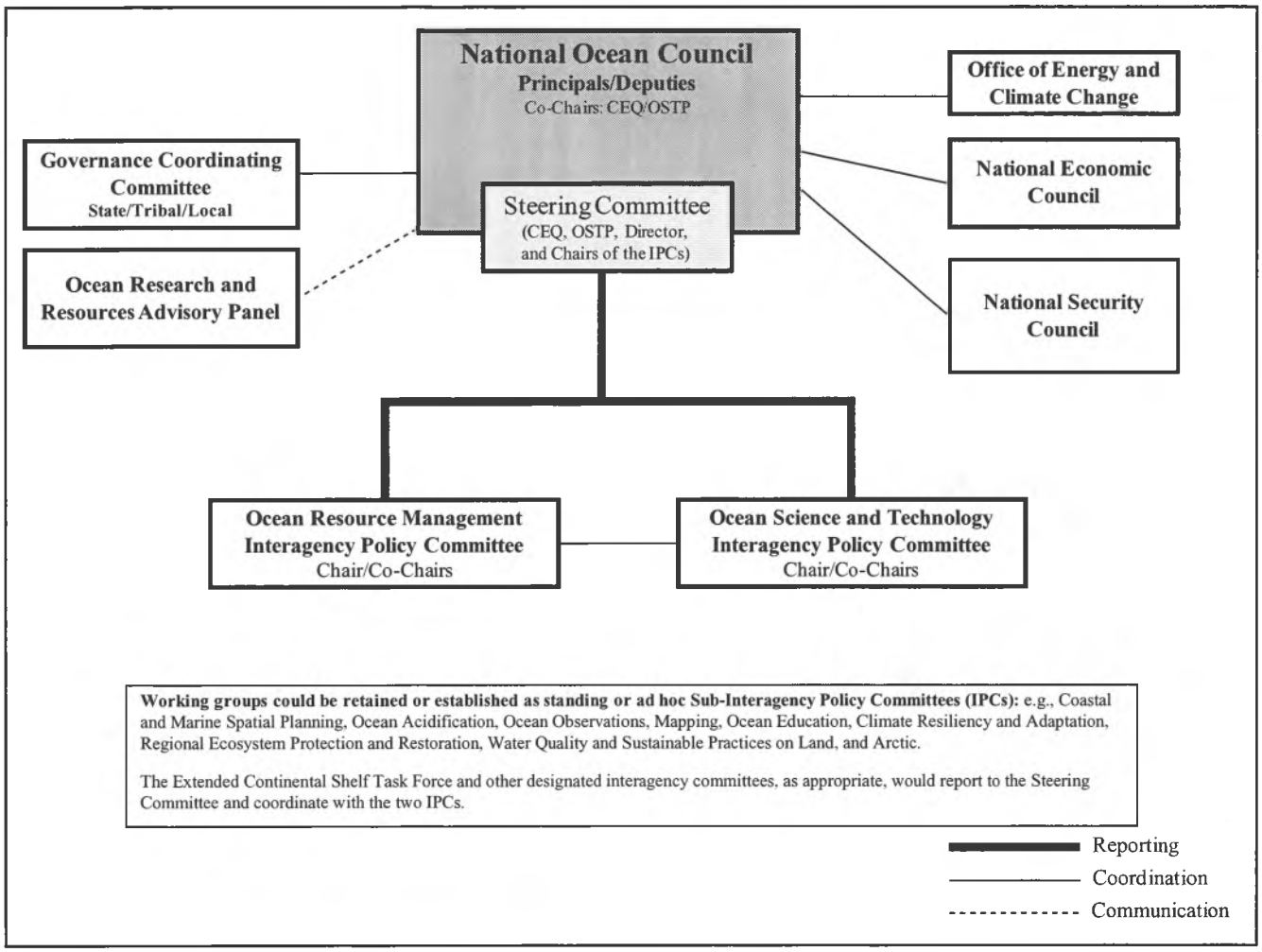
3. Formally engaging with State, tribal, and local authorities to address relevant issues through the creation of a new committee comprised of their designated representatives;

4. Strengthening the link between science and management through a new NOC Steering Committee; and

5. Strengthening coordination between the NOC, the National Security Council, the National Economic Council, the Office of Energy and Climate Change, the Council on Environmental Quality, the Office of Science and Technology Policy, the Office of Management and Budget, and other White House entities.

[1] The Committee on Ocean Policy was established by Executive Order 13366 in 2004 and has only been moderately effective in establishing forums for bringing Federal agencies together to coordinate on ocean-related matters.

Policy Coordination Framework



These recommendations establish high-level direction and policy guidance from a clearly designated and identifiable authority. They also call for more consistent and sustained senior-level participation and attention on ocean-related issues from all member agencies and departments essential to effective management. The Task Force is confident that this combination of improvements provides a framework for more successful policy coordination to improve the stewardship of the ocean, our coasts, and the Great Lakes.

Implementation Strategy

The Task Force recommends an implementation strategy that identifies nine priority objectives (i.e., categories for action) that our Nation should pursue. These priority objectives provide a bridge between policy and specific actions, but do not prescribe in detail how individual entities will undertake their responsibilities, leaving those details to be determined through the development of strategic action plans. The Task Force recommends the following nine priority objectives:

National Priority Objectives

1. **Ecosystem-Based Management:** Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes.
2. **Coastal and Marine Spatial Planning:** Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management in the United States.
3. **Inform Decisions and Improve Understanding:** Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.
4. **Coordinate and Support:** Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government, and as appropriate, engage with the international community.
5. **Resiliency and Adaptation to Climate Change and Ocean Acidification:** Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.
6. **Regional Ecosystem Protection and Restoration:** Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, State, tribal, local, and regional levels.
7. **Water Quality and Sustainable Practices on Land:** Enhance water quality in the ocean, along our coasts, and in the Great Lakes by promoting and implementing sustainable practices on land.
8. **Changing Conditions in the Arctic:** Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.
9. **Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure:** Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrate that system into international observation efforts.

The NOC would develop strategic action plans for each of the priority objectives, focusing on key areas identified by the Task Force. Each strategic action plan would identify specific and measurable near-term, mid-term, and long-term actions, with appropriate milestones, performance measures, and outcomes to meet each objective. In addition, each plan would explicitly identify key lead and participating agencies; gaps and needs in science and technology; potential resource requirements and efficiencies; and steps for integrating or coordinating current and out-year budgets. This strategy would allow adequate time to fully consider the necessary details for implementation, and, as appropriate, to coordinate and collaborate with States, tribal, and local authorities, regional governance structures, academic institutions, non-governmental organizations, recreational users, and private enterprise.

Framework for Effective Coastal and Marine Spatial Planning

As called for in President Obama's June 12, 2009 memorandum, the Task Force recommendations provide a framework for CMSP that offers a new, comprehensive, integrated, regionally-based approach to planning and managing uses and activities. The recommended framework places sound science and the best available information at the heart of decision-making and would bring Federal, State, and tribal partners together in an unprecedented manner to cooperatively develop coastal and marine spatial plans (CMS Plans). This process is designed to decrease user conflict, improve planning and regulatory efficiencies, decrease associated costs and delays, engage affected communities and stakeholders, and preserve critical ecosystem functions and services. The recommendations emphasize

The National Goals of Coastal and Marine Spatial Planning

1. Support sustainable, safe, secure, efficient, and productive uses of the ocean, our coasts, and the Great Lakes, including those that contribute to the economy, commerce, recreation, conservation, homeland and national security, human health, safety, and welfare;
2. Protect, maintain, and restore the Nation's ocean, coastal, and Great Lakes resources and ensure resilient ecosystems and their ability to provide sustained delivery of ecosystem services;
3. Provide for and maintain public access to the ocean, coasts, and Great Lakes;
4. Promote compatibility among uses and reduce user conflicts and environmental impacts;
5. Improve the rigor, coherence, and consistency of decision-making and regulatory processes;
6. Increase certainty and predictability in planning for and implementing new investments for ocean, coastal, and Great Lakes uses; and
7. Enhance interagency, intergovernmental, and international communication and collaboration.

the importance of frequent and robust stakeholder, scientific, and public engagement throughout the planning process.

The recommended framework includes a unified definition of CMSP, identifies the reasons for engaging in the process, and describes the proposed geographic scope of the planning areas. The framework articulates national goals and guiding principles that would be followed in CMSP efforts and the development and implementation of CMS Plans. Under this framework, the United States will be subdivided into nine regional planning areas: Northeast, Mid-Atlantic, South Atlantic, Great Lakes, Caribbean, Gulf of Mexico, West Coast, Pacific Islands, and Alaska/Arctic regions. Each region will have a corresponding regional planning body consisting of Federal, State, and tribal representatives to develop regional goals, objectives, and ultimately regional CMS plans. To provide for national consistency and support, the framework establishes and describes planning steps and elements, a process by which the NOC would guide and certify the development of regional CMS Plans, a method to address CMS Plan adherence and compliance, a robust information management system to allow easy access to and transparency of data and information necessary for planning, and mechanisms for frequent stakeholder and public input. In addition, the framework describes an implementation approach that maximizes flexibility among the regions, addresses regional capacity, and aims to have CMS Plans for all regions by 2015.

III. Support for Joining the Law of the Sea Convention

The Task Force strongly and unanimously supports United States accession to the Convention on the Law of the Sea and ratification of its 1994 Implementing Agreement. The Law of the Sea Convention is the bedrock legal instrument governing activities on, over, and under the world's oceans. United States accession to the Convention will further our national security, environmental, economic, and diplomatic interests.

Key reasons for accession include:

- The Convention has garnered the unequivocal support of our national security leadership under both Republican and Democratic administrations, because, among other things, it codifies essential navigational rights and freedoms upon which our Armed Forces rely.
- The Convention sets forth the rights and responsibilities of nations to prevent, reduce, and control pollution of the marine environment and to protect and preserve resources off their shores.
- By becoming a party to the Convention, U.S. legal rights to our extended continental shelf can be put on the strongest legal foundation.
- As a party to the Law of the Sea Convention, the United States would have the ability to participate formally and more effectively in the interpretation and development of the Convention.

- Joining the Law of the Sea Convention would reaffirm and enhance United States leadership in global ocean affairs.

IV. Conclusion

In response to President Obama's June 12, 2009 memorandum, and after careful consideration of thousands of valuable comments from political leaders, public and private organizations, and citizens, the Task Force is pleased to submit these final recommendations. Once implemented, these final recommendations will provide the first-ever comprehensive national policy of the United States to improve stewardship of the ocean, our coasts, and the Great Lakes.

The Task Force is unanimous in its call for the Nation to set a new course for improved stewardship of the ocean, our coasts, and the Great Lakes. This must include a comprehensive, integrated, transparent, science-based, and ecosystem-based planning process to achieve the sustainable use of the ocean, our coasts, and the Great Lakes. The Task Force is mindful that these recommendations may create a level of uncertainty and anxiety among those who rely on these resources and may generate questions about how they align with existing processes, authorities, and budget challenges. The NOC will address questions and specifics as implementation progresses. Meaningful and frequent opportunities for stakeholder and public engagement throughout the implementation of the National Policy and implementation of coastal and marine spatial planning will be an essential component of cooperatively addressing these uncertainties head-on, and the Task Force recommendations embrace this approach. The Task Force is confident that the investments and improvements described in these final recommendations will advance the economic interests of the United States through sustainable and productive ocean uses; significantly improve our capacity to address the long-term challenges and impacts of climate and environmental changes; and provide a lasting foundation for improving the stewardship of and further enhancing the many vital benefits our Nation can derive from these resources.

With a clear National Policy and a revitalized, empowered, unified, and comprehensive framework to coordinate efforts set forth in these recommendations, we can achieve an America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured so as to promote the well-being, prosperity, and security of present and future generations.

RECOMMENDATIONS

PART ONE. NATIONAL POLICY FOR THE STEWARDSHIP OF THE OCEAN, OUR COASTS, AND THE GREAT LAKES

I. Vision

An America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured so as to promote the well-being, prosperity, and security of present and future generations.

II. National Policy Context

The Value of the Ocean, Our Coasts, and the Great Lakes

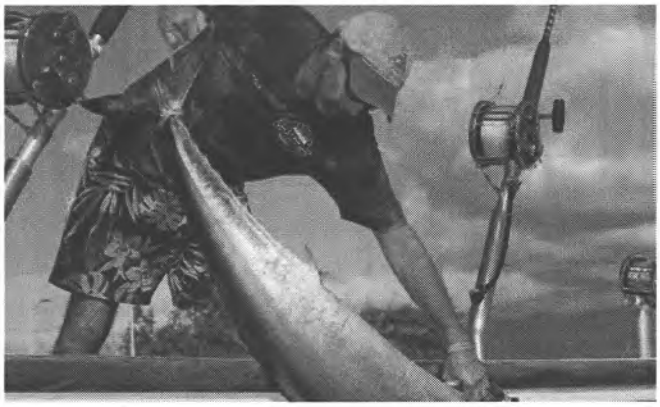
America is intricately connected to and directly reliant on the ocean, our coasts, and the Great Lakes. Each of us – whether living and working in the country's heartland or along its coasts – affects and is affected by these places. Their beauty inspires us, and their bounty contributes to our national well-being and security. Nearly half of our population is located in coastal counties. Our rich and productive coastal regions and waters account for the great majority of the national economy, totaling trillions of dollars each year, and support distant communities that may not even be aware of the connection between the land and sea. Millions of visitors enjoy our Nation's seashores each year, contributing not only to the economy, but also to personal and communal satisfaction and fulfillment. The sea is both a refuge for spiritual reflection and a powerhouse of excitement for educating students of all ages and interests.

With over 95,000 miles of coastline and the largest Exclusive Economic Zone (EEZ) in the world, our Nation benefits from a wealth of goods and services derived from the ocean, our coasts, and the Great Lakes. They provide food, fresh water, minerals, energy, and other natural resources and ecological benefits. They support tens of millions of jobs and

play a critical role in our Nation's transportation, economy, and trade, as well as in the global mobility and readiness of our Armed Forces and the maintenance of international peace and security. They are also vital places for recreation, including boating, fishing, swimming, nature watching, and diving, which are critical to the economic, social, and cultural fabric of our country.

The ocean supports human health and well-being in myriad ways, including as a source of healthy foods, pharmaceuticals, and other beneficial compounds. The ocean is a source of existing energy and offers numerous opportunities for renewable energy, which can help to secure our energy independence and mitigate climate change.

The ocean and Great Lakes exert significant influence over how our planet functions. Covering over 70 percent of the Earth, the ocean plays a primary role in our planet's environment and natural operations, including weather and climate. The ocean's ability to absorb and store heat from the atmosphere and transport it to other parts of the globe keeps daily temperatures within a livable range. The Great Lakes are the largest freshwater system on Earth, with 10,000 miles of shoreline and some 95 percent of the Nation's fresh surface water. While we commonly refer to different oceans (Atlantic, Pacific, Arctic, etc.), it is important to recognize that all of these bodies of water are connected and influenced by each other. These linkages require our Nation to recognize that we benefit from and affect one global ocean.



The ocean shapes and sustains all life on Earth. We are dependent on the ocean for the air we breathe, the food we eat, and the water we drink. Though we may not think about it, processes on land and in the water, including biological processes, are intricately linked so that changes in one can have profound effects on the other. The ocean is both the beginning and the end of the Earth's water cycle. Water that evaporates from the surface of the ocean becomes rain that falls on our fields and fills our aquifers. Much of this precipitation eventually finds rivers which flow back to the sea, starting the cycle once more. Half of the oxygen we breathe comes from microscopic plants living in the ocean. Coastal barrier islands, coral reefs, mangroves, and wetlands serve as buffers between coastal communities and damaging floods and storms. Coastal wetlands are a nursery for many recreational and commercial fish species, provide essential habitat for many migratory birds and mammals, and serve as a natural filter helping to keep our waters clean. Ocean and coastal ecosystems absorb and detoxify many pollutants,

recycle nutrients, and help control pests and pathogens. Marine ecosystems house biological diversity exceeding that found in the world's rain forests.

Challenges Facing the Ocean, Our Coasts, and the Great Lakes

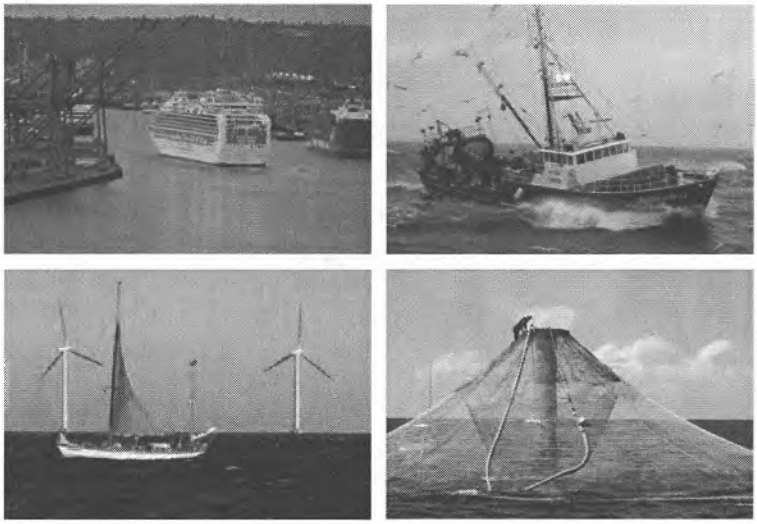
The importance of ocean, coastal, and Great Lakes ecosystems cannot be overstated; simply put, we need them to survive. It is clear that these invaluable and life-sustaining assets are vulnerable to human activities and, at the same time, human communities are rendered more vulnerable when these resources are degraded. Yet ocean, coastal, and Great Lakes ecosystems are experiencing an unprecedented rate of change due to human activities. We are only now beginning to understand the full extent of the direct and indirect consequences of our actions on these systems.

Climate change is impacting the ocean, our coasts, and the Great Lakes. Increasing water temperatures are altering habitats, migratory patterns, and ecosystem structure and function. Coastal communities are facing sea-level rise, inundation, increased threats from storms, erosion, and significant loss of coastal wetlands. The ocean's ability to absorb carbon dioxide from the atmosphere buffers the impacts of climate change, but also causes the ocean to become more acidic, threatening not only the survival of individual species of marine life, but also entire marine ecosystems. The ocean buffers increased global temperatures by absorbing heat, but increasing temperatures are causing sea levels to rise by expanding seawater volume and melting land-based ice. Increased temperatures may eventually reduce the ocean's ability to absorb carbon dioxide. Conversely, climate change is predicted to lower the water levels of the Great Lakes, thereby altering water cycles, habitats, and economic uses of the lakes.

Along many areas of our coasts and within the Great Lakes, biological diversity is in decline due to overfishing, introduction of invasive species, and loss and degradation of essential habitats from coastal development and associated human activities. The introduction of non-native species can carry significant ecological and economic costs. Human and marine ecosystem health are threatened by a range of challenges, including increased levels of exposure to toxins from harmful algal blooms and other sources, and greater contact with infectious agents. Areas in numerous bays, estuaries, gulfs, and the Great Lakes are now consistently low in or lacking oxygen, creating dead zones along our bays and coasts. Unsustainable fishing (e.g., overfishing) remains a serious concern with consequences for marine ecosystems and human communities. In the Arctic, environmental changes are revealing the vulnerability of its ecosystems. These changes are increasing stressors and impacts on the ecosystems, people, and communities in the region and are presenting new domestic and international management challenges.

Many of these concerns are attributable not only to activities within ocean, coastal, and Great Lakes ecosystems, but also to actions that take place in our Nation's interior. For example, our industries, agricultural and transportation operations, cities, and suburbs generate various forms of pollution. Industrial operations emit pollutants, such as nitrogen and mercury, into the atmosphere that often find their way into the ocean and Great Lakes. Rain washes residues, chemicals, and oily runoff from our roadways into our estuaries and coastal waters. Heavy rainfall events can wash sediment, pesticides, debris, and nutrients from our fields, lawns, and agricultural operations into our waters. Urban and suburban development, including the construction of roads, highways, and other infrastructure, as well as modification to rivers and streams, can adversely affect the habitats of aquatic and terrestrial species.

Demands on the ocean, our coasts, and the Great Lakes are intensifying, spurred by population growth, migration to coastal areas, and economic activities. Human uses of the ocean, coasts, and the Great Lakes are expanding at a rate that challenges our ability to plan and manage them under the current sector-by-sector approach. New and expanding uses—including energy development, shipping, aquaculture, and emerging security requirements—are expected to place increasing demands on our ocean, coastal, and Great Lakes ecosystems. There is also increasing demand for access to these places for recreational, cultural, and other societal pursuits. As these demands increase, overlapping uses and differing views about which activities should occur where can generate conflicts and misunderstandings. At the same time, there is an overarching need to sustain and preserve abundant marine resources and healthy ecosystems that are critical to the well-being and continued prosperity of our Nation.



The State of the National Framework for Policy Coordination

The challenges we face in the stewardship of the ocean, our coasts, and the Great Lakes lie not only within the ecosystems themselves, but also in the laws, authorities, and governance structures intended to manage our use and conservation of them. United States governance and management of these areas span hundreds of domestic policies, laws, and regulations covering international, Federal, State, tribal, and local interests. These issues range from stewardship and resource use, to maritime safety and commerce, national security, water quality, ports and other transportation infrastructure, and energy. Challenges and gaps arise from the complexity and structure of this regime.

These challenges are not limited to our domestic governance and management regimes. Our Nation, as a major maritime power and coastal State, has a large stake in the development and interpretation

of international law and policy applicable to the ocean, our coasts, and the Great Lakes. Our national security interests are tightly linked to navigational rights and freedoms, as well as to operational flexibility. Our national security and economic interests are also linked to our ability to secure U.S. sovereign rights over resources in extensive marine areas off our coasts, to promote and protect U.S. interests in the marine environment, and to ensure that our maritime interests are respected and considered internationally. The Administration's support for accession to the 1982 United Nations Convention on the Law of the Sea (the Law of the Sea Convention) reflects several important objectives, including strengthening our Nation's ability to participate in and influence international law and policy related to the ocean.

Time to Act

The time has come for a national policy to uphold our stewardship responsibilities, ensure accountability for our actions, and serve as a model of balanced, productive, efficient, sustainable, and informed ocean, coastal, and Great Lakes use, management, and conservation within the global community. Today, as never before, we better comprehend the linkages among land, air, fresh water, ocean, ice, and human activities. We recognize that change is occurring rapidly and must be addressed. Advances in science and technology provide better and timelier information and understanding to guide decision-making. By applying the principles of ecosystem-based management (in which we integrate ecological, social, economic, commerce, health, and security goals, and recognize humans as key components of the ecosystem and healthy ecosystems as essential to human well-being) and adaptive management (whereby we routinely assess management actions to allow for better informed and improved future decisions) in a coordinated and collaborative approach, the Nation can improve its response to environmental, social, economic, and security challenges. With a clear national policy and a revitalized, empowered, unifying, and comprehensive framework to coordinate efforts among Federal, State, tribal, and local authorities, including regional governance structures, non-governmental organizations, the private sector, and the public, we can work together toward the changes needed to secure the health and prosperity of the ocean, our coasts, and the Great Lakes.

III. Policy

America's stewardship of the ocean, our coasts, and the Great Lakes is intrinsically and intimately linked to environmental sustainability, human health and well-being, national prosperity, adaptation to climate and other environmental changes, social justice, international diplomacy, and national and homeland security. Therefore, it is the policy of the United States to:

1. Healthy and Resilient Ocean, Coasts, and Great Lakes

   - Protect, maintain, and restore the health and biological diversity of ocean, coastal, and Great Lakes ecosystems and resources;

   - Improve the resiliency of ocean, coastal, and Great Lakes ecosystems, communities, and economies;

- Bolster the conservation and sustainable uses of land in ways that will improve the health of ocean, coastal, and Great Lakes ecosystems; and

- Use the best available science and knowledge to inform decisions affecting the ocean, our coasts, and the Great Lakes, and enhance humanity's capacity to understand, respond, and adapt to a changing global environment.

2. Safe and Productive Ocean, Coasts, and Great Lakes

- Support sustainable, safe, secure, and productive access to, and uses of, the ocean, our coasts, and the Great Lakes;

- Respect and preserve our Nation's maritime heritage, including our social, cultural, recreational, and historical values; and

- Exercise rights and jurisdiction and perform duties in accordance with applicable international law, including respect for and preservation of navigational rights and freedoms, which are essential for the global economy and international peace and security.

3. Understood and Treasured Ocean, Coasts, and Great Lakes

- Increase scientific understanding of ocean, coastal, and Great Lakes ecosystems as part of the global interconnected systems of air, land, ice, and water, including their relationships to humans and their activities;

- Improve our understanding and awareness of changing environmental conditions, trends, and their causes, and of human activities taking place in ocean, coastal, and Great Lakes waters; and

- Foster a public understanding of the value of the ocean, our coasts, and the Great Lakes to build a foundation for improved stewardship.

The United States will promote the objectives of this policy by:

- Ensuring a comprehensive and collaborative framework for the stewardship of the ocean, our coasts, and the Great Lakes that facilitates cohesive actions across the Federal Government, as well as participation of State, tribal, and local authorities, regional governance structures, non-governmental organizations, the public, and the private sector;

- Cooperating and exercising leadership at the international level, including by joining the Law of the Sea Convention; and

- Supporting ocean stewardship in a fiscally responsible manner.

IV. Principles

1. United States management decisions and actions affecting the ocean, our coasts, and the Great Lakes will be guided by the following stewardship principles to further this policy:

   a. As responsible environmental stewards we will protect, maintain, and restore the health, productivity, and resiliency of ocean, coastal, and Great Lakes ecosystems (including their waters and resources). Policies, programs, and activities of the United States should be

managed and conducted in a manner that seeks to prevent or minimize adverse environmental impacts to the ocean, our coasts, and the Great Lakes ecosystems and resources, including cumulative impacts, and to ensure and improve their integrity. They should be managed and conducted in a manner that does not undermine efforts to protect, maintain, and restore healthy and biologically diverse ecosystems and the full range of services they provide;

b. Decisions affecting the ocean, our coasts, and the Great Lakes should be informed by and consistent with the best available science. Decision-making will also be guided by a precautionary approach as reflected in the Rio Declaration of 1992, which states in pertinent part, "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;" and

c. Actions taken to protect the ocean, our coasts, and the Great Lakes should endeavor to promote the principles that environmental damage should be avoided wherever practicable and that environmental costs should be internalized, taking into account the approach that those who cause environmental damage should generally bear the cost of that damage.

2. Human activities that may affect ocean, coastal, and Great Lakes ecosystems should be managed using ecosystem-based management and adaptive management, through an integrated framework that accounts for the interdependence of the land, air, water, ice, and the interconnectedness between human populations and these environments. Management should include monitoring and have the flexibility to adapt to evolving knowledge and understanding, changes in the global environment, and emerging uses.

3. Current and future uses of ocean, coastal, and Great Lakes ecosystems and resources should be managed and effectively balanced in a way that:

   a. Maintains and enhances the environmental sustainability of multiple uses, including those that contribute to the economy, commerce, recreation, security, and human health;

   b. Harmonizes competing and complementary uses effectively;

   c. Integrates efforts to protect, maintain, and restore the health, productivity, and resiliency of ocean, coastal, and Great Lakes ecosystems and the services they provide; and

   d. Recognizes environmental changes and impacts, including those associated with an increasingly ice-diminished Arctic, sea-level rise, and ocean acidification.

4. The United States should support disciplinary and interdisciplinary science, research, monitoring, mapping, modeling, forecasting, exploration, and assessment to continually improve understanding of ocean, coastal, and Great Lakes ecosystems. These efforts should include improving understanding of physical, biological, ecological, and chemical processes and changes,

their interconnectedness with other parts of the Earth system and with human populations, and the potential social and economic consequences of management decisions on the long-term health and well-being of the population, including human health and safety. This knowledge, along with traditional knowledge, should be applied through ecosystem-based management and adaptive management. Information resulting from these efforts should be easily accessible to the public.

5. The United States should develop an improved awareness of changing environmental conditions and trends, and their causes, and of human activities that take place in the ocean, coastal, and Great Lakes environments.

6. United States policies, programs, and activities should enhance formal and informal education about the ocean, our coasts, and the Great Lakes and their uses to build a foundation for greater understanding and improved stewardship, and build capacity to produce future scientists, managers, and members of a dynamic and innovative workforce.

7. The United States should cooperate and provide leadership internationally in the protection, management, and sustainable use of the world's ocean, coastal regions, and the Great Lakes in keeping with applicable conventions and agreements, and with customary international law, as reflected in the Law of the Sea Convention.

8. United States programs, policies, and activities that may impact ocean, coastal, or Great Lakes ecosystems, or engage the use of their resources, should be designed to meet measurable benchmarks in support of clear goals and objectives related to stewardship of these ecosystems.

    a. These goals and objectives of programs and activities should be periodically reevaluated and their effectiveness assessed. This information should be used to adjust management priorities and guide future management and resource decisions; and

    b. The United States should develop appropriate standards and methods for measurement and assessment of parameters associated with the health of ocean, coastal and Great Lakes ecosystems.

9. United States policies, programs, and activities that may impact ocean, coastal, or Great Lakes ecosystems, or engage the use of their resources, should be assessed and conducted within an integrated and comprehensive interagency planning framework that:

a. Considers and addresses the full suite of impacts on resources, biological diversity, and ecosystems;

b. Is based on the best available scientific knowledge;

c. Considers and addresses potential use conflicts;

d. Ensures and advances coordination and collaboration across federal, state, tribal, and local jurisdictional lines, and with regional governance structures, the private sector, foreign governments, and international organizations, as appropriate;

e. Is coordinated and promotes consistency with our homeland and national security and foreign policy interests;

f. Is coordinated and promotes consistency with other national strategies that include environmental stewardship components relevant to the ocean, our coasts, and the Great Lakes;

g. Considers and respects our nation's maritime heritage, including our social, cultural, historical, recreational, and aesthetic values;

h. Aims to maximize long-term net benefits to society by considering a range of reasonable alternatives that balance potential economic, environmental, public health and safety, and other advantages; distributive impacts; and social justice and equity;

i. Operates through an open and transparent approach that encourages broad public participation;

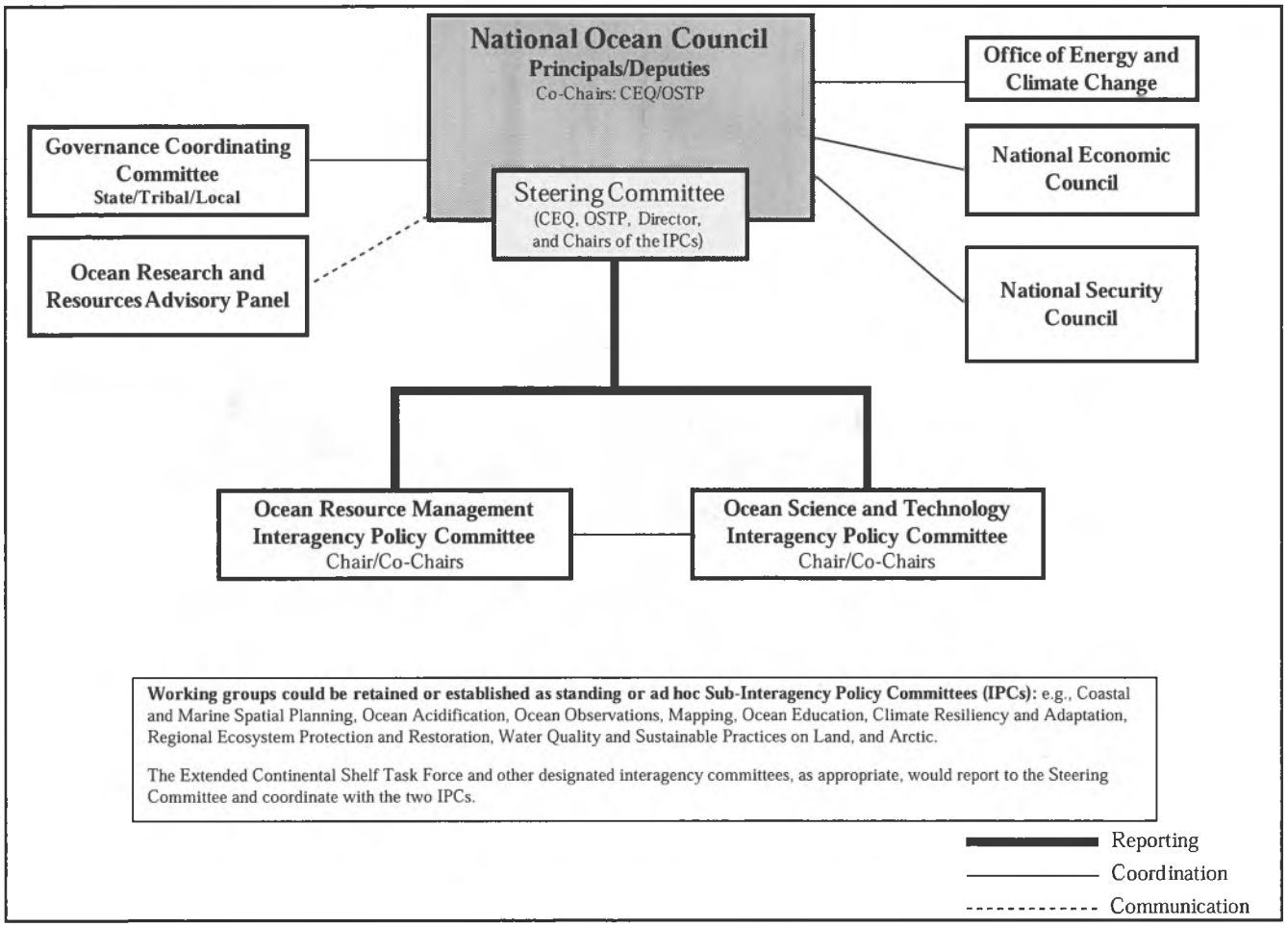
j. Ensures consistency with management and budgetary goals and compliance with relevant legal requirements;

k. Seeks to eliminate redundancy and encourage efficiencies and synergies; and

l. Includes a reporting and accountability mechanism.

Implementing a number of the policy elements and principles directed above will require appropriate resources and assets. Departments and agencies shall work to identify future budgetary, administrative, regulatory, or legislative proposal requirements to implement these elements within the budgetary and management guidelines of the President's budget.

PART TWO. POLICY COORDINATION FRAMEWORK



The recommended policy coordination framework provides a combination of modifications to the structure of the existing Committee on Ocean Policy, a stronger mandate and direction, and renewed and sustained high-level engagement. This combination of improvements provides a framework for more successful policy coordination to improve the stewardship of the ocean, our coasts, and the Great Lakes. The recommended policy coordination framework would provide a reinvigorated structure that would strengthen ocean governance and coordination by providing clear and visible leadership and sustained high-level engagement within the Federal Government. Additionally, the structure would provide for greater participation by, and coordination of State, tribal, and local authorities, and regional governance structures. The linkage between management and science would be strengthened, as would coordination with other senior level entities on relevant economic, climate, and security matters. This combination of improvements would enhance the stewardship of the ocean, our coasts, and the Great Lakes.

I. National Ocean Council

Structure

The National Ocean Council (NOC) would be a dual Principal- and Deputy-level committee. Membership of the NOC would include: the Secretaries of State, Defense, the Interior, Agriculture, Health and Human Services, Commerce, Labor, Transportation, Energy, and Homeland Security; the Attorney General; the Administrator of the Environmental Protection Agency; the Chair of the Council on Environmental Quality (CEQ); the Director of the Office of Management and Budget (OMB); the Administrator of the National Aeronautics and Space Administration; the Director of National Intelligence; the Director of the Office of Science and Technology Policy (OSTP); the Director of the National Science Foundation; the Chairman of the Federal Energy Regulatory Commission;[2] the Chairman of the Joint Chiefs of Staff; the Assistants to the President for National Security Affairs, Homeland Security and Counterterrorism, Domestic Policy, Energy and Climate Change, and Economic Policy; an employee of the United States designated by the Vice President; the Under Secretary of Commerce for Oceans and Atmosphere (NOAA Administrator); and such other officers or employees of the United States as the Co-Chairs may from time to time designate.

Co-Chairs

The NOC would be co-chaired by the Chair of the CEQ and the Director of OSTP. This construct would provide the NOC with the balance of equities at the most senior level of its leadership and better facilitate interagency cooperation and collaboration.

Function

Subject to the direction of the President and unless as otherwise provided for by law, the NOC would perform the following functions:

1. **Tier-one functions of the NOC (Principal-level).** The NOC has overall responsibility for implementation of the National Policy, including coastal and marine spatial planning. Functions

[2] Federal Energy Regulatory Commission and other independent regulatory agencies participate on the NOC by invitation of the Co-Chairs.

would include: (1) periodically update and set national priority objectives; (2) review and provide annual direction on National Policy implementation objectives based on Administration priorities and recommendations from the Deputy-level; and (3) be a forum for dispute resolution and decision-making of issues that could not be resolved at the Deputy-level. The NOC would be required to meet a minimum of twice per year, but the Co-Chairs could call additional meetings as necessary for dispute resolution or other purposes.

2. **Tier Two (Deputy-level) functions would include**: (1) ensure execution of National Policy implementation objectives; (2) ensure implementation of coastal and marine spatial planning; (3) transmit Administration priorities to the Ocean Resource Management Interagency Policy Committee (ORM-IPC) and Ocean Science and Technology Interagency Policy Committee (OST-IPC); (4) ensure activities of and products from the ORM-IPC and OST-IPC are consistent with Administration policy; (5) coordinate with the National Security Council (NSC), National Economic Council (NEC),[3] Office of Energy and Climate Change (OECC), and other offices, as appropriate; (6) provide direction and feedback to, and receive external input and advice from, its advisory bodies; and (7) assist with dispute resolution and decision-making, and if unable to do so, to forward the issues to the Principal-level. This group would also assume the duties of the statutorily mandated National Ocean Research Leadership Council (NORLC) under 10 U.S.C. § 7902.

The Deputies would be required to meet a minimum of quarterly.

II. Authorities and Responsibilities of the National Ocean Council Co-Chairs

1. Advise the President on the Implementation of the National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes

The Co-Chairs would advise the President on matters regarding implementation of the *National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes* (National Policy), consistent with the consensus views of the NOC. If consensus cannot be achieved, the Co-Chairs would provide their own views equally with the views of each member of the NOC.

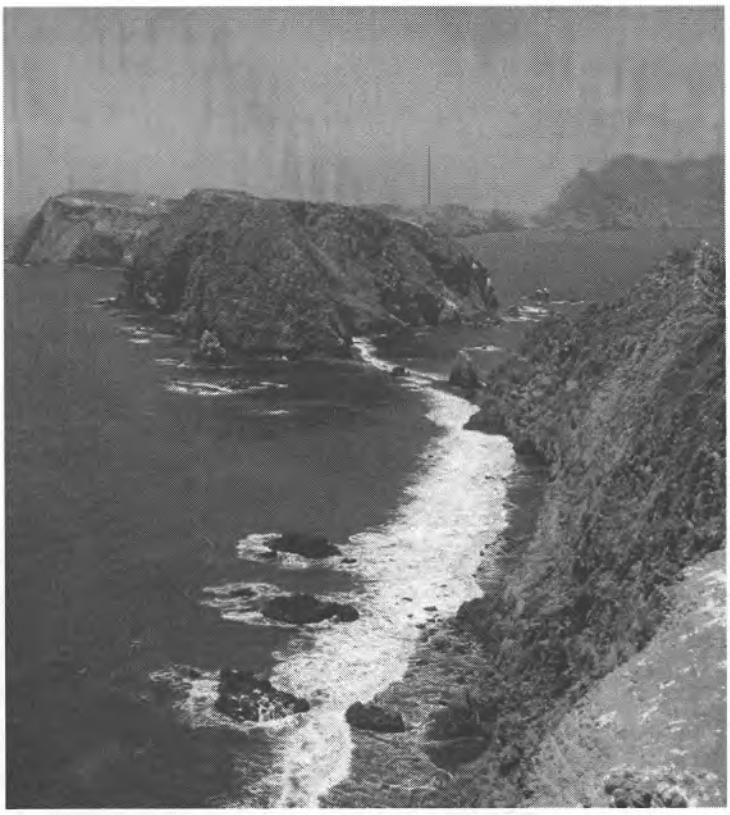
2. Implementation of the National Policy

On behalf of the NOC, the Co-Chairs would have overall responsibility for coordinating and facilitating the implementation of the National Policy, subject to the direction of the NOC and the President, including the following:

- **Development of Strategic Action Plans** – The Co-Chairs would facilitate development by the NOC of strategic action plans to further the National Policy and identify progress

[3] The existing Committee on the Marine Transportation System's coordination with the NOC governance structure would be done through the National Economic Council, at both the Principal-level and Deputy-level. Coordination with the ORM-IPC and OST-IPC would also be developed, as appropriate.

toward meeting defined goals and objectives.



- **Implementation of Coastal and Marine Spatial Planning** – The Co-Chairs would facilitate implementation of coastal and marine spatial planning in accordance with Part 4 below.

- **Reporting and Accountability** – The Co-Chairs would be responsible for: (1) coordinating interagency reporting on implementation and progress; (2) monitoring and ensuring effective implementation of policy decisions; (3) providing oversight and accountability for document preparation; and (4) coordinating and expediting interagency review and clearance of documents and reports within the NOC purview.

- **Budget** – The Co-Chairs would coordinate the development of an annual budget guidance memorandum on ocean priorities consistent with the goals and objectives of the National Policy. While it is understood that the Co-Chairs' authority would not be construed to impair or otherwise affect the function of the Director of OMB, they would work with OMB to issue interagency budget guidance consistent with annual priorities, develop crosscuts to inform the annual priorities on ocean, coastal, and Great Lakes stewardship, and consult with OMB and the NOC to identify programs that contribute significantly to the National Policy. The Co-Chairs also would work with OMB to coordinate preparation of the biennial Federal Ocean and Coastal Activities Report mandated by Section 5 of the Oceans Act of 2000.

- **Emerging Issues** – The Co-Chairs would bring any Presidential ocean actions or priorities to the NOC, as appropriate, for action and implementation and would coordinate proper management of and response to emerging issues of relevance to the National Policy.

- **International** – In implementing this policy, the Co-Chairs would coordinate with the Secretary of State and the heads of other relevant agencies on matters related to the policy issues that arise within the Intergovernmental Oceanographic Commission, International Whaling Commission, Arctic Council, International Maritime Organization, regional fishery management organizations, and other similar international organizations.

3. Co-Chairs of the NOC

- The Co-Chairs shall have authority to call NOC meetings, draft the agenda, prioritize issues, and call Deputies' meetings.

4. Coordination and Integration

   - The Co-Chairs would be the point of contact to coordinate with the National Security Advisor (NSA), NEC Director, and Assistant to the President for Energy and Climate Change (APECC), and other senior White House officials, as appropriate. The Co-Chairs would have authority to request meetings with these entities for the purposes of coordination and resolution of issues of overlapping responsibility.

5. Decision-Making and Dispute Resolution

   - The Co-Chairs would seek to encourage decisions and recommendations based on consensus of the NOC.

   - Disputes that could not be resolved at the Deputy-level would be referred to the Co-Chairs. The Co-Chairs would facilitate resolution among the Principals.

   - With respect to those matters in which resolutions or consensus could not be reached, the Co-Chairs would coordinate with the APECC, NEC Director, and NSA, as appropriate, to frame the disputed issue or issues for decision by the President.

   - The establishment of the NOC would not be construed to impair or otherwise affect: (1) authority granted by law to an executive department or agency or the head thereof; or (2) functions assigned by the President to the NSC (or subordinate bodies) relating to matters affecting foreign affairs, national security, homeland security, or intelligence – any of these matters that are not resolved by consensus within the NOC will be forwarded to the NSC for resolution.

III. Steering Committee

Structure

The Steering Committee would be a high-level, streamlined body of five members from OSTP, CEQ, and one Chair each of the ORM-IPC and OST-IPC, and the Director of the NOC Staff. The Steering Committee would meet at least every other month, but more often as issues require, and work in consultation with NSC, NEC, and OMB to ensure their respective input on relevant matters, as appropriate. NOC staff would attend these meetings and be responsible for ensuring the implementation of agreed-upon actions.

Function

The Steering Committee would be the key forum for ensuring integration and coordination on priority areas within the NOC. In particular, it would ensure that there is coordination of management and science issues and that the activities of the ORM-IPC and OST-IPC are aligned to fully support implementation of the National Policy and priorities agreed upon by the NOC. The Steering Committee would identify key issues and assist in developing the agenda for the NOC. The NOC staff would be responsible for ensuring the implementation of agreed upon actions. In addition, the Extended Continental Shelf Task Force and other designated interagency committees, as appropriate, would report to the Steering Committee.

IV. National Ocean Council Staff Leadership and Support

Structure

Two senior-level staff members, a Director of the NOC Staff, and a Deputy Director, would support the Co-Chairs in the implementation of the National Policy. On a day-to-day basis they would be responsible for ensuring the execution of the functions of the full-time staff supporting the NOC. They would be charged with ensuring the effective operation of the NOC, and the efficient implementation of the National Policy, under the guidance of the Co-Chairs. In addition, the NOC would initially be supported by an ocean policy office consisting of a minimum of six to eight dedicated staff comprised of interagency representatives on staggered two-year assignments from departments, agencies, and offices represented on the NOC. These full-time NOC staff personnel would report to the staff Director and Deputy Director.

Function

The staff Director and Deputy Director, as appropriate, would represent the Co-Chairs at policy-level meetings and forums, external events, and interaction with Congress. They would work with the IPC Co-Chairs to also ensure policy coordination and integration of the IPCs and facilitate close coordination between the NOC and its Ocean Research and Resources Advisory Panel (ORRAP) and Governance Coordinating Committee (GCC). They would oversee the NOC staff on a day-to-day basis and serve as the points of contact to coordinate at a staff level with CEQ, NSC, NEC, OSTP, OECC, and other offices, as appropriate. The staff Director, Deputy Director, and other NOC staff personnel would serve as the core support to the NOC in its operations and in implementation of the National Policy. Each member of the NOC staff would be required to have programmatic experience and analytical skills. Each staff member would work to provide administrative support to, and ensure coordination among, the NOC and the IPCs, GCC, and other appropriate entities.

V. Ocean Resource Management Interagency Policy Committee

Structure

The ORM-IPC is the successor to the current Subcommittee on Integrated Management of Ocean Resources. Chairs of the ORM-IPC are designated by the NOC. The group would consist of Deputy Assistant Secretaries or comparable representatives, or appropriate senior-level representatives with decision-making authority from departments, agencies and offices represented on the NOC. The ORM-IPC reports to the NOC. The ORM-IPC may establish Sub-IPCs as necessary, as approved by the NOC.

Function

The ORM-IPC would function as the ocean resource management body of the NOC, with an emphasis on ensuring the interagency implementation of the National Policy, national priority objectives, and other priorities defined or approved by the NOC. This would include the development of strategic plans, in coordination with the OST-IPC, for the implementation of priority management objectives,

with clear outcomes, milestones, deadlines, designated agencies, and performance measures with an adaptive review process. The ORM-IPC Chairs would develop a charter for the operation of the body, to be approved by the NOC, including, but not limited to, membership, meetings (e.g., requiring that it meet at least every two months), development of a new or updated work plan based on direction from the NOC, and a process for external input (e.g., State, tribal, local, regional, and the public).

VI. Ocean Science and Technology Interagency Policy Committee

Structure

The National Science and Technology Council's (NSTC) Joint Subcommittee on Ocean Science and Technology (JSOST) would serve as the OST-IPC. Chairs of the OST-IPC would be appointed through NSTC procedures in consultation with the NOC. The group would consist of Deputy Assistant Secretaries or comparable representatives, or appropriate senior-level representatives with decision-making authority from departments, agencies, and offices represented on the NOC. The NSTC would direct the OST-IPC to advise and assist the NOC in consonance with this National Policy and to work with associated bodies (e.g., the ORM-IPC) accordingly.

Function

The OST-IPC would function as the ocean science and technology body of the NOC, with an emphasis on ensuring the interagency implementation of the National Policy, national priority objectives, and other priorities for science and technology objectives. This would include the development of strategic

plans (e.g., the Ocean Research Priorities Plan and Implementation Strategy), in coordination with the ORM-IPC, for interagency implementation of priority science and technology objectives, with clear outcomes, milestones, deadlines, designated agencies, and performance measures with an adaptive review process. The OST-IPC Chairs, in close coordination with the NOC, would develop a charter for the operation of the body, to be approved by the NSTC, and would include, but not be limited to, membership, meetings (e.g., requiring that it meet at least every two months), development of a new or updated work plan based on input from the NOC, and a process for external input (e.g., State, tribal, regional, and public). The OST-IPC would also retain the legislatively mandated functions of JSOST, report to the NSTC's Committee on Environment and Natural Resources, and maintain a close operational relationship with the NOC. It would continue to adhere to the rules and regulations of the NSTC. The OST-IPC may establish Sub-IPCs, as necessary, and will do so under NSTC procedures and in close coordination with the NOC.

VII. Governance Coordinating Committee

Structure

The NOC, in consultation with the White House Office of Intergovernmental Affairs, would establish the GCC that would consist of eighteen members from States, federally-recognized tribes, and local governments. Members would be chosen by the NOC and would be comprised of: (1) one State representative each from the Great Lakes Region, Gulf of Mexico Region, Mid-Atlantic Region, Northeast Region, South Atlantic Region, and West Coast Region, chosen in consultation with the Governors represented on the existing regional governance structures;[4] (2) one State representative each from Alaska, the Pacific Islands,[5] and the Caribbean,[6] chosen in consultation with respective Governors; (3) two at-large representatives from inland States, chosen in consultation with the National Governors Association; (4) one State legislative representative, chosen in consultation with the National Conference of State Legislatures; (5) three at-large tribal representatives, chosen in consultation with tribal councils, national and regional tribal organizations (e.g., the National Congress of American Indians); and (6) three local government representatives from coastal States (i.e., two mayors and one county official), chosen in consultation with the U.S. Conference of Mayors, the National League of Cities, and the National Association of Counties. Representatives would serve for staggered two-year terms. These representatives would select a Chair and Vice-Chair from their members. In addition, the GCC may establish subcommittees chaired by representatives of the GCC. These subcommittees would include additional representation, as appropriate, from State, tribal, and local governments, respectively, to provide for greater collaboration and expanded exchange of views. The GCC would be supported by the NOC staff.

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[4] Existing regional governance structures include the Great Lakes Commission, the Governors' South Atlantic Alliance, the Gulf of Mexico Alliance, the Mid-Atlantic Regional Council on the Ocean, the Northeast Regional Ocean Council, and the West Coast Governors' Agreement on Ocean Health.

[5] For purposes of this section "Pacific Islands" include Hawaii, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa.

[6] For purposes of this section "Caribbean" includes the Commonwealth of Puerto Rico and the U.S. Virgin Islands.

Function

The role of the GCC would be to serve as a formal body for State, tribal, and local government representatives to deliberate and coordinate with the NOC on issues of inter-jurisdictional collaboration and cooperation on the National Policy and related matters. These matters would include coordinating on the development of a uniform procedure to facilitate resolution at the regional level of disputes regarding the development of coastal and marine spatial plans (CMS Plans) prior to elevation to the NOC and providing advice on long-term strategic management and research priorities. The GCC would submit to the IPCs and the Steering Committee ocean and coastal related issues for potential discussion by the NOC and provide input on issues at the request of the Steering Committee. The GCC would also have regular and continued communication with the IPCs, via the NOC Steering Committee, throughout the development of the strategic action plans and implementation of the National Policy.

The United States has a unique legal relationship with federally recognized American Indian and Alaska Native tribal governments (tribes) as set forth in United States treaties, statutes, Executive Orders, and court decisions. These instruments establish a framework for the Federal Government's recognition of and support for tribal sovereignty and tribal self-government and self-determination, consistent with applicable Federal law, but not necessarily with State law. While the GCC includes three tribal representatives, the function of the GCC and these representatives would not replace Government-to-Government consultations with tribes under existing authorities.

VIII. Ocean Research and Resources Advisory Panel

Structure

The ORRAP is a legislatively established body that advises the NORLC under the Federal Advisory Committee Act (FACA).

Function

The ORRAP would provide independent advice and guidance to the NOC. Current membership is comprised of individuals from the National Academies, State governments, academia, and ocean industries, representing marine science, marine policy, and other related fields. However, ORRAP membership would be reviewed to determine whether to include additional representatives to broaden the level of expertise in support of the goals of the National Policy. The NOC would routinely provide guidance and direction on the areas for which it seeks advice and recommendations from the ORRAP.

IX. Review and Evaluation

After 12 months of operation, the NOC would conduct a review of the governance structure to evaluate its effectiveness and make any necessary changes or improvements.

PART THREE. IMPLEMENTATION STRATEGY

National Priority Objectives

HOW WE DO BUSINESS

1. **Ecosystem-Based Management:** Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes.
2. **Coastal and Marine Spatial Planning:** Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management in the United States.
3. **Inform Decisions and Improve Understanding:** Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.
4. **Coordinate and Support:** Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government and, as appropriate, engage with the international community.

AREAS OF SPECIAL EMPHASIS

1. **Resiliency and Adaptation to Climate Change and Ocean Acidification:** Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.
2. **Regional Ecosystem Protection and Restoration:** Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, State, tribal, local, and regional levels.
3. **Water Quality and Sustainable Practices on Land:** Enhance water quality in the ocean, along our coasts, and in the Great Lakes by promoting and implementing sustainable practices on land.
4. **Changing Conditions in the Arctic:** Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.
5. **Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure:** Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system and integrate that system into international observation efforts.

I. Introduction

The National Policy would provide our Nation with a comprehensive approach, solidly based on science and technology, to uphold our stewardship responsibilities, and ensure accountability for our actions to present and future generations. Furthermore, the United States intends, through the National Policy, to serve as a model of balanced, productive, efficient, sustainable, and informed ocean, coastal, and Great Lakes use, management, and conservation within the global community. This implementation strategy recommends a clear set of priority objectives that our Nation should pursue to further the National Policy.

Overview of National Priority Objectives

This implementation strategy recommends nine priority objectives. The first four, which together frame *How We Do Business,* represent overarching ways in which the Federal Government must operate differently or better to improve stewardship of the ocean, our coasts, and the Great Lakes. The implementation of ecosystem-based management embodies a fundamental shift in how the United States manages these resources, and provides a foundation for how the remaining objectives would be implemented. Within that construct, the implementation of coastal and marine spatial planning and management would mark the beginning of a new era of comprehensive, integrated techniques to address conservation, economic activity, user conflict, and sustainable use of ocean, coastal, and Great Lakes resources. The other overarching objectives – to better inform decisions and improve understanding by the public through a strengthened ability to obtain and use science and information and to better coordinate and support science-based management across various authorities and governance structures are, in and of themselves, not new concepts. However, these efforts have suffered from the lack of a clear National Policy and a comprehensive framework within which to achieve desired outcomes.

The implementation strategy also identifies five *Areas of Special Emphasis,* each of which represents a substantive area of particular importance to achieving the National Policy. These priority areas of work seek to address some of the most pressing challenges facing the ocean, our coasts, and the Great Lakes. For many years, scientists, resource managers, private industry, and others have been wrestling with these issues with a variety of existing Federal Government programs in place to address them. While those efforts have delivered their share of results, in each of these critical areas more can – and must –

be done. In many cases, we have lacked the capability and understanding – both scientific and technical – to affect the type of change required. In the last several years, however, science has significantly evolved and advanced, and our capacity to respond to environmental and technological changes in these five areas has improved substantially. With this strategy, these specific areas of work should be viewed as national priorities with a renewed and coordinated effort at finding and implementing solutions. Over time, the NOC will assess the progress on these areas and also identify other areas to be addressed.

Planning

Together, these nine priority objectives provide a bridge between the National Policy and action on the ground and in the water, but do not prescribe in detail how individual entities would undertake these responsibilities. For each priority objective, the NOC would be responsible for, and oversee development of, a strategic action plan within six to twelve months from its establishment. The NOC's ORM-IPC and OST-IPC would be charged with developing these plans. The plans would address the *Obstacles* and *Opportunities* identified for each objective and would focus on, but not be limited to, the key areas identified under each objective. In addition, each plan would:

- Identify specific and measurable near-term, mid-term, and long-term actions, with appropriate milestones, performance measures, and outcomes to fulfill each objective;
- Consider smaller-scale, incremental, and opportunistic efforts that build upon existing activities, as well as more complex, larger-scale actions that have the potential to be truly transformative;
- Explicitly identify key lead and participating agencies;
- Identify gaps and needs in science and technology; and
- Identify potential resource requirements and efficiencies; and steps for integrating or coordinating current and out-year budgets.

The plans would be adaptive to allow for modification and addition of new actions based on new information or changing conditions. Their effective implementation would also require clear and easily understood requirements and regulations, where appropriate, that include enforcement as a critical component. Implementation of the National Policy for the stewardship of the ocean, our coasts, and the Great Lakes will recognize that different legal regimes, with their associated freedoms, rights, and duties, apply in different maritime zones. The plans would be implemented in a manner consistent with applicable international conventions and agreements and with customary international law as reflected in the Law of the Sea Convention. The plans and their implementation would be assessed and reviewed annually by the NOC and modified as needed based on the success or failure of the agreed upon actions. Upon identification and finalization of plans, the NOC Co-Chairs, in collaboration with OMB, would develop an annual interagency ocean budget guidance memorandum. Recognizing the reality of the limited availability of new resources, each of the Federal agencies engaged in the implementation

of strategic action plans would re-evaluate how resources should best be allocated in light of their statutory and regulatory mandates.

While these plans are under development, any agency that is conducting an activity that supports or furthers one of the objectives would bring them to the attention of the NOC. The NOC – working with the agency – would review the activity to determine how it might best contribute to overall implementation of the priority objectives, including being incorporated into the relevant strategic action plan.

Transparency and Collaboration

Transparency in developing strategic action plans and implementing the National Policy is critical. As the NOC develops and revises the plans, it will ensure substantial opportunity for public participation. Final plans, revisions, and reports of how well plan performance measures are being met would be made publicly available.

The effective implementation of this far-reaching and comprehensive National Policy would require active collaboration of the Federal Government with State, tribal, and local authorities, regional governance structures, academic institutions, non-governmental organizations, recreational interests, and private enterprise. In developing and revising the plans, the NOC would reach out to these interested parties, as appropriate, through the NOC's GCC, the ORRAP, workshops, and by other means. Furthermore, international collaboration on a broad range of ocean issues is an important component of these objectives. The Nation plays a leadership role in various international forums that deal with these issues, such as the Arctic Council, the International Maritime Organization, the Intergovernmental Oceanographic Commission, regional fisheries management organizations, and the International Whaling Commission. By joining the Law of the Sea Convention now, we can reaffirm and enhance United States leadership in the development and interpretation of international law applicable to the ocean. The Convention's provisions are highly favorable to the national security, environmental, and economic interests of the United States. Becoming a party would give the United States the ability to participate formally and more effectively in the interpretation and development of the Convention.

II. National Priority Objectives

How We Do Business

1. **Ecosystem-Based Management: Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes.**

Obstacles and Opportunities

Traditional management of resource use and other activities in the ocean, along our coasts, and in the Great Lakes has focused on individual species, resources, areas, or actions with limited consideration for how the management practices of one might impact the sustainability of another. This has often led to disjointed management approaches resulting in loss of resources, economic hardship, and environments at risk. To ensure healthier, more resilient, and productive ocean, coastal, and Great Lakes environments, comprehensive management systems are needed that fully integrate ecological, social, economic, and security goals into decisions. Embedding ecosystem-based management, grounded in science, as an overarching principle would be a fundamental shift in the traditional way the Federal Government approaches management of the ocean, our coasts, and the Great Lakes. It would provide the opportunity to ensure proactive and holistic approaches to better manage the use and conservation of these valuable resources. This broad-based application of ecosystem-based management would provide a framework for the management of our resources, and allow for such benefits as helping to restore fish populations, control invasive species, support healthy coastal and Great Lakes communities and ecosystems, restore sensitive species and habitats, protect human health, and rationally allow for emerging uses of the ocean, including new energy production.

The Plan Should Address:

- "Best practices" for developing and implementing effective ecosystem-based management systems;
- Identification and prioritization of geographic areas of special sensitivity or in greatest need for ecosystem-based management;
- Establishment of a process for working with States, tribal, and local authorities and regional governance structures to apply the most successful approaches in these areas of the greatest need; and
- Measures to ensure that decisions about ocean, coastal, and Great Lakes activities, uses, and goals are made based on the best available science and incorporate principles of ecosystem-based management.

2. **Coastal and Marine Spatial Planning: Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management in the United States.**

Obstacles and Opportunities

The ocean, our coasts, and the Great Lakes are host to countless commercial, recreational, scientific, energy, and security activities, which often occur in or near areas set aside and managed for

conservation and resource protection goals. Overlapping uses and differing views, about what activities should occur and where, can generate conflicts and misunderstandings. Coastal and marine spatial planning (CMSP) that fully incorporates the principles of ecosystem-based management will provide a means to objectively and transparently guide and balance allocation decisions for use of ocean, coastal, and Great Lakes waters and resources. It would allow for the reduction of cumulative impacts from human uses on marine ecosystems, provide greater certainty for the public and private sector in planning new investments, and reduce conflicts among uses and between using and preserving the environment to sustain critical ecological, economic, recreational, and cultural services for this and future generations.

The Plan Should Address:

- Implementation and expansion of the Framework for Effective Coastal and Marine Spatial Planning as described later in this document.

3. **<u>Inform Decisions and Improve Understanding:</u> Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.**

Obstacles and Opportunities

A broad program of basic and applied disciplinary and interdisciplinary scientific research, mapping, monitoring, observation, and assessment, coupled with development of forecasts, models, and other decision-support tools, is required to build knowledge of ocean, coastal, and Great Lakes ecosystems and processes and ensure that management and policies are based on sound science. Increased understanding of watershed processes and the linkages with our coasts will be necessary to develop better decision-support tools to adequately manage human uses, human impacts, including disproportionate impacts on minority or low income populations, and watershed conservation activities that affect our ocean and coasts. In addition, increased scientific knowledge and a more comprehensive awareness and a detailed understanding of current and emerging human activities taking place in and around our waters are essential to sound ocean planning and management. However, there are significant gaps in our understanding of ocean ecosystem dynamics, ocean conditions and trends, and the complex links between these conditions and human health, economic opportunities, national and homeland security, and social justice. There is significant opportunity to improve how and what information we gather to better understand change and respond

to challenges, better integrate current scientific knowledge (natural, social and traditional/ cultural) and real-time data into decision-making, improve the management and integration of data supporting science and decision-making, and identify and close knowledge gaps necessary to adequately understand the impacts of human activities on the ocean, our coasts, and the Great Lakes. A diverse, interdisciplinary, ocean-literate workforce that has the appropriate skills and training to capitalize on these opportunities is needed. In addition, formal and informal education programs developed and implemented to target grades K-12 and beyond would create opportunities for enhanced appreciation of coastal and ocean issues, and better prepare the workforce of the future. Robust education programs already exist in many NOC member agencies and can serve as the foundation for increasing knowledge on ocean, coastal, and Great Lakes issues. Success in building our knowledge and applying it to improve management also relies on an engaged and informed public. Many Americans do not realize the importance of the ocean, our coasts, and the Great Lakes to their daily lives, the benefits they provide, or the possibilities they present for further discovery. There is great opportunity to raise awareness and identify ways we can help protect our waters and their resources.

Inform and Improve

The Plan Should Address:

- Identification of priority issues in addressing emerging topics and changes in ocean, coastal, and Great Lakes ecosystems and processes;

- Specific scientific requirements and research needs, including the need for reconciling inconsistent standards, physical infrastructure, research platforms, organizations, and data management, to identify critical gaps, ensure high quality data, and provide information necessary to inform management, including mechanisms to transition research results into information products and tools for management;

- The development of a more comprehensive awareness of environmental conditions and trends and human activities that take place in the ocean, coastal, and Great Lakes environments; and

- Requirements for routine integrated ecosystem assessments and forecasts, including impacts related to climate change, to address vulnerability, risks, and resiliency, and inform tradeoffs and priority-setting.

Educate

The Plan Should Address:

- Challenges, gaps, opportunities, and effective strategies for training and recruiting the current and next generation of disciplinary and interdisciplinary scientists, technicians, operators, managers, and policy-makers, with a particular focus on the needs of disadvantaged or under-served communities; and

- Identification of successful formal and informal education and public outreach approaches, including their application toward a focused nation-wide campaign to build public awareness, engagement, understanding, and informed decision-making, with specific emphasis on the state of ecosystems.

4. **Coordinate and Support: Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government and, as appropriate, engage with the international community.**

Obstacles and Opportunities

One of the significant obstacles to effective management of the ocean, our coasts, and the Great Lakes is the complex set of Federal, State, tribal, and local laws, authorities, mandates, and governance structures intended to manage their use and conservation. Consistent approaches to the management of resources, including ecosystem-based and adaptive management, are difficult to achieve given this shared, piece-meal, and overlapping jurisdictional model. Furthermore, the United States is party to numerous international agreements and subject to customary international law regarding use and protection of the ocean and the Great Lakes. The United States should engage with international partners bilaterally and multilaterally to achieve increased cooperation and coordination on ocean issues. Through increased communication, coordination, and integration across all levels of government, we can streamline processes, reduce duplicative efforts, leverage resources, resolve disparities, and enhance synergy. A set of shared principles and objectives coordinated among all levels of government would translate into effective outcomes consistent with the National Policy.

Coordinate

The Plan Should Address:

- Identification of gaps, inconsistencies, and duplications in statutory authorities, policies, and regulations, and taking necessary and appropriate actions to address them;

- Procedures to identify and align mutual and consistent management objectives and actions across jurisdictions;

- Tangible tools and procedures to prevent and resolve conflicts across jurisdictions and disagreements concerning jointly managed ocean, coastal, and Great Lakes resources; and
- Opportunities for engaging the international community to further the objectives of the policy, as appropriate.

Support

The Plan Should Address:

- Actions to assist the States in advancing the network of regional alliances to protect ocean, coastal, and Great Lakes health;
- Evaluation of existing or new funding sources and options to protect, maintain, and restore ocean resources; and
- Legislative or regulatory changes necessary to simplify the sharing and transfer of resources among Federal, State, tribal, and local agencies.

Areas of Special Emphasis

1. **Resiliency and Adaptation to Climate Change and Ocean Acidification: Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.**

Obstacles and Opportunities

The ocean plays a central role in shaping the Earth's climate and influencing climate variability. Because of this important relationship and the ecosystem services that the ocean, our coasts, and Great Lakes provide, global climate change and its associated impacts as well as ocean acidification pose some of the most serious threats to these ecosystems and coastal communities. Warming ocean temperatures have a profound impact on the distribution of rainfall over land, the melting of ice sheets, and the distribution and productivity of species. Sea-level rise, increased severe storm events, rapid erosion, and salt water intrusion threaten low-lying coastal communities with the destruction of infrastructure, flood inundation, the potential displacement of millions of people, and the loss of key species and habitats. At the same time, climate change is predicted to lower the water levels of the Great Lakes, thereby altering water cycles and supply, habitat, and economic uses of the Lakes. In addition, ocean acidification is expected to have significant and largely negative impacts on the marine food web, ocean ecosystems as a whole, and biological diversity in general. Since climate change and ocean acidification may have widespread impacts,

increased coordination of monitoring and mapping efforts and improved understanding of the changes in the ocean are vital to minimizing these impacts on our marine and Great Lakes ecosystems and coastal communities. We have an opportunity and a responsibility to develop strategies for reducing the vulnerability, increasing the resilience, and improving adaptation of human and natural systems to climate change impacts, as well as for mitigating the effects of climate change itself.

The Plan Should Address:

- Research, observations and modeling needed to forecast regional and local scale climate change impacts and related vulnerabilities for natural resources, health, infrastructure, and livelihoods, including social and economic impacts;
- Better integration of ocean and coastal science into the broader climate dialogue and measures to improve understanding of the connections among land, water, air, ice, and human activities;
- Evaluation of potential social and economic costs related to sea-level rise, such as accelerating erosion, increased saltwater intrusion, and more severe coastal and inland flooding;
- Adaptive actions to identified climate change impacts and related vulnerabilities, such as ocean acidification, and the development of ecological and economic resilience strategies and priorities for research and monitoring to address these strategies;
- Changes to local and regional ocean and lake management systems that incorporate changing climate risks and elements of resilient systems; and
- A comprehensive approach to understanding human health implications of policies for the ocean, our coasts, and Great Lakes, and for identifying opportunities for the protection and enhancement of human health.

2. **Regional Ecosystem Protection and Restoration: Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, State, tribal, local, and regional levels.**

Obstacles and Opportunities

Along our coasts and the Great Lakes, essential habitats continue to suffer significant losses and degradation due to coastal development, sea-level rise, and associated human activities. Impacts on these ecosystems and the people and communities in these areas are presenting new management challenges. Additionally, external stressors, including invasive species, are impacting native species and habitat. While progress has been made in addressing some of these challenges through ecosystem-based management, the threat of critical habitat loss and degradation of ecosystem services is still apparent in the Gulf Coast, the Chesapeake Bay, Puget Sound, South Florida, San Francisco Bay, and the Great Lakes. By addressing coastal and ocean challenges that cross jurisdictional boundaries and sectors on a regional and ecosystem scale, we can more effectively manage these resources. Because climate change is impacting our coastlines, it has become even more important to assess and place priorities on ecosystem restoration projects. These experiences provide valuable lessons for other coastal ecosystems.

The Plan Should Address:

- Prioritization of the locations and geographic scope of coastal and Great Lakes ecosystem restoration projects, including implementation of the Great Lakes Restoration Initiative;
- Interim and longer term goals and mechanisms to facilitate collaboration among stakeholders to implement projects;
- Best practices for collaborative science-based planning to achieve ecosystem restoration goals building on the lessons learned in ongoing ecosystem restoration efforts;
- Impacts of invasive species on ocean, coastal, and Great Lakes ecosystems, and a range of methodologies for control and prevention of these species; and
- Protection, maintenance, and restoration of populations and essential habitats supporting fisheries, protected species, ecosystems, and biological diversity.

3. **Water Quality and Sustainable Practices on Land: Enhance water quality in the ocean, along our coasts, and in the Great Lakes by promoting and implementing sustainable practices on land.**

Obstacles and Opportunities

Nonpoint source pollution (pollution that comes from diffuse sources instead of one specific point), caused by poor land management practices, is the leading cause of water quality problems in the United States and a major cause of rapidly declining ocean and coastal ecosystem health. Runoff from suburban streets and lawns, agricultural and industrial uses, transportation activities, and urban development – even hundreds of miles away – negatively impacts water quality, resulting in deleterious effects on ocean, coastal, and Great Lakes systems as evidenced by harmful algal blooms, expansive dead zones, marine debris, and increased incidents of human illness. Areas with particularly poor water quality are known to experience frequent beach closures, massive fish kills, and areas of toxic sediments. Since this pollution comes from many diffuse sources throughout the country, addressing it requires a strong commitment to coordination and cooperation between multiple sectors and among Federal, State, tribal, local authorities, and regional governance structures. Fortunately, a number of point and non-point source prevention programs are available to Federal, State, tribal, local, regional, and private entities to reduce the amount of pollutants that are transported from our Nation's watersheds and into our coastal waters. There are opportunities to achieve significant reductions in these inputs to our coasts and ocean through concrete mechanisms that integrate and coordinate land-based pollution reduction programs.

The Plan Should Address:

- The major impacts of urban and suburban development and agriculture, including forestry and animal feedlots, on ocean, coastal, and Great Lakes waters;
- The relative contributions of significant land-based sources of pollutants, sediments, and nutrients to receiving coastal waters and ways to address them, including recommendations of how to integrate and improve existing land-based conservation and pollution programs;
- Best management practices, use of conservation programs, and other approaches for controlling the most significant land-based sources of nutrients, sediments, pathogens, toxic chemicals, solid waste, marine debris, and invasive species; and
- The establishment of a comprehensive monitoring framework and integration with State monitoring programs.

4. **Changing Conditions in the Arctic: Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.**

Obstacles and Opportunities

Climate change is having a disproportionally greater impact on polar regions than elsewhere, and the Arctic region is faced with serious problems. Permafrost is thawing at an accelerated rate, which leads to the release of large amounts of methane. Multi-seasonal sea ice is rapidly deteriorating. Much of the Alaskan Arctic seashore is threatened by coastal erosion and other environmental challenges. Increased human activity in the area is bringing additional stressors to the Arctic environment, with serious implications for Arctic communities and ecosystems. At the same time, the diminishing ice presents opportunities and pressures for increased development of living and non-living resources and for increased commerce and transportation. Working with all of the stakeholders, including the indigenous communities, we have the opportunity to develop proactive plans, informed by the best science available, to manage and encourage use while protecting the fragile Arctic environment.

The Plan Should Address:

- Better ways to conserve, protect, and sustainably manage Arctic coastal and ocean resources, effectively respond to the risk of increased pollution and other environmental degradation on humans and marine species, and adequately safeguard living marine resources;

- New collaborations and partnerships to better monitor and assess environmental conditions and devise early warning and emergency response systems and procedures to be prepared for and respond to emerging events in the Arctic region, such as environmental disasters;

- Consistency and coordination with the implementation of United States Arctic Region Policy as promulgated in National Security Presidential Directive 66/Homeland Security Presidential Directive 25 (2009); and

- Improvement of the scientific understanding of the Arctic system and how it is changing in response to climate-induced and other changes.

5. **Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure: Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system and integrate that system into international observation efforts.**

Obstacles and Opportunities

Our ability to understand weather, climate, and ocean conditions, to forecast key environmental processes, and to strengthen ocean management decision-making at all levels is informed by a sound knowledge base. Efficient and effective coordination of the many available tools, continued development of new tools and infrastructure, and integration of them into a cohesive, unified, robust system is becoming increasingly difficult as an ever increasing number of data collection and processing systems come on line. New ground-breaking observation technologies give us the ability to observe and study global processes at all scales. These new tools, if fully integrated, will significantly advance our knowledge and understanding of the ocean, our coasts, and the Great Lakes. Furthermore, successful integration of new tools and data will improve our ability to engage in science-based decision-making and ecosystem-based management by ensuring that biological, ecological, and social data and processes are included in the calculus.

The Plan Should Address:

- A nationally integrated system of ocean, coastal, and Great Lakes observing systems, comprised of Federal and non-Federal components, and cooperation with international partners and organizations, as appropriate;

- Regional and national needs for ocean information, to gather specific data on key ocean, coastal, and Great Lakes variables that are required to support the areas of special emphasis and other national needs;

- The use of unmanned vehicles and remote sensing platforms and satellites to gather data on the health and productivity of the ocean, our coasts, and the Great Lakes;

- The capabilities and gaps of the National Oceanographic Fleet of ships and related facilities; and

- Data management, communication, access, and modeling systems for the timely integration and dissemination of data and information products.

PART FOUR. THE FRAMEWORK FOR EFFECTIVE COASTAL AND MARINE SPATIAL PLANNING

I. Introduction

Coastal and marine spatial planning is one of the nine priority objectives in the recommendations. This framework for CMSP in the United States provides a definition of CMSP, identifies the reasons for engaging in CMSP, and describes its geographic scope. It articulates national CMSP goals and guiding principles that would be adhered to in CMSP efforts and the eventual development and implementation of coastal and marine spatial plans. In addition, this framework describes how CMSP and CMS Plans would be regional in scope and developed cooperatively among Federal, State, tribal, local authorities, and regional governance structures, with substantial stakeholder and public input.

II. What is Coastal and Marine Spatial Planning?

CMSP is a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas. CMSP identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives. In practical terms, CMSP provides a public policy process for society to better determine how the ocean, coasts, and Great Lakes are sustainably used and protected - now and for future generations.

III. Why Coastal and Marine Spatial Planning?

The Nation's interests in the ocean, our coasts, and the Great Lakes support a growing number of significant and often competing uses and activities, including commercial, recreational, cultural, energy, scientific, conservation, and homeland and national security activities. Combined, these activities profoundly influence and benefit coastal, regional, and national economies and cultures. However, human uses of our ocean, coasts, and the Great Lakes are expanding at a rate that challenges our ability to plan and manage them under the current sector-by-sector approach. While many existing permitting processes include aspects of cross-sectoral planning (through, for example, the process governed by the National Environmental Policy Act), most focus solely on a limited range of management tools and outcomes (e.g., oil and gas leases, fishery management plans, and marine protected areas). Missing from this picture is a more integrated, comprehensive, ecosystem-based, flexible, and proactive approach to planning and managing these uses and activities. This new approach would be national in scope to address national interests, but also scalable and specific to regional and local needs. Without such an improved approach, we risk an increase in user conflicts, continued planning and regulatory inefficiencies with their associated costs and delays, and the potential loss of critical economic, ecosystem, social, and cultural services for present and future generations.

Traditional, New, and Expanding Ocean, Coastal, And Great Lakes Uses

The ocean, our coasts, and the Great Lakes are home to and support myriad important human uses. CMSP provides an effective process to better manage a range of social, economic, and cultural uses, including:

- Aquaculture (fish, shellfish, and seaweed farming)
- Commerce and Transportation (e.g., cargo and cruise ships, tankers, and ferries)
- Commercial Fishing
- Environmental/Conservation (e.g., marine sanctuaries, reserves, national parks, and wildlife refuges)
- Maritime Heritage and Archeology
- Mining (e.g., sand and gravel)
- Oil and Gas Exploration and Development
- Ports and Harbors
- Recreational Fishing
- Renewable Energy (e.g., wind, wave, tidal, current, and thermal)
- Other Recreation (e.g., boating, beach access, swimming, surfing, nature and whale watching, and diving)
- Scientific Research and Exploration
- Security, Emergency Response, and Military Readiness Activities
- Subsistence Uses
- Tourism
- Traditional Hunting, Fishing, and Gathering
- Working Waterfronts

Recent scientific and ocean policy assessments have demonstrated that a fundamental change in our current management system is required to achieve the long-term health of our ocean, coasts, and Great Lakes in order to sustain the services and benefits they provide to society. The present way we

manage these areas cannot properly account for cumulative effects, sustaining multiple ecosystem services, and holistically and explicitly evaluating the tradeoffs associated with proposed alternative human uses.

Scientific understanding and information are central to achieving an integrated and transparent planning process. Natural and social sciences can inform decisions about how to achieve societal objectives from the Nation's ocean, coastal, and Great Lakes waters, both now and into the future, while maintaining ecosystem integrity. Built on this foundation of sound science, this new system for planning should facilitate maintenance of essential ecosystem services, encourage compatible uses, minimize conflicts, evaluate tradeoffs in an open and transparent manner, and include significant and meaningful stakeholder involvement.

CMSP can facilitate sustainable economic growth. For instance:

In the Netherlands-
A "preferred sand mining area" has been identified within its territorial sea. This use allocation through marine spatial planning will allow sand extraction closer to shore at less cost to both the private sector and the government, especially in the next 20 years when it is used for coastal adaptation to anticipated climate change.

In Germany-
An environmental assessment for a wind farm permit costs about €1 million (US$1.5 million) to prepare. Because the federal government has already prepared a Strategic Environmental Assessment for its marine spatial plan that includes priority areas for wind farms, costs of preparing and reviewing an environmental assessment for every permit proposed in a "Priority Wind Farm Area" will be reduced or avoided.

Examples Courtesy of Dr. Charles Ehler, UNESCO

The Benefits of CMSP

As recommended in this framework, CMSP is intended to yield substantial economic, ecological, and social benefits. To do so, it must fully incorporate the principles of sound science for ecosystem-based and adaptive management, be transparent, and be informed by stakeholders and the public. Many have raised concerns regarding whether CMSP would result in additional layers of regulatory review or delays in decision-making. To the contrary, CMSP is intended to build upon and significantly improve existing Federal, State, tribal, local, and regional decision-making and planning processes. Thus, while the development of CMSP would require significant initial investments of both human and financial resources, these investments are expected to result in substantial benefits. Several States, regions, and other nations have already recognized the many advantages of marine spatial planning, undertaken the planning process, and are eager to take positive steps to realize those advantages.

CMSP is intended to facilitate sustainable economic growth in coastal communities by providing transparency and predictability for economic investments in coastal, marine, and Great Lakes industries, transportation, public infrastructure, and related businesses. CMSP could promote national objectives such as enhanced national energy security and trade and provide specific economic incentives (e.g., cost savings and more predictable and faster project implementation) for commercial users.

CMSP allows proactive planning to integrate a wide range of ecosystem services. For instance:

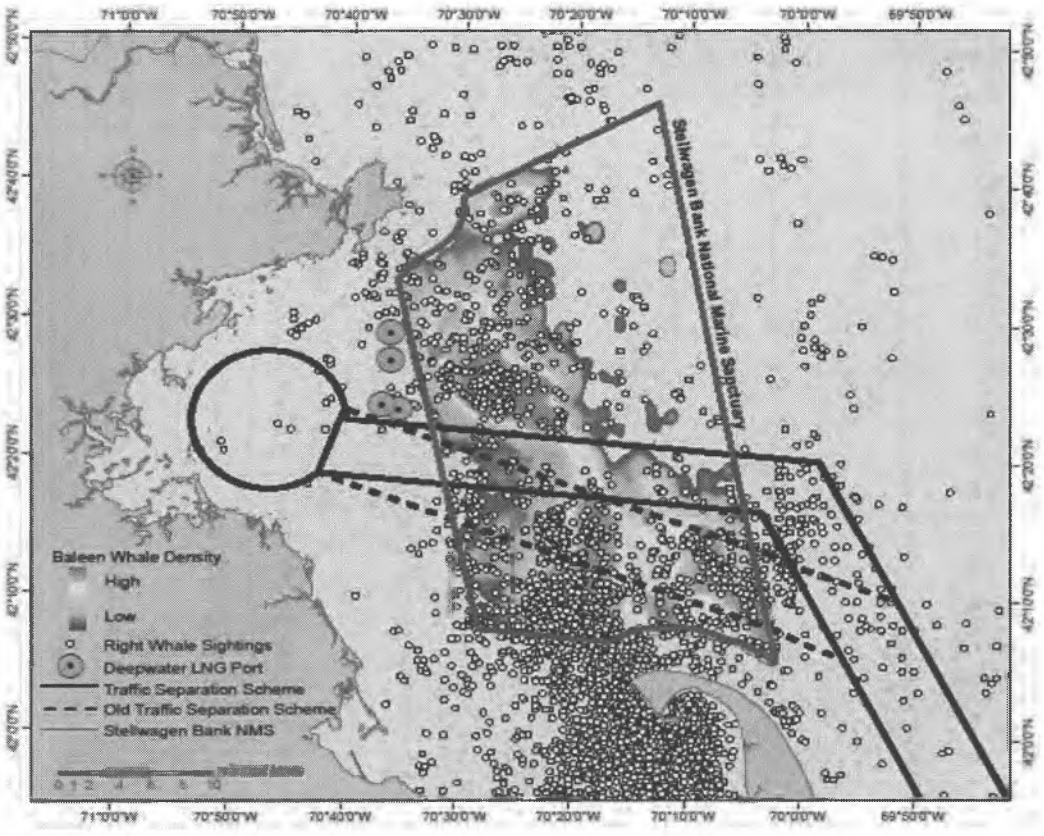
Provisioning
Energy, Seafood, Biomedical

Regulating and Supporting
Flood Prevention, Biological Diversity Maintenance, Climate Regulation, Erosion Control, Control of Pests and Pathogens, Nutrient Recycling, and Primary Production

Cultural Services
Education, Recreational, Heritage, and Spiritual

CMSP is intended to improve ecosystem health and services by planning human uses in concert with the conservation of important ecological areas, such as areas of high productivity and biological diversity; areas and key species that are critical to ecosystem function and resiliency; areas of spawning, breeding, and feeding; areas of rare or functionally vulnerable marine resources; and migratory corridors. Enhanced ecosystem services and benefits can be attained through CMSP because they are centrally incorporated into the CMS Plan as desired outcomes of the process and not just evaluated in the context of individual Federal or State agency action. CMSP allows for a comprehensive look at multiple sector demands which would provide a more complete evaluation of cumulative effects. This ultimately is intended to result in protection of areas that are essential for the resiliency and maintenance of healthy ecosystem services and biological diversity, and to maximize the ability of marine resources to continue to support a wide variety of human uses.

Example of the Potential Benefits of CMSP: Stellwagen Bank National Marine Sanctuary



Comprehensive planning enabled NOAA, the United States Coast Guard, and several other government agencies and stakeholders to examine shipping needs, proposed deepwater liquefied natural gas port locations, and endangered whale distribution in a successful effort to reconfigure the Boston Traffic Separation Scheme (TSS) to reduce the risk of whale mortality due to collisions with ships in the Stellwagen Bank National Marine Sanctuary. The reconfigured TSS reduced risk of collision by an estimated 81% for all baleen whales and 58% for endangered right whales. Industry TSS transit times increased by only 9 – 22 minutes (depending on speed) and conflict with deepwater ports was eliminated. In addition, the new route decreased the overlap between ships using the TSS, commercial fishing vessels, and whale watch vessels, thereby increasing maritime safety. CMSP has the significant potential of applying this integrated, multi-objective, multi-sector approach on a broader and sustained scale.

Diagram Courtesy of NOAA/Stellwagen Bank National Marine Sanctuary

From a societal perspective, CMSP would improve opportunities for community and citizen participation in open planning processes that would determine the future of the ocean, our coasts, and the Great Lakes. For example, the CMSP process would recognize the social, economic, public health, and conservation benefits of sustainable recreational use of ocean, coastal, and Great Lakes resources (e.g., fishing, boating, swimming, and diving), by providing improved coordination with recreational users to ensure consideration of continued access and opportunities to experience and enjoy these activities consistent with safety and conservation goals. Integrated engagement and coordination should result in stronger and more diverse ocean, coastal, and Great Lakes stewardship, economies, and communities. Moreover, CMSP can assist managers in planning activities to sustain cultural and recreational uses, human health and safety, and the continued security of the United States. For

instance, CMSP would help to ensure that planning areas identified as important for public use and recreation are not subject to increased risk of harmful algal blooms, infectious disease agents, chemical pollution, or unsustainable growth of industrial uses.

IV. Integration, Cooperation, and Coordination

Strong partnerships among Federal, State, tribal, and local authorities, and regional governance structures would be essential to a truly forward-looking, comprehensive CMSP effort. One of the significant benefits of CMSP is to improve the ability of these authorities to seamlessly coordinate their objectives with broader planning efforts by participating in the CMSP process for areas within and beyond their jurisdictional waters. Many States and regional governance structures have already engaged in some form of comprehensive marine planning and CMSP would build upon and incorporate these efforts. Also, the United States has a unique legal relationship with federally-recognized American Indian and Alaska Native tribal governments. These tribal governments, and the indigenous populations in Hawaii and the United States Commonwealths and Territories, are integrally linked to the maritime realm and would play an important role in CMSP.

The United States shares maritime and Great Lakes boundaries with a number of countries and has the world's largest EEZ and an extensive Continental Shelf. The development of CMSP provides opportunities for engagement with other countries, in coordination with the Department of State and other relevant agencies. The views and decisions of relevant international fora should be taken into account, where appropriate, in CMSP and the development of CMS Plans.

The ability for States and tribes to participate in the CMSP process for areas within and beyond their respective jurisdictions can afford the following potential opportunities and incentives:

- Encourage and inform the Federal government to better manage resources or address processes that transcend jurisdictional boundaries;
- Define local and regional objectives and develop and implement CMSP in a way that is meaningful to regionally specific concerns;
- Leverage, strengthen, and magnify local planning objectives through integration with regional and national planning efforts;
- Proactively address concerns over proposed activities impacting State and tribal interests and minimize use conflicts before they escalate;
- Leverage support from the Federal government to build CMSP capacity, access CMSP data, and acquire scientific, technical, and financial assistance;
- Access data through CMSP portal(s) and utilize science tools developed, established, and maintained for CMSP efforts;
- Benefit from sustained Federal participation on the regional planning bodies that consist of representatives empowered to make decisions and commitments on behalf of their respective agencies, in turn helping to integrate and improve decision-making;
- Provide a clearer and easier point of access for all Federal agencies with regard to ocean, coastal, and Great Lakes issues; and
- Achieve regulatory efficiencies, reduction in administrative delays, and cost savings.

Similarly, as the United States is a leader in various international fora that deal with marine issues, the United States should introduce relevant aspects of CMSP for consideration by such bodies.

V. Public and Stakeholder Engagement

In addition to coordination and cooperation among all levels of government, robust public and stakeholder engagement is integral to a successful CMSP process. Given the multi-objective nature of CMSP it is critical to ensure there are numerous opportunities for a broad range of input to gain a better understanding of the human uses and influences on the planning area, and expectations, interests, and requirements for the future. Including a broad range of interests throughout the planning and implementation of CMSP is necessary to strengthen mutual and shared understanding about relevant problems and opportunities and will better inform the process and its outcomes.

VI. The Authority for Coastal and Marine Spatial Planning

Federal statutes often include authorizing language that explicitly gives agencies the responsibility to plan and implement the objectives of the statutes. Moreover, several Federal statutes specifically authorize agency planning with respect to the ocean, coastal, and Great Lakes environments. Federal agencies and departments also administer a range of statutes and authorized programs that provide a legal basis to implement CMSP. These statutory and regulatory authorities may govern the process for making decisions (e.g., through Administrative Procedure Act rulemaking and adjudications) and not just the ultimate decisions made. The processes and decision-making CMSP envisions would be carried out consistent with and under the authority of these statutes. State, tribal, and local authorities also have a range of existing authorities to implement CMSP, although this will vary among and within regions. This framework for CMSP is to provide all agencies with agreed upon principles and goals to guide their actions under these authorities, and to develop mechanisms so that Federal, State, tribal, and local authorities, and regional governance structures can proactively and cooperatively work together to exercise their respective authorities.

An agency or department's capacity to internalize the elements of any particular CMS Plan would vary depending on the nature of applicable statutes. CMSP is intended to provide a better framework for application of these existing laws and agency authorities, but is not intended to supersede them. Where pre-existing legal constraints, either procedural or substantive, are identified for any Federal agency, the NOC would work with the agency to evaluate necessary and appropriate legislative solutions or changes to regulations to address the constraints. In the interim, agencies would comply with existing legal requirements but should endeavor, to the maximum extent possible, to integrate their actions with those of other partners to a CMS Plan.

VII. The National Goals of Coastal and Marine Spatial Planning

For CMSP to be successful, it must be based on clear, broad-based goals that define the desired outcomes to be achieved. CMSP in the United States would be developed and implemented to further the following goals:

1. Support sustainable, safe, secure, efficient, and productive uses of the ocean, our coasts, and the Great Lakes, including those that contribute to the economy, commerce, recreation, conservation, homeland and national security, human health, safety, and welfare;

2. Protect, maintain, and restore the Nation's ocean, coastal, and Great Lakes resources and ensure resilient ecosystems and their ability to provide sustained delivery of ecosystem services;

3. Provide for and maintain public access to the ocean, coasts, and Great Lakes;

4. Promote compatibility among uses and reduce user conflicts and environmental impacts;

5. Improve the rigor, coherence, efficiency, and consistency of decision-making and regulatory processes;

6. Increase certainty and predictability in planning for and implementing new investments for ocean, coastal, and Great Lakes uses; and

7. Enhance interagency, intergovernmental, and international communication and collaboration.

VIII. The National Guiding Principles for Coastal and Marine Spatial Planning

In order to achieve the national goals of CMSP, planning efforts are to be guided by the following principles:

1. CMSP would use an ecosystem-based management approach that addresses cumulative effects to ensure the protection, integrity, maintenance, resilience, and restoration of ocean, coastal, and Great Lakes ecosystems, while promoting multiple sustainable uses.

2. Multiple existing uses (e.g., commercial fishing, recreational fishing and boating, subsistence uses, marine transportation, sand and gravel mining, and oil and gas operations) and emerging uses (e.g., off-shore renewable energy and aquaculture) would be managed in a manner that reduces conflict, enhances compatibility among uses and with sustained ecosystem functions and services, provides for public access, and increases certainty and predictability for economic investments.

3. CMSP development and implementation would ensure frequent and transparent broad-based, inclusive engagement of partners, the public, and stakeholders, including with those most impacted (or potentially impacted) by the planning process and with underserved communities.

4. CMSP would take into account and build upon the existing marine spatial planning efforts at the regional, State, tribal, and local level.

5. CMS Plans and the standards and methods used to evaluate alternatives, tradeoffs, cumulative effects, and sustainable uses in the planning process would be based on clearly stated objectives.

6. Development, implementation, and evaluation of CMS Plans would be informed by

sound science and the best available information, including the natural and social sciences, and relevant local and traditional knowledge.

7. CMSP would be guided by the precautionary approach as reflected in Principle 15 of the Rio Declaration, "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

8. CMSP would be adaptive and flexible to accommodate changing environmental conditions and impacts, including those associated with global climate change, sea-level rise, and ocean acidification; and new and emerging uses, advances in science and technology, and policy changes.

9. CMSP objectives and progress toward those objectives would be evaluated in a regular and systematic manner, with public input, and adapted to ensure that the desired environmental, economic, and societal outcomes are achieved.

10. The development of CMS Plans would be coordinated and compatible with homeland and national security interests, energy needs, foreign policy interests, emergency response and preparedness plans and frameworks, and other national strategies, including the flexibility to meet current and future needs.

11. CMS Plans would be implemented in accordance with customary international law, including as reflected in the Law of the Sea Convention, and with treaties and other international agreements to which the U.S. is a party.

12. CMS Plans would be implemented in accordance with applicable Federal and State laws, regulations, and Executive Orders.

IX. Geographic Scope of Coastal and Marine Spatial Planning

The geographic scope of the planning area for CMSP in the United States includes the territorial sea, the EEZ, and the Continental Shelf. The geographic scope of the planning area would extend landward to the mean high-water line. The geographic scope for the Great Lakes would extend from the ordinary high-water mark and include the lakebed, subsoil, and water column to the limit of the United States and Canada international boundary, as maintained by the International Boundary Commission, and includes Lake St. Clair and the connecting channels between lakes. Privately owned lands as defined by law would be excluded from the geographic scope.

The geographic scope would include inland bays and estuaries in both coastal and Great Lakes settings. Inclusion of inland bays and estuaries is essential because of the significant ecological, social, and economic linkages between these areas with offshore areas. Additional inland areas may be included in the planning area as the regional planning bodies, described in Section X of this Part, deem appropriate. Regardless, consideration of inland activities would be necessary to account for the significant interaction between upstream activities and ocean, coastal, and Great Lakes uses and ecosystem health. Likewise, consideration would also be given to activities occurring beyond the EEZ and continental shelf that may influence resources or activities within the planning area.

The Great Lakes and CMSP

Great Lakes resources are governed in part by a body of law, treaties, and regional policy that is distinct from our ocean and other coastal areas. Of paramount significance is the Great Lakes Water Quality Agreement (GLWQA) with Canada and its implementation under various Federal laws that commit each country to restore and maintain the chemical, physical, and biological integrity of the Great Lakes through use of ecosystem-based management. However, while various Federal regulatory authorities apply in the United States Great Lakes, the submerged lands underlying them are largely under the jurisdiction and ownership of the Great Lakes States.

CMSP efforts in the Great Lakes would be complementary to and closely coordinated with the GLWQA and other Great Lakes initiatives and authorities, such as the President's Great Lakes Restoration Initiative and Executive Order 13340, which established a cabinet-level Great Lakes Interagency Task Force, its Regional Working Group, and a multi-stakeholder Great Lakes Regional Collaboration.

Land-based Activities and Their Relation to CMSP

Although the geographic scope of the CMSP area in the United States would not include upland areas unless a regional planning body determines to include them, the health and well-being of the ocean, our coasts, and the Great Lakes are in large part the result of the interrelationships among land, water, air, and human activities. Effective management of environmental health and services, maritime economies, commerce, national and homeland security interests, and public access necessitate connecting land-based planning efforts with ocean, coastal, and Great Lakes planning. Thus, successful implementation of CMSP would ultimately depend upon a better integration of coastal planning that considers influences from, and activities within, coastal watersheds and other contributing land areas. Land-based watershed planning efforts (e.g., components of the Great Lakes Restoration Initiative Action Plan) should inform and influence CMSP within each region. Similarly, ocean, coastal, and Great Lakes activities that affect land-based ecosystems should be considered and accounted for during CMSP efforts using the existing State and Federal programs including the Coastal Zone Management Act (CZMA), Clean Water Act, Clean Air Act, and other relevant authorities. It is the intent of the CMSP process to better understand how current mandates and programs interact towards the common goals of CMSP and, in doing so, to better coordinate, and where appropriate, strengthen their collective

benefits. In addition, watershed monitoring, terrestrial observation activities, and ocean, coastal, and Great Lakes observation systems should be linked to provide the necessary information on interactions and impacts across the land-sea boundary.

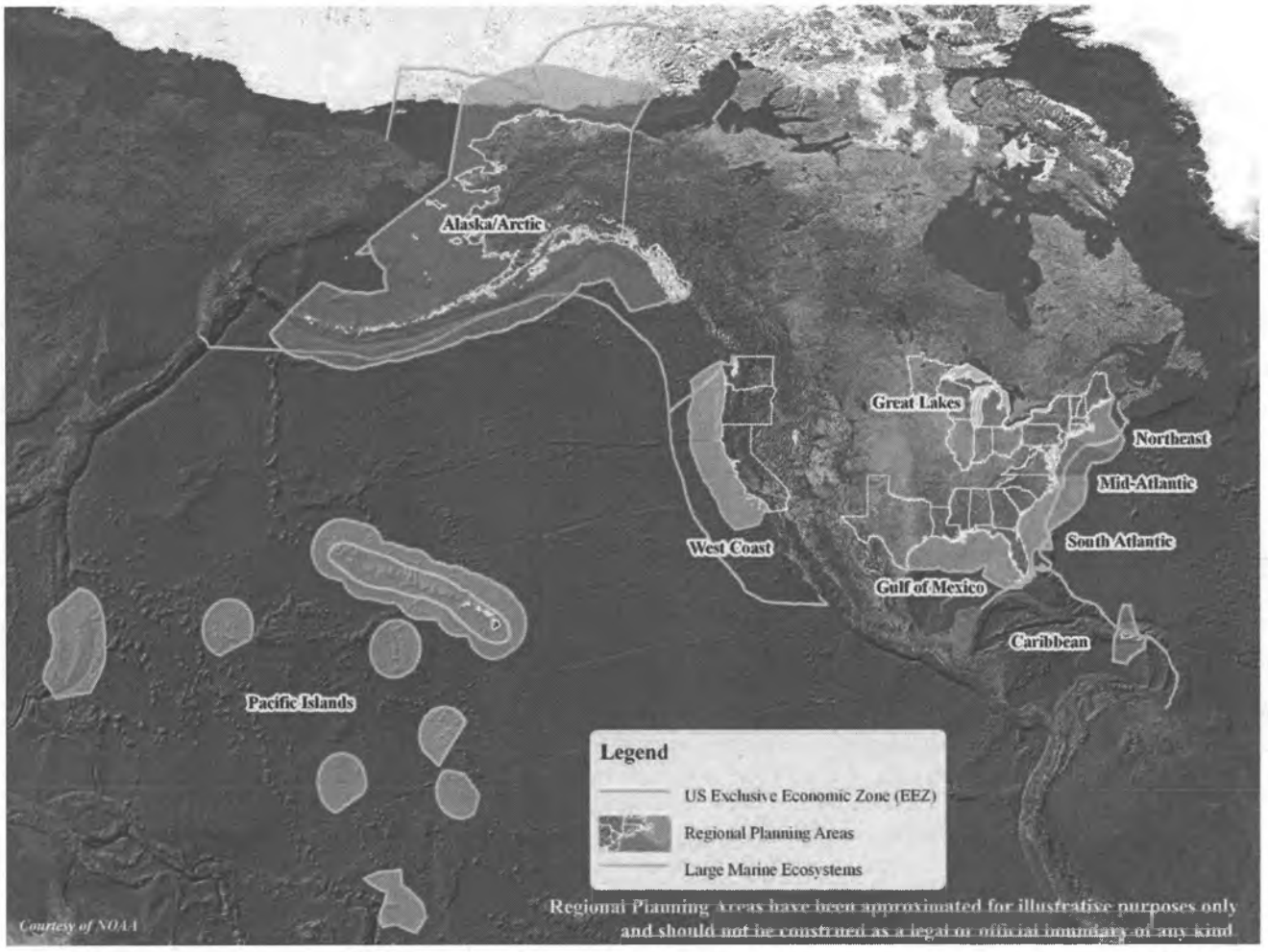
X. Development and Implementation of Coastal and Marine Spatial Planning

CMSP would be developed and implemented using a regional approach to allow for the variability of economic, environmental, and social aspects among different areas of the United States. This section describes the regional approach, recommended steps, and the essential elements to be included in the development and implementation of CMSP.

Given the importance of conducting CMSP from an ecosystem-based perspective, combined with the likely involvement of existing regional governance structures in developing plans, a consistent planning scale with which to initiate CMSP is at the large marine ecosystem (LME) scale.[7] These recognized LMEs were defined on the basis of consistent ecological conditions and other factors. Overall, the boundaries of regional governance structures for the Northeast, Mid-Atlantic, South Atlantic, Gulf Coast, and West Coast lie within LME boundaries. This regional approach, consistent with the LMEs, would also be applied to the Great Lakes, Alaska, the Pacific Islands, and the Caribbean. Therefore, for CMSP purposes, the United States would be subdivided into nine regional planning areas based on LMEs, with modifications as necessary to ensure inclusion of the entire U.S. EEZ and Continental Shelf and to allow for incorporation of existing state or regional ocean governance bodies. The NOC would facilitate the development of regional CMS Plans for those areas.

[7] The U.S. ocean and coastal waters hold all or parts of eleven LMEs: the West Bering Sea, East Bering Sea, Chukchi Sea, Beaufort Sea, Gulf of Alaska, California Current, Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Insular Pacific-Hawaiian, and the Caribbean Sea. For representational purposes only, the five Alaskan LMEs are depicted as a single complex in the map on page 52. Although, as a large fresh-water system, the Great Lakes are not usually considered an LME, they do represent a large regional ecosystem of similar scale and are considered as such for this framework. Further detail on LMEs can be found at: http://www.lme.noaa.gov.

Large Marine Ecosystems and Regional Planning Areas



Regional Planning Body

The NOC would work with the States[8] and federally-recognized tribes, including Alaska Native Villages, to create regional planning bodies – coinciding with the regional planning areas – for the development of regional CMS Plans. The membership of each of the nine regional planning bodies would consist of Federal, State, and tribal authorities relevant to CMSP for that region (e.g., resource management, including coastal zone management and fisheries management, science, homeland and national security, transportation, and public health). Members would be of an appropriate level of responsibility within their respective governing body to be able to make decisions and commitments throughout the process. Each regional planning body would identify Federal and non-Federal co-leads.[9] Appropriate State and tribal representation would be determined by applicable States and tribes, consistent with the types of representation described by the NOC per Section XVI of this Part. Regional planning bodies would develop a mechanism to engage other indigenous community representatives

[8] For purposes of this framework, "States" also include the Commonwealth of Puerto Rico, the U.S. Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa.

[9] Each regional planning body would have one Federal co-lead, one State co-lead, and, as appropriate, one tribal co-lead. The co-leads would be responsible for guiding and facilitating the timely progress of the CMSP process, but would not have final decision-making authority.

with jurisdictional responsibilities or interests relevant to CMSP, as well as coordinate with appropriate local authorities throughout the CMSP process. In addition, the regional planning bodies would provide a formal mechanism for consultation with the Regional Fishery Management Councils (RFMCs) across their respective regions on fishery related issues given their unique statutory responsibilities under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and quasi-regulatory role in fisheries management.[10] The NOC would prepare guidance for regional planning bodies in meeting these consultative process requirements in order to ensure consistency across regions. In the future, if other statutorily-mandated or quasi-regulatory groups are identified, the NOC would determine whether a formal mechanism for consultation should be developed for such groups and, if necessary, provide guidance for regional planning bodies on the development of such a process.

Nine Proposed Regional Planning Areas and Corresponding Minimum State Representation

1. **Alaska /Arctic Region:** Alaska
2. **Caribbean Region:** Puerto Rico and U.S Virgin Islands
3. **Great Lakes Region:** Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin
4. **Gulf of Mexico Region:** Alabama, Florida, Louisiana, Mississippi, and Texas
5. **Mid-Atlantic Region:** Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia
6. **Northeast Region:** Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
7. **Pacific Islands Region:** Hawaii, Commonwealth of the Northern Mariana Islands, American Samoa, and Guam
8. **South Atlantic Region:** Florida, Georgia, North Carolina, and South Carolina
9. **West Coast Region:** California, Oregon, and Washington

Each regional planning body[11] should make every effort to ensure representation from all States within a region, ideally through, or as part of, the existing regional governance structures created by or including the States to address cross-cutting issues, including regional planning. Given that activities that happen outside of the planning area of each regional planning body may affect CMSP decisions in that area, ex officio membership on these bodies could be extended to adjacent coastal States to help integrate and enhance consistency among regions. Inland States may also be afforded membership, as determined appropriate by the regional planning body. It is also recognized that the United States shares maritime boundaries with other nations (e.g., Canada and Mexico) and the regional planning bodies for those respective areas may include ex officio representatives or observers from these nations.

[10] There are no Regional Fishery Management Councils in the Great Lakes Region, but the Great Lakes regional planning body should work with the Great Lakes Fishery Commission and other relevant entities, as appropriate.

[11] The Task Force based the State membership of the nine regional planning areas in part on the membership of the existing regional governance structures, where they exist, with the following one exception: Pennsylvania was added to the Mid-Atlantic Region, in addition to the Great Lakes Region, because Pennsylvania has a coastline on the Delaware River that would, under the defined geographic scope, be included in the CMSP regional planning area.

Furthermore, there would be flexibility to develop sub-regional plans provided that these plans are encompassed in an overarching regional CMS Plan and overseen by the regional planning body. This construct may be particularly useful in the Alaska/Arctic and Pacific Islands Regions given the geographic breadth, the logistical constraints of coordinating resources across a region that spans the international dateline, and that multiple LMEs are encompassed by the Alaska/Arctic Region.

CMSP Development Agreement

The members of each regional planning body (the "partners") would prepare and execute a CMSP Development Agreement, a model of which the NOC would develop as described in Section XVI of this Part. The Development Agreement would be an express commitment to work cooperatively to engage in CMSP and develop eventual CMS Plans, identify the regional planning body members for each of the partners, and define ground rules, roles, and responsibilities of the partners.

Dispute Resolution Process

CMSP would provide a process for resolving conflicts should members of the regional planning bodies disagree during the development or modification of CMS Plans and in the interpretation of NOC-certified CMS Plans. The NOC would develop this process, in cooperation with the GCC, to ensure consistency from region to region. This process would be designed in a way to ensure that most disputes would be resolved at the regional level. If a conflict cannot be resolved at the regional level, the regional planning body leads would elevate the issue to the NOC for resolution, via the NOC resolution process outlined earlier. In those instances in which such a conflict reflects a dispute between Federal and non-Federal members at the regional level, the NOC would consult with the GCC as part of this process. Disputes regarding a specific agency's decisions pursuant to its statutory authority would be addressed through the various procedures and mechanisms available under that authority or other relevant authorities (e.g., Administrative Procedure Act).

Work Plan

Each regional planning body would develop a formal regional work plan that describes the agreed-upon process for CMSP and development of CMS Plans (including all essential elements), specifies members, identifies co-leads, establishes key milestones, identifies resources, specifies time frames, and addresses the essential elements required for the planning process, as defined below. The work plan would allow flexibility to account for the particular circumstances of a given region (e.g., if a region has existing State plans). In addition, each work plan would specify a formal mechanism for consultation to engage the RFMCs within the region as well as a mechanism to engage the indigenous community representatives. The work plan should also describe how the regional planning body would coordinate with appropriate local authorities. The NOC would review and approve each regional work plan prior to its implementation.

Essential Elements of the CMSP Process

Essential Elements of the CMSP Process

- Identify Regional Objectives
- Identify Existing Efforts that Should Help Shape the Plan throughout the Process
- Engage Stakeholders and the Public at Key Points throughout the Process
- Consult Scientists and Technical and Other Experts
- Analyze Data, Uses, Services, and Impacts
- Develop and Evaluate Alternative Future Spatial Management Scenarios and Tradeoffs
- Prepare and Release for Public Comment a Draft CMS Plan with Supporting Environmental Impact Analysis Documentation
- Create a Final CMS Plan and Submit for NOC Review
- Implement, Monitor, Evaluate, and Modify (as needed) the NOC-certified CMS Plan

The CMSP process consists of a series of steps that would eventually lead to the development of a comprehensive, multi-sectoral, and multi-objective CMS Plan. Although the CMSP process envisions optimum flexibility among and within regions, the following essential elements – and how the partners plan to accomplish them – would need to be addressed in the work plan in order to ensure a level of national consistency across regions. The process would be adaptive and refined as regions gain experience with CMSP.

- **Identify Regional Objectives:** Each region would define and agree upon a set of specific and measurable regional objectives that provide clear direction, outcomes, and timeframes for completion. These regional objectives would be consistent with the national goals and principles identified in this framework and with any national objectives the NOC has articulated for purposes of CMSP. These objectives would serve as a statement of purpose and need for action to guide the planning process and eventual development of an ecosystem-based, comprehensive, integrated CMS Plan.

- **Identify Existing Efforts that Should Help Shape the Plan throughout the Process:** The regional planning body would identify existing efforts (e.g., State and Federal ocean plans, data management efforts, and CMSP decision products) that would allow the regional plan to build on existing work. This work should be leveraged and expanded to enable a more

organic and holistic approach that would advance the region as a whole while not duplicating or hindering existing and ongoing efforts. These existing efforts can include those that are region-wide, State focused, or more site-specific marine spatial plans or efforts (e.g., Great Lakes Restoration Initiative Action Plan, Massachusetts Ocean Plan, Rhode Island Ocean Special Area Management Plan, or National Marine Sanctuary management plans), as well as issue-specific plans that seek to incorporate some aspects of CMSP approaches and principles (e.g., ocean energy and fishery management plans), as appropriate.

- **Engage Stakeholders and the Public at Key Points throughout the Process:** The regional planning body would ensure there is frequent and regular stakeholder engagement throughout all phases of the CMSP process, including development, adoption, implementation, evaluation, and adaptive management phases. To better ensure all concerns and ideas are considered, stakeholder engagement should be emphasized with those most impacted (or potentially impacted) by the planning process. Considerations should also be given to ensuring inclusion of underserved communities. Regions would establish an inclusive and transparent process for stakeholder participation (or, if applicable, utilizing an existing process) that ensures engagement with a representative balance of major social, cultural, economic, environmental, recreational, human health, and security interests. The regional planning body should also identify previous stakeholder input to regional or State CMSP efforts including the existing documentation on their input and needs. Stakeholder and public participation would be sought through a variety of robust participatory mechanisms that may include, but are not limited to, workshops, town halls, public hearings, public comment processes, and other appropriate means. Stakeholder and public engagement would be consistent with existing requirements for public notice and input under applicable laws. Additionally, regional planning bodies would operate with the maximum amount of transparency, participation, and collaboration to the extent permissible by law. The NOC would provide guidance on such operating procedures including methods that ensure effective public and stakeholder participation, encourage diversity of opinions, and contribute to the accountability of the CMSP process (e.g., public meetings, document availability, and timely public notification).

- **Consult Scientists and Technical and Other Experts:** The regional planning body would consult scientists, technical experts, and those with traditional knowledge of or expertise in coastal and marine sciences and other relevant disciplines throughout the process to ensure that CMSP is based on sound science and the best available information. To this end, the regional planning body would establish regional scientific participation and consultation mechanisms to ensure that the regional planning body obtains relevant information. Such consultation could take the form of regional private-public technology and science partnerships. In addition, the regional planning bodies would work with existing science and technical entities, such as the regional ocean observation organizations, and other organizations with relevant physical, biological, ecological, and social science expertise. Scientific participation and consultation mechanisms would provide scientific and technical oversight and support to the regional planning body throughout the CMS Plan development, implementation, and evaluation phases.

- **Analyze Data, Uses, Services, and Impacts:** With assistance from scientific and technical experts, the regional planning body would investigate, assess, forecast, and analyze the following:

  - Important physical and ecological patterns and processes (e.g., basic habitat distributions and critical habitat functions) that occur in the planning area, including their response to changing conditions;

  - The ecological condition and relative ecological importance or values of areas within the planning area, including identification of areas of particular ecological importance, using regionally-developed evaluation and prioritization schemes that are consistent with national guidance provided by the NOC;

  - The economic and environmental benefits and impacts of ocean, coastal, and Great Lakes uses in the region;

  - The relationships and linkages within and among regional ecosystems, including neighboring regions both within and outside the planning area, and the impacts of anticipated human uses on those connections;

  - The spatial distribution of, and conflicts and compatibilities among, current and emerging ocean uses in the area;

  - Important ecosystem services in the planning area and their vulnerability or resilience to the effects of human uses, natural hazards, and global climate change;

  - The contributions of existing placed-based management measures and authorities; and

  - Future requirements of existing and emerging ocean, coastal, and Great Lakes uses.

  This analysis would form the basis of the Regional Assessment described in the Essential Elements of the CMS Plan below. The regional planning body would identify and leverage existing approaches and efforts to collect information as well as clearly identify where there are gaps in data and information and what assumptions are made in the assessments, forecasts, and analyses to 'compensate' for lack of information and data.

- **Develop and Evaluate Alternative Future Spatial Management Scenarios and Tradeoffs:** The regional planning body would identify a range of alternative future spatial management scenarios based upon the information gathered on current, emerging, and proposed human uses, ecosystem conditions, and ecosystem services. Comparative analyses would assess, forecast, and analyze the tradeoffs and cumulative effects and benefits among multiple human use alternatives. The alternatives and the supporting analyses would provide the basis for a draft CMS Plan.

- **Prepare and Release for Public Comment a Draft CMS Plan with Supporting Environmental Impact Analysis Documentation:** Once a draft CMS plan and supporting environmental impact analyses, including alternatives, are completed, the regional planning body would release it for

appropriate public review and comment. During the development of a CMS Plan and before formal adoption of a final CMS Plan, regional planning bodies would also have the flexibility to move forward with CMSP efforts and agreements to address ongoing issues and regional coordination. It is recognized that these agreements would likely become part of the final CMS Plan. In drafting the CMS Plan, the regional planning body would resolve disputes using the process developed by the NOC, as discussed above in this Section.

- **Create a Final CMS Plan and Submit for NOC Review:** Based on public review of the draft plan and alternatives, the regional planning body would develop the final CMS Plan and environmental impact analysis that includes elements detailed in the Essential Elements of the Plan. The regional planning body would submit the final CMS Plan to the NOC for national consistency certification, as described in Section XII of this Part. Certification by the NOC would not occur until after release of the final CMS Plan for 30 days of public notice. These CMS Plans are intended to be iterative and are expected to be modified through the adaptive process described below.

- **Implement, Monitor, Evaluate, and Modify (as needed) the NOC-Certified CMS Plan:** The regional planning body would have an ongoing responsibility to monitor and assess the effectiveness of the CMS Plan. The regional planning body would adapt the CMS Plan, as necessary, based on relevant changes in ecological, economic, human health, safety, security, or social conditions and information. During implementation, each region would integrate new data and scientific findings to refine regional objectives and their respective goals. As new technologies are developed to observe and monitor ocean, coastal, and Great Lakes environments and their uses, they would be considered for application in regional CMSP monitoring and evaluation efforts.

Essential Elements of the CMS Plan

Essential Elements of the CMS Plan

- Regional Overview and Scope of Planning Area
- Regulatory Context
- Regional Assessment
- Objectives, Strategies, Methods, and Mechanisms for CMSP
- Compliance Mechanisms
- Monitoring and Evaluation Mechanisms
- Incorporation of the Dispute Resolution Process

CMS Plans are expected to vary from region to region according to the specific needs, capacity, and issues particular to each region. A completed CMS Plan would contain the following essential elements in order to ensure national consistency across regions and certification by the NOC. Scientific data, information, and knowledge, as well as relevant traditional knowledge would underpin each of these essential elements.

- **Regional Overview and Scope of Planning Area:** The CMS Plan would include a regional overview of the planning area. This overview would include a description of the planning area's ecosystems and their biological, chemical, and physical environments; social, recreational, human health, safety, security, and economic uses; ecological and conservation considerations, including identification of important ecological areas, habitats, flora, and fauna; and other concerns of the region. The overview would describe how the CMS Plan relates to and furthers the National Policy, CMSP national goals and principles, any national objectives developed by the NOC, regional objectives, and other relevant national, regional, State, and other policies. The CMS Plan would also define the geographic scope of the planning area.

- **Regulatory Context:** The CMS Plan would describe the statutes, rules, and regulations relevant to implementing CMSP throughout all levels of government. It would also describe, as appropriate, the principal existing planning processes (e.g., Great Lakes Restoration Initiative Action Plan or State marine spatial plans) that may be relied on or incorporated as part of the regional CMS Plan.

- **Regional Assessment:** The CMS Plan would include a regional assessment, based on environmental, social, economic, and other necessary data and knowledge, describing the existing and predicted future conditions, uses, and characteristics of the ocean, coastal, or Great Lakes areas covered in the CMS Plan. The regional assessment would include: relevant biological, chemical, ecological, physical, cultural, and historical characteristics of the planning area; ecologically important or sensitive species/habitats/ecosystems; and areas of human activities. The assessment would also include an analysis of ecological condition or health and of cumulative risks as well as forecasts and models of cumulative impacts. The regional assessment would explain the information obtained and analyses conducted during the planning process and how they were used to help determine management decisions and plan alternatives.

- **Objectives, Strategies, Methods, and Mechanisms for CMSP:** This section would describe the regional objectives and proposed strategies, methods, and mechanisms for CMSP for the region. It would provide the analysis, evaluation of options, and the basis for the conclusions made in the CMS Plan. It would describe the spatial determinations for conservation and uses, at the appropriate scale, and include any necessary visual representations. The CMS Plan would describe the strategies, methods, and mechanisms for integrated or coordinated decision-making, including addressing use conflicts. The CMS Plan would further describe the continuing processes by which implementation would proceed, including mechanisms to ensure that individual partner and collaborative decision-making are reviewed for consistency with plan priorities and objectives. The CMS Plan would describe continued opportunities for stakeholder and public engagement. It would provide the flexibility needed to accommodate activities and operations in preparation for and response to disasters, emergencies, and similar incidents. The CMS Plan would also consider a regional process for requesting variances and amendments.

- **Compliance Mechanisms:** The CMS Plan would specify mechanisms to enhance coordination and cooperation among decision-makers and promote consistency in each agency's interpretation and application of its respective existing laws and regulations used for implementation and enforcement of CMS Plans.

- **Monitoring and Evaluation Mechanisms:** The CMS Plan would specify the monitoring and evaluation mechanisms, including a reporting mechanism, to be employed to assess the effectiveness of the CMS Plan and identify where and when changes need to be considered. As part of monitoring and evaluation, regional planning bodies would define a clear set of regional performance measures to be used to assess whether or not the region is meeting national and regional objectives and goals.

Additionally, regional planning bodies would participate in the periodic execution of regional ecosystem assessments to evaluate impacts of management actions from economic, ecological, and social perspectives in order to inform the CMS Plan. Monitoring and evaluation will follow from and build upon the original regional assessment, consistent with national guidance provided by the NOC.

- **Incorporation of the Dispute Resolution Process:** The CMS Plan would incorporate the dispute resolution process, as described in Section X of this Part.

XI. The Nature of the Planning Process and National Ocean Council-Certified Coastal and Marine Spatial Plans

CMSP is intended to provide Federal, State, tribal, and regional bodies, stakeholders, and the public with a meaningful forum within which to develop a plan to better manage multiple sustainable uses, resolve conflicts, and support ecosystem-based management of the ocean, coasts, and Great Lakes in accordance with shared goals, guiding principles, and applicable legal authorities. In this way, regional objectives and national objectives, goals, and guiding principles can be considered in a single, comprehensive, and integrated process. In order to be successful, the outcome of CMSP would have to result in meaningful improvements in the way that Federal, State, tribal, local, and regional bodies, stakeholders, and the public participate in the use and conservation of these areas.

While the goal of this framework is to move toward comprehensive, integrated, flexible, proactive, ecosystem-based CMSP, this would not happen instantaneously. CMSP must be initiated and developed thoughtfully, allowing for time to address the myriad complexities and challenges that would undoubtedly arise as the process moves forward. Moreover, while this framework identifies some of the incentives and benefits for a coordinated Federal, State, tribal, and regional effort and envisions a fully coordinated planning process, there would be substantial flexibility to determine how best to develop and implement CMSP for each particular region. In the event that a particular State or tribe opts not to participate in the development or implementation of a CMS Plan, the development or implementation of the CMS Plan would continue. While this is not optimal because it would not result in a fully integrated CMS Plan, the benefits of coordinated planning among the participating partners warrant its completion.

Development and implementation of CMS Plans would be an iterative process leading to a comprehensive, multi-objective, multi-sectoral plan within the first five years. Since each region may have different drivers and capabilities for CMSP, regions may choose to prioritize initial development and implementation steps. While CMSP should help resolve many use conflicts, it is not realistic to expect that all such conflicts would be resolved. Further, partners might agree not to resolve certain issues in a CMS Plan at a particular time, but rather to acknowledge these issues and indicate how the parties would continue to work on them as part of the iterative CMSP process. Such issues may be resolved as data gaps are filled, new information is developed, or as State or Federal legal authorities are enacted, changed, or updated.

To ensure that CMSP is effective and has a positive overall impact, each partner participating in CMSP would need to commit in good faith to: (1) a cooperative, open, and transparent CMSP process leading to the development and implementation of CMS Plans, acknowledging that each partner may have different authorities and non-discretionary mission objectives that must be fully addressed; (2) ensure that consideration of the National Policy, national CMSP goals, objectives, and principles, and regional CMSP objectives are incorporated into the decision-making process of all the partners consistent with existing statutory, regulatory, and other authorities, and the critical needs of emergency response, and homeland and national security activities; and (3) dispute resolution processes that enable concerns and issues not resolved through the cooperative planning process to be resolved quickly, rationally, and fairly.

Signing onto the CMS Plan would be an express commitment by the partners to act in accordance with the CMS Plan, within the limits of applicable statutory, regulatory, and other authorities, and respecting critical emergency response and homeland and national security needs. Thus, State and Federal regulatory authorities would adhere to, for example, the processes for improved and more efficient permitting, environmental reviews, and other decision-making identified in the CMS Plan to the extent these actions do not conflict with existing legal obligations. State and Federal authorities with programs relevant to the CMS Plan would in a timely manner review and modify programs, as appropriate, to ensure their respective activities, including discretionary spending (e.g., grants and cooperative agreements), adhere to the CMS Plan to the extent possible. State and Federal agencies

would also be expected to formally incorporate relevant components of the CMS Plan into their ongoing operations or activities consistent with existing law. This may be implemented in a variety of ways. For example, agencies could enter into memoranda of understanding (MOUs) to coordinate or unify permit reviews and decision-making processes. Where existing regulatory or statutory requirements impose constraints on the ability of an agency to fully implement the CMS Plan, the agency would seek, as appropriate, regulatory or legislative changes to fully implement the CMS Plan.

Relationship of CMSP to Existing Authorities

CMSP under this framework would not vest the NOC or regional planning bodies with new or independent legal authority to supersede existing Federal, State, or tribal authorities. Rather, the NOC would facilitate the development of CMSP and provide national context and guidance within which bottom-up, flexible, regionally-based CMS Plans would be developed and implemented. Regional planning bodies would function as convening and planning bodies that comprise Federal, State, and tribal representatives responsible for implementing existing authorities to create a process, and ultimately a plan, to better apply such existing authorities to achieve agreed upon regional goals and objectives.

In and of themselves, CMS Plans, would not be regulatory or necessarily constitute final agency decision-making. However, they are intended to guide agency decision-making and agencies would adhere to the final CMS Plans to the extent possible, consistent with existing authorities, as described in Section XIV of this Part. Adherence to and implementation of the CMS Plan would be the result of a multi-year planning process by which regional planning body members would openly discuss their respective legal authorities, requirements, and processes and how they can be better applied in the CMSP context. Once a CMS Plan is approved, Federal, State, and tribal authorities would implement them through their respective legal authorities. Thus, for example, State permitting decisions remain within the purview and are the responsibility of the relevant State agency, not the NOC, regional planning body, or any of its other members. Also, as described earlier, disputes regarding a specific agency's decisions pursuant to its statutory authority would be addressed through the various procedures and mechanisms available under that authority or other relevant authorities (e.g., Administrative Procedure Act).

One example of the potential relationship between CMSP and existing authorities is the application of CZMA Federal consistency. Since there will be multiple Federal agencies and States involved in any one CMS Plan, the Federal agencies would need to determine how CZMA review would occur as

Federal agencies adopt the plan. For example, if a State works with the Federal agencies to develop a CMS Plan, the CMS Plan could include measures to ensure that it is consistent to the maximum extent practicable with the enforceable policies of a State's CZMA program. The relevant State could consider potential changes to the State's enforceable policies to achieve agreed upon regional CMSP objectives. Also, a CMS Plan might include CZMA Federal consistency administrative efficiencies so that CZMA review would not be needed for some activities. Finally, if a State incorporates a CMS Plan into its federally approved CZMA program, then it is likely that the CMS Plan would not need a CZMA Federal consistency review.

Relationship of CMSP to Existing Regional Entities

As mentioned above, the regional planning bodies would build upon the efforts of the existing regional governance structures. The regional planning bodies in conjunction with the NOC and the GCC would establish formal mechanisms or consultative processes to engage entities with statutorily-mandated or quasi-regulatory bodies that have an express role in the management and regulation of ocean, coastal, and Great Lakes resources. Specifically, as discussed earlier in Section X, a formal mechanism for consultation with the RFMCs would be incorporated into the CMSP process. In addition, regional planning bodies would coordinate with other existing regional entities and bodies such as Harbor Safety Committees, Regional Aquatic Nuisance Species Panels, and Area Maritime Security Committees, as appropriate.

Relationship of CMSP to Existing Plans and Projects

CMSP is not meant to delay or halt existing or pending plans and projects related to marine and Great Lakes environments or their uses. However, those responsible for making decisions on such plans and projects would be expected to take into account the national CMSP goals and principles, national policies, and any identified national and regional CMSP objectives in future decision-making to the extent possible under existing law. Once a CMS Plan is put into effect following NOC certification, its implementation would be phased in to avoid undue disruption or delay of projects with pending permits or other applications. The NOC would provide additional guidance on how best to accomplish this phased-in approach.

XII National Consistency

Certification by the NOC for National Consistency

The NOC would review each regional CMS Plan to ensure it is consistent with the National Policy, CMSP goals and principles as provided in this framework, any national objectives, performance measures, or guidance the NOC has articulated, and any other relevant national priorities. The NOC's review would ensure that the CMS Plans include all the essential elements described in this framework. The NOC would also consider the CMS Plan's compatibility with an adjacent region's CMS plan regarding issues that cross regional boundaries. Certification by the NOC would not occur until after release of the final CMS Plan for 30 days of public notice. The NOC would review and make a

decision on certification within six months of receipt of the CMS Plan. If a regional CMS Plan does not meet certification requirements, the NOC would work with the regional planning body to address issues with the CMS Plan and could allow for approval of those parts of a CMS Plan that do meet such requirements. Upon certification by the NOC, a decision document adopting the CMS Plan would be co-signed by senior State officials (e.g., Governors), tribal representatives, as appropriate, and senior officials of the Federal agencies represented on the regional planning body. Upon signature by the partners, the CMS Plan would be considered "in effect" and implementation would begin.[12]

National CMSP Objectives, Performance Measures, and Guidance

The NOC would establish national objectives, national outcome-based performance measures, and guidance to promote national consistency in the development and implementation of CMS Plans. Because the intent of CMSP is integration across sectors, the NOC would develop a range of national objectives. These may include: economic, conservation, security, and social objectives. The NOC would also develop national performance measures to evaluate, monitor, and report on progress towards implementing national CMSP objectives. As specified in the *Essential Elements of the CMSP Process* and the *Essential Elements of the Plan*, regional planning bodies would develop region-specific objectives and associated performance measures, as part of the regional CMSP process. Regional performance measures developed by the regional planning bodies would be used to track improvements towards stated CMS Plan objectives. These regional measures and objectives would be consistent with the nationally established objectives and measures.

Regional and national performance measures should directly relate to the stated national and regional objectives established in the CMSP process. Performance measures would assess both conservation and socio-economic objectives of the CMS Plan. Measures of conservation may include, but are not limited to, indicators of ecosystem health such as the status of native species diversity and abundance, habitat diversity and connectivity, and key species (*i.e.*, species known to drive the structure and function of ecosystems). In addition, socio-economic measures would be developed and may include, but are not limited to: the economic value or productivity of certain economic sectors, such as commercial and recreational fisheries, aquaculture, and offshore energy; the number of recreation days; and the time

[12] If the NOC does not certify a plan, it would provide to the regional planning body the specific reasons for its decision. The regional planning body would then have continued opportunity to address the NOC's reasons and resubmit the plan.

required for permit applications to complete the regulatory process. Performance measures would provide a means of demonstrating results of and provide accountability for the CMSP process to stakeholders, the general public, and decision-makers.

The NOC would develop guidance in conjunction with the regional planning bodies for regional objectives and concomitant performance measures to ensure that they are cost-effective, measurable, interpretable, grounded in theory, responsive, and specific. The NOC would develop consistent guidance for these ecological and socio-economic approaches and tools to assist regional planning bodies in these efforts in order to provide for nationally applicable common scales of assessment. This will ensure that regional planning bodies are given the independence and flexibility to develop regionally meaningful objectives and measures, but also assure that regional measures and reporting are consistent with a national CMSP performance system.

XIII. Consistency with International Law

CMS Plans would be implemented in accordance with customary international law, including as reflected in the Law of the Sea Convention, and with treaties and other international agreements to which the United States is a party. Seaward of the baseline, development and implementation of CMS Plans are to be consistent with the extent to which the United States exercises its rights and jurisdiction and performs duties in its territorial sea, EEZ, and Continental Shelf. CMS Plans would not change the rights, duties, and jurisdiction of the United States under international law, including with respect to navigational rights and freedoms. Nothing in this document or in CMS Plans developed pursuant to it would create private rights of action or other enforceable individual legal rights regarding the meaning and applicability of international law.

XIV. Adherence to and Compliance with National Ocean Council-Certified Coastal and Marine Spatial Plans

Signatories and all NOC member agencies would adhere to a NOC-certified CMS Plan, within the limits of their existing statutory and regulatory authorities. If a signatory intends to take an action that does not substantially adhere to a certified CMS Plan, it would need to provide advance notice to the regional planning body and the NOC, including justification (e.g., new statutory requirement) for the non-adherence. The CMS Plan signatories and the NOC would periodically evaluate the reasons requiring deviation from a NOC-certified CMS Plan, and, as appropriate, develop recommendations for minimizing these deviations in the future, including CMS Plan modification or underlying regulatory or statutory changes. Disputes regarding agency interpretation of a CMS Plan would be resolved according to the dispute resolution process developed by the NOC, as described above.

Agencies would incorporate components of the CMS Plan into their respective regulations to the extent possible. Adherence with CMSP would be achieved through Federal and State agencies and tribal authorities incorporating CMS Plans into their pre-planning, planning, and permitting processes, to the extent consistent with existing laws and regulations. The CMS Plan signatories would periodically

review these processes, and where legal constraints are identified, would seek to remedy these constraints, including by working with the NOC to evaluate whether a legislative solution or changes to regulations are necessary and appropriate.

The effectiveness of the CMSP process depends, in-part, on the willingness and the ability of Federal, State, and tribal authorities to ensure that activities of third-parties are in compliance with relevant laws and regulations. The Nation would not achieve the benefits of comprehensive and integrated CMSP if there were inconsistent use or violation of the applicable laws and regulations. Successful enforcement, carried out by agencies exercising their individual enforcement authorities and responsibilities, must be based upon clear, concise, and easily understood requirements that reflect the practical realities of compliance and enforcement.

CMS Plans would provide a framework for improved coordination and cooperation among Federal, State, tribal, and local enforcement agencies as they work together to enforce existing regulations in accordance with their respective authorities in support of regional goals that often extend beyond individual agency jurisdictions. To the extent permitted by existing laws and regulations, this cooperative regional approach should build productive partnerships that encourage sharing of information and best practices, help foster mutually agreed upon enforcement priorities and strategies, and make more effective use of scarce enforcement resources by focusing those resources on the highest regional enforcement priorities. A cooperative enforcement approach for Federal, State, and tribal CMSP-related laws could also facilitate more consistent interpretation and application of regulations across agencies and jurisdictions, resulting in greater certainty and understanding for ocean, coastal, and Great Lakes users, which in turn could foster improved compliance and overall effectiveness. The NOC and CMS Plan signatories would periodically review enforcement effectiveness and seek to remedy any conflicts or gaps in existing Federal-State-tribal coordinated enforcement mechanisms.

XV. Scientific Knowledge and Data Integration, Research, Management, and Access

CMSP is fundamentally science-based and adaptive in response to new evidence, technology, and understanding. Essential to CMSP are scientific knowledge and data, collectively referred to here as *information.* Information is necessary to comprehensively, consistently, and continually investigate, assess, forecast, and analyze human uses, ecosystem conditions, management alternatives, information and data gaps, and CMS Plan effectiveness. Reflecting our long history of ocean science and exploration, the United States holds vast stores of natural and social science information about ocean, coastal, and Great Lakes ecosystems and their uses which can immediately be used to begin informing CMS Plan development. However, data and knowledge gaps, particularly regarding the complexities of these ecosystems, human use patterns, and the relationship between the two, indicate the need for continuing research to supplement existing information, especially in the context of changing environmental conditions and societal needs. Additional CMSP research will provide new information, including on specific and cumulative effects, ecosystems processes and resiliency, and the assessment and valuation of ecosystem services.

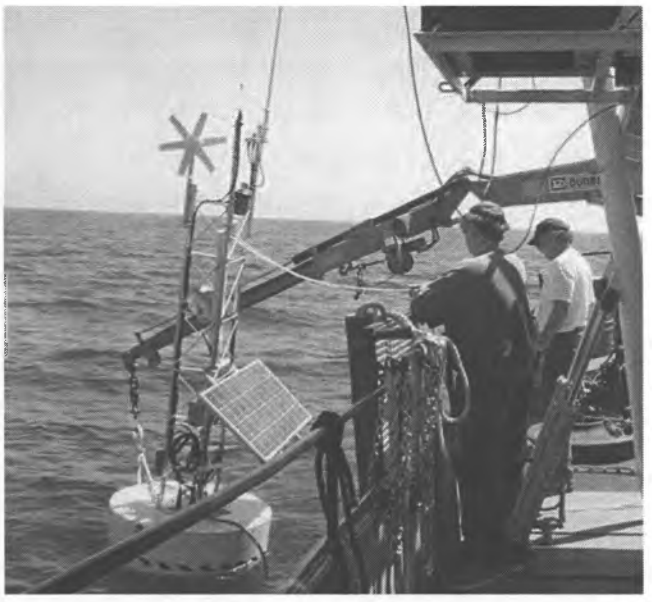
Relevant and credible information is critical for successful planning and, in turn, must be accessible to Federal, State, and local managers, tribes, academics, the private sector, and the public. A robust national information management system dedicated to coastal and marine scientific data and information products is required to meet the diverse data and application requirements of CMSP, and the varying technical capabilities of users. The NOC, working with the regional planning bodies, would create a system that is compatible with existing Federal information systems, captures relevant Federal information resources, has effective governance and accountability across agencies, and preserves data confidentiality, where appropriate. The NOC would leverage and build upon existing national data systems and initiatives (e.g., ocean observation), where appropriate. Within this construct, Federal agencies and the other regional partners would make relevant data, metadata, and derived products available and web accessible using recognized national and international standards and protocols to the extent permitted by law and regulation. In addition, State agencies, tribes, academia, the private sector, stakeholders, and other non-governmental sources would be encouraged to make their relevant information and knowledge, including local and traditional knowledge, available through this system. Exceptions would include sensitive but unclassified information that cannot be synthesized and modified into a format that is appropriate for broader distribution, pursuant to CMSP needs and information that is proprietary, statutorily confidential, or classified information.

Principles to Manage and Disseminate CMSP Information

- CMSP information is a national strategic asset and must be developed and managed on an ongoing basis to meet planning needs.
- CMSP information would be made available and accessible with nationally compliant "information about information" (i.e., metadata) to stakeholders.
- Federal agencies would improve metadata to make information easier to discover, retrieve, use, and manage.
- CMSP information that is collected, produced, or disseminated by Federal agencies, including information obtained from non-Federal sources, would meet government-wide information quality standards, and any other additional minimum standards adopted by the NOC.

To provide easy user access to agency CMSP-related information, a national information management system with either a central portal or regional portals that connect to CMSP information would be developed. The NOC would identify a Federal lead agency or collaborative entity to manage, implement, and update the CMSP portal(s) and components of the information management system. System interoperability, information exchange, and information and application technologies are intrinsically linked and would be developed and implemented together within the CMSP portal(s). To ensure national consistency, minimum data standards for CMSP information would be adopted and include standards for information quality. All information management and provision activities would be developed and updated with participation from existing and appropriate Federal data centers and initiatives. The NOC would ensure that the information is publicly available and easy-to-access

through computer readable files and web service formats that support a variety of CMSP and user needs. This could include web browsers, geospatial web services, and other web-based collaborative resources. The CMSP portal would leverage emerging web technologies, including private sector partnerships, to increase transparency and promote public engagement.

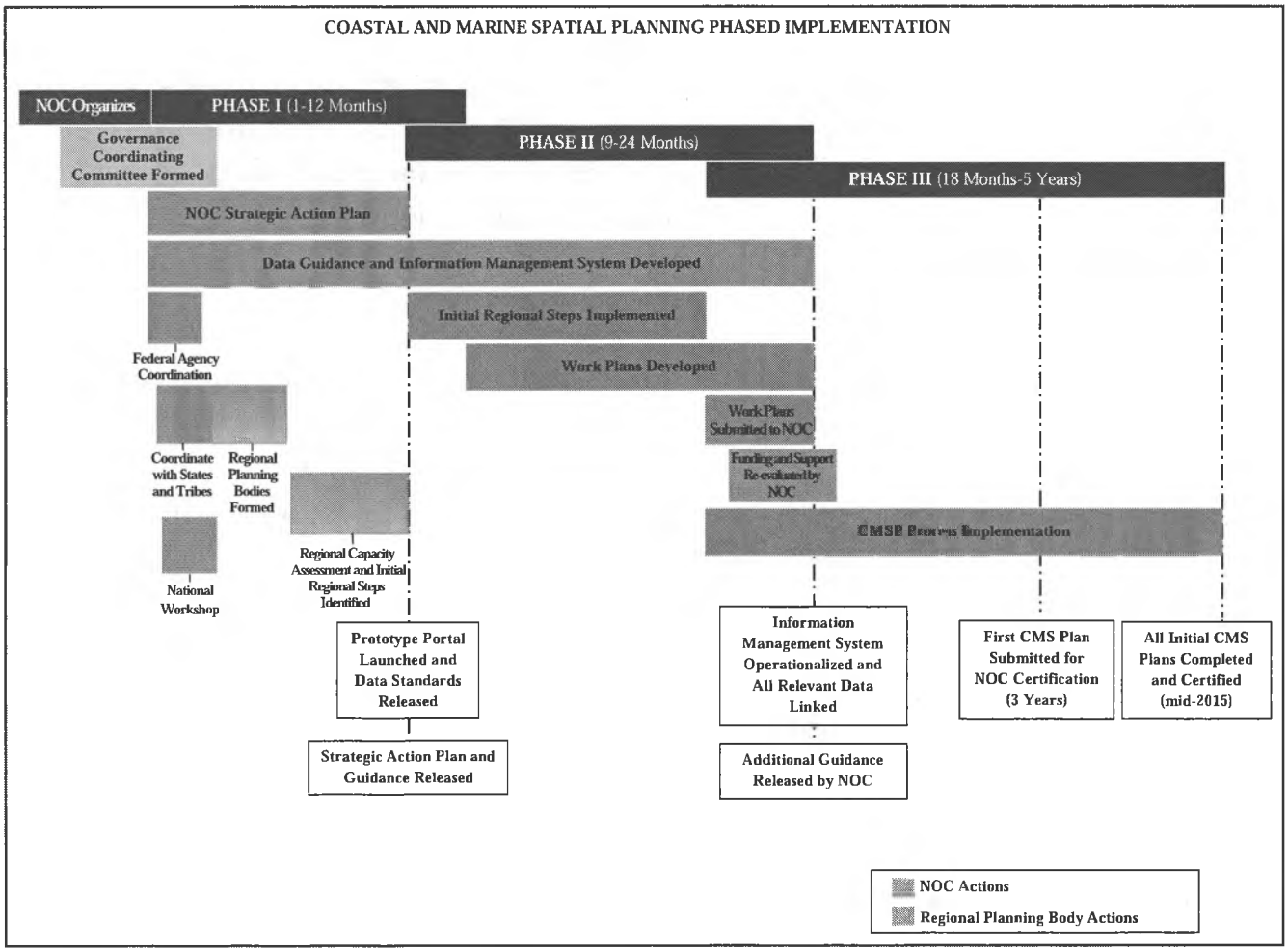


In order to build upon the existing CMSP scientific foundation, the NOC would establish mechanisms to identify and address priority CMSP science needs. This would include identification of priority CMSP research, data acquisition and information synthesis gaps, and new tools that would be required to apply science more effectively in the CMSP process. Identification of data, information, and research needs would be conducted on a regular basis as part of the adaptive and iterative process to improve the development and application of CMSP over time.

Additionally, nationally consistent, derived data products, ranging from consistent habitat maps as data layers to specialized decision-support tools, would be developed to provide a consistent framework for regional assessments and alternative future spatial management scenarios. The NOC may provide further guidance for using such information in decision-making, for example, how to decide which areas are of particular ecological importance or value. Designed or adapted specifically for CMSP, these science-based decision-support tools, including models, assessments, and visualization capabilities,

would enable the regional planning bodies to synthesize information most relevant to CMSP decisions in ways that produce robust comprehensive CMS Plans. These tools would offer a shared knowledge base for meaningful stakeholder engagement, objective assessment of alternative and future scenarios, identification of the types of uses that are consistent with societal objectives, and regular evaluation of CMS Plans. They would be developed and made accessible in a way that regional and State efforts could build upon or add regional specific data and information to leverage these efforts and analyze the regionally-specific aspects of their planning within the broader national framework.

XVI. Implementation



Implementation of this framework would occur in multiple phases through the NOC and among the regions. As a first step, the NOC would undertake initial actions to develop and build a foundation for the national CMSP efforts. Concurrently, the NOC would directly engage States and tribes to discuss cooperative strategies to move forward with CMSP. Recognizing the extensive scope of the task of developing and implementing CMSP, it is important for Federal, State, tribal, and other partners to prioritize efforts in this initial implementation period. Each of the regions could have different priorities and be at varying stages in the development of the data, analyses, and the relevant issues for

policy-makers. With these differences in mind, the phased approach outlined below would enable the NOC and the regions sufficient time to develop capacity, build on existing efforts, and leverage and gain efficiencies from lessons learned. In order to best achieve the completion of CMS Plans in all regions by 2015, the NOC would have the flexibility to make minor adjustments or modifications to this implementation schedule.

Phase I (1-12 months)

Many of the actions the NOC and State, tribal, and regional representatives commence in Phase I would serve as the foundation to implement CMSP on a national scale.

Develop NOC Internal Organization and Begin Strategic Action Plan (Months 1-9)

In the first month of Phase I, building on the initial establishment and organization period of the NOC, the NOC would determine how best to incorporate CMSP into the NOC governance structure (e.g., establish a CMSP Interagency Policy Sub-Committee), decide on the roles of individual agencies in implementing specific elements of the CMSP framework, including identification of a lead Federal agency for each regional planning body that would serve with non-Federal co-lead(s), and assess resource needs including personnel, financial, and technical CMSP support.

The NOC would then begin development of a strategic action plan to address specific areas that require additional consideration, analysis, and elaboration. The strategic action plan would be released in six to nine months and include: national objectives; national performance measures; guidance regarding the development of a national information management system, including identification of additional CMSP information and research needs; legal analysis and recommendations for legislative changes, if necessary; description of a dispute resolution mechanism, as described previously; and any additional guidance the NOC deems appropriate for CMSP. The NOC would also further assess the relationship between RFMCs and regional planning bodies and determine the most effective mechanism for engagement in the CMSP process, including whether representation on the regional planning bodies is the best method for such engagement. The NOC would ensure opportunity for the GCC, existing regional governance organizations, and public participation as it develops the strategic action plan for coastal and marine spatial planning. The NOC, in cooperation with the GCC, would provide for a mechanism for resolving disputes if they occur among the members of the regional planning bodies during the development of CMS Plans, as described in Section X of this Part.

Develop and Implement Public and Stakeholder Engagement

Early and meaningful steps to facilitate public and stakeholder outreach and education regarding CMSP and its implementation are vital to advance national CMSP efforts. As discussed above, the NOC would ensure substantial opportunity for public participation as it develops all nine strategic action plans, including the strategic action plan for coastal and marine spatial planning. Also, to better inform all participants and the public, the NOC would work with Federal agencies and the regional planning bodies, when established, to guide the drafting and production of educational materials, guidebooks,

manuals, and other materials. These materials would be developed keeping in mind that the content should reflect the issues, language, and methods that would be meaningful in a particular region. These materials would include a glossary of key CMSP terms in order to reduce potential misunderstandings that could result in an inconsistent or ineffective CMSP process. The NOC, in coordination with the regional planning bodies, when established, would hold additional informational workshops for stakeholders to discuss the CMSP process and potential ways stakeholder participation would take place. Additional stakeholder engagement would be conducted by the regional planning bodies throughout the CMSP process.

National Objectives and National Performance Measures

As part of the strategic action plan, the NOC would establish national objectives for CMSP consistent with, and in furtherance of, the National Policy, CMSP goals and principles, and other relevant national goals and priorities. These national objectives would serve as additional direction for the development of regional objectives and to help to maintain national and regional consistency of CMSP. Along with these objectives, national outcome-based performance measures would be established to help define success and measure results.

Guidance Regarding the Development of a National Information Management System

While overarching objectives and measures would help direct CMSP efforts, guidance on data, technology, and tools would also be developed. During the first six to nine months, initial actions to coordinate, integrate, and manage data would be necessary. The NOC would begin development of a national information management system and CMSP portal(s), adopt minimum data standards consistent with government-wide information quality standards, identify a Federal lead agency or entity to manage, implement, and update the CMSP portal(s), identify and begin development of any new standard tools or models needed for CMSP in all regions, and identify additional CMSP information and research needs. At the end of nine months, guidance on these fundamentals would be released as part of the strategic action plan and a prototype CMSP portal(s) would be operational. However, building the information management system and linking the relevant data may take up to two years and would be ongoing as new information becomes available.

Legal Analysis and Recommendations of Legislative Changes, if Necessary

Also, as part of the strategic action plan, the NOC would oversee efforts to identify gaps and conflicts in Federal authorities and recommend potential steps to reconcile them. This effort would examine how various statutory authorities of particular agencies can be harmonized in order to support comprehensive, integrated CMSP. Further, the NOC would consider how legal authorities of Federal, State, tribal, and local entities might collectively be used to support implementation of regional CMSP efforts. In doing so, the NOC should identify objective priorities and existing grant or other assistance programs that can support CMSP, consistent with relevant authorities.

Convene and Organize Federal Agency Representatives in the Regions (Months 1-2)

National and regional Federal agency representatives would convene to discuss current and improved methods for communicating, sharing data and products, exploring regulatory efficiencies, and determining how best to work with State and tribal partners to achieve a CMS Plan. Due diligence is necessary on the part of the Federal community to self organize and coordinate among agencies before engaging State and tribal partners to ensure that a service is being provided in a way that meets considerations unique to each region.

Develop Model Agreement (Months 1-3)

During the first three months of Phase I, the NOC would create and make available a model development agreement to be used by the regional planning bodies. This model would be used to foster efficiency and consistency in forming the regional planning bodies. As described in Section X of this Part, the development agreement would be an express commitment to work cooperatively to engage in CMSP and develop eventual CMS Plans, identify the lead representatives for each of the partners, and define ground rules, roles, and responsibilities of the partners.

Organize and Convene a National Workshop(s) and CMSP Simulation Exercise (Months 2-4)

Within the initial two to four months of Phase I, the NOC would also organize and convene, with input from the GCC, one or more workshops and a CMSP process simulation exercise for potential regional planning body representatives. The workshop(s) would be a forum to directly engage Federal, State, and tribal representatives, to give an overview of CMSP and the national framework, to demonstrate and test how this framework would work in a planning exercise, and to discuss collaborative strategies to move forward. The NOC would identify lessons learned and additional operational issues that were brought to light from the workshop(s) and exercise within two months of workshop completion.

Determine Composition of and Establish Regional Planning Bodies (Months 4-6)

After the workshop and exercise are held, the NOC, with advice from the GCC, would determine the additional types of representation needed for the composition of the regional planning bodies. Once the composition of the regional planning bodies is determined, the NOC would coordinate with the appropriate State authorities (e.g., Governors) and tribal representatives to establish regional planning bodies for each of the nine regions, identify specific members, and enter into a development agreement.

Capacity Assessment and Identification of Initial Regional Steps (Months 6-12)

During the latter six to twelve months of Phase I, the regional planning bodies would conduct a regional CMSP capacity assessment. The assessment would evaluate capabilities, expertise, and resources in each region available to develop and implement CMSP. In addition, the assessment would help to identify and prioritize initial regional steps described below in Phase II. The NOC, in coordination with the regional planning bodies, would make a determination on how best to meet the needs identified in the capacity assessment and to support the initial regional steps through existing mechanisms, and possibly new resources and/or funding mechanisms.

Develop Stakeholder and Scientific Participation Process (Months 6-18)

During Phase I, each regional planning body would begin to identify key stakeholders, scientific and technical experts, non-governmental organizations, and other partners to engage in the CMSP process. A formal mechanism for regular stakeholder, scientific, and technical input would be established and incorporated into the process. Additionally, regional planning bodies, in conjunction with the NOC, would establish procedures and methods to ensure transparency, participation, and collaboration in the planning process, such as public meetings, document availability, and timely public notification.

Phase II (9-24 months)

Building on Phase I's initial foundational steps of CMSP implementation, Phase II focuses on building capacity and testing specific issues or elements of the process.

Initial Regional Steps (Months 9-18) and Work Plan Development (Months 12-24)

During Phase II, the NOC would enable the regions to focus during the initial work plan development period on those issues that are of highest regional priority. In this way, these early steps in each region can serve as a test for the other regions for specific issues. For example, a region may select to begin CMSP efforts by organizing, gathering, and analyzing data, whereas another region may select to focus on developing regional CMS Plan objectives. The focus for each region's initial steps should be agreed upon after the capacity assessment is completed at the end of Phase I. After the initial regional steps are underway, the regional planning bodies would begin development of a full CMSP work plan, as detailed in Section X of this Part. In development of its work plan, each regional planning body should integrate the lessons learned from its and other regions' initial steps and also consider how to best integrate relevant ongoing regional planning initiatives.

Work Plan Submittal and Planning Process Preparation (Months 18-24)

Once initial regional steps are completed or in tandem with their completion, the regional planning bodies would submit to the NOC a package consisting of the proposed work plan. Once the work plan is submitted, the NOC would re-evaluate how best to support the regional CMSP effort through existing mechanisms, and possibly new resources or funding mechanisms to build on the lessons learned from the initial regional CMSP steps. For example, support might involve individual agencies

contributing staff or technical expertise to efforts coordinated through the NOC, or identifying existing grant programs to help support CMSP and achieve mutually agreed upon outcomes.

Phase III (18 months to 5 years)

While continuing to advance the actions and steps of Phases I and II, regional planning bodies would build out and scale up their efforts to establish a comprehensive CMSP process during Phase III to develop, multi-objective, multi-sectoral CMS Plans in all regions.

Develop and Carry Out CMSP Process and Provide Feedback from Initial Regional Steps (Months 18 and beyond)

After the initial regional steps are undertaken by each region, the regional planning bodies would transition into Phase III, developing and carrying out a CMSP process using the initial regional steps and the work of the NOC as a foundation. There is recognition that some regions' planning processes might be longer or more complicated than others. The timeframes for completion of the CMSP process are intended to be flexible to account for differing levels of resources, capacity, and other factors. During this process, regional planning bodies, in coordination with the NOC, would develop a mechanism for providing feedback and status reports to the NOC and appropriate State and tribal leadership to share lessons learned, best practices, and ensure routine and frequent communication nationally and among the regions. The regional planning bodies, in coordination with the NOC, would also ensure consistency, address questions and concerns, and adaptively manage the effort as appropriate. Although there would be flexibility in the framework to allow for variable CMSP process timeframes, regional planning bodies are encouraged to have final CMS Plans completed in three years and all regions would be expected to have final CMS Plans certified and implementation started by mid-2015. These final CMS Plans are intended to be iterative and are expected to be modified through the adaptive process beyond 2015.

XVII. Priorities for Financial and Other Support

Recognizing the reality of the limited availability of new resources, each of the Federal agencies engaged in this bold mission of developing and implementing CMSP would re-evaluate how resources are allocated in light of their statutory and regulatory mandates. Agencies would use the implementing actions of the President to recommend adjustments to their respective agency priorities to better align with the approved National Policy and CMSP goals. As CMSP is developed and implemented over time, the NOC would consider any additional resource needs through the budget prioritization process described earlier. Various Federal agencies would have differing roles to support the scientific basis and governance structures necessary to develop and implement CMSP. The following four areas should receive initial priority consideration for financial and other support for CMSP.

1. National Workshop(s) and Simulation Exercise

Priority: Hold a national workshop(s) and simulation exercise.

Rationale: The first step towards a constructive process for CMSP would be for the participants to engage in a forum that creates a common vision for implementing CMSP, to identify challenges and solutions for regional CMSP development, and to enhance the capacity of regions to implement CMSP. This priority also would include support to ensure widespread involvement of Federal, State, and tribal representatives.

2. Initial Support for Regional CMSP Processes

Priority: Support the development of regional CMSP, including the capacity for regional planning bodies and the NOC to carry out initial CMSP activities.

Rationale: A comprehensive and inclusive approach for regional CMSP planning processes would be based on each region engaging Federal, State, and tribal representatives to form the regional planning bodies. An effective process to sustain initial CMSP activities would necessitate regional planning bodies to organize and establish the necessary CMSP coordination (e.g., partnerships, interagency teams, and technical support staffing). To attain national and regional objectives, regional planning bodies would assess capacities, target resources, and begin implementing initial regional steps (e.g., stakeholder engagement, information acquisition, and CMS Plan development). This priority would also include support for the NOC to establish and carry out the necessary national CMSP steps (e.g., national objectives, national guidance, and building regional capacities), as described in Section XVI of this Part.

3. National Data and Information Management System, Prototype CMSP Portal(s) and Initial Development of Science and Information Needs

Priority: Improve and integrate the information (i.e., data and knowledge) used to inform CMSP; and identify additional scientific research to support CMSP information needs.

Rationale: Effective CMSP would utilize the best available data and objective analyses. Such information would be nationally consistent, publicly available, and easily accessible to promote public engagement and allow for a consistent framework for regional implementation. Priority would be given to developing the national information management system and a prototype CMSP data portal(s). Subsequent efforts would identify and fill key national information needs,[13] and develop CMSP decision-support tools and derived data products, including visualization tools, forecasting, and routine integrated ecosystem assessments. Additionally, scientific understanding is central to make informed CMSP decisions that reflect an integrated and transparent planning framework. To achieve this end would require a robust research foundation.

[13] Identification and filling information gaps, as previously presented in the framework, is an ongoing and iterative process. This framework recognizes that the acquisition of data and knowledge would proceed in tandem with developing CMS Plans using sound science and the best available information.

4. Public Outreach and Stakeholder Engagement

Priority: Build the knowledge, skills, and understanding of CMSP through regional planning bodies and stakeholder workshops, blogs, webinars, and other outreach methods.

Rationale: An informed and engaged public and stakeholder community is critical to the effective implementation of the CMS Plans. Effective CMSP is predicated on the building of knowledge, skills, and understanding of CMSP through a range of robust outreach approaches.

PART FIVE. CONCLUSION

In response to President Obama's June 12, 2009 memorandum, and after careful consideration of thousands of valuable comments from political leaders, public and private organizations, and citizens, the Task Force is pleased to submit these final recommendations for a comprehensive national ocean policy, an improved governance structure, a targeted implementation strategy, and a framework for effective coastal and marine spatial planning. Once implemented, these final recommendations will provide the first-ever comprehensive national policy of the United States to improve stewardship of the ocean, our coasts, and the Great Lakes.

The Task Force is unanimous in its call for the Nation to set a new course for improved stewardship of the ocean, our coasts, and the Great Lakes. This must include a comprehensive, integrated, transparent, science-based, and ecosystem-based planning process to achieve the sustainable uses of the ocean, our coasts and the Great Lakes. The Task Force is mindful that these recommendations may create a level of uncertainty and anxiety among those who rely on these resources and may generate questions about how they align with existing processes, authorities, and budget challenges. The NOC will address questions and specifics as implementation progresses. Meaningful and frequent opportunities for stakeholder and public engagement throughout the implementation of the National Policy and implementation of coastal and marine spatial planning will be an essential component of cooperatively addressing these uncertainties head-on, and the Task Force recommendations embrace this approach. The Task Force is confident that the investments and improvements described in these final recommendations will advance the economic interests of the United States through sustainable and productive ocean uses; significantly improve our capacity to address the long-term challenges and impacts of climate and environmental changes; and provide a lasting foundation for further enhancing the many vital benefits our Nation can derive from these areas.

With a clear National Policy and a revitalized, empowered, unified, and comprehensive framework to coordinate efforts set forth in these recommendations, we can achieve an America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured so as to promote the well-being, prosperity, and security of present and future generations.

APPENDIX A.
PRESIDENTIAL MEMORANDUM ON A NATIONAL POLICY FOR THE OCEAN, OUR COASTS, AND THE GREAT LAKES

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release June 12, 2009

June 12, 2009

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

SUBJECT: NATIONAL POLICY FOR THE OCEANS, OUR COASTS, AND THE GREAT LAKES

The oceans, our coasts, and the Great Lakes provide jobs, food, energy resources, ecological services, recreation, and tourism opportunities, and play critical roles in our Nation's transportation, economy, and trade, as well as the global mobility of our Armed Forces and the maintenance of international peace and security. We have a stewardship responsibility to maintain healthy, resilient, and sustainable oceans, coasts, and Great Lakes resources for the benefit of this and future generations.

Yet, the oceans, coasts, and Great Lakes are subject to substantial pressures and face significant environmental challenges. Challenges include water pollution and degraded coastal water quality caused by industrial and commercial activities both onshore and offshore, habitat loss, fishing impacts, invasive species, disease, rising sea levels, and ocean acidification. Oceans both influence and are affected by climate change. They not only affect climate processes but they are also under stress from the impacts of climate change. Renewable energy, shipping, and aquaculture are also expected to place growing demands on ocean and Great Lakes resources. These resources therefore require protection through the numerous Federal, State, and local authorities with responsibility and jurisdiction over the oceans, coasts, and Great Lakes.

To succeed in protecting the oceans, coasts, and Great Lakes, the United States needs to act within a unifying framework under a clear national policy, including a comprehensive, ecosystem-based framework for the longterm conservation and use of our resources.

In order to better meet our Nation's stewardship responsibilities for the oceans, coasts, and Great Lakes, there is established an Interagency Ocean Policy Task Force (Task Force), to be led by the Chair of the Council on Environmental Quality. The Task Force shall be composed of senior policy-level officials from the executive departments, agencies, and offices represented on the Committee on Ocean Policy established by section 3 of Executive Order 13366 of December 17, 2004. This Task Force is not meant to duplicate that structure, but rather is intended to be a temporary entity with the following responsibilities:

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(OVER)

1. Within 90 days from the date of this memorandum, the Task Force shall develop recommendations that include:

a. A national policy that ensures the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhances the sustainability of ocean and coastal economies, preserves our maritime heritage, provides for adaptive management to enhance our understanding of and capacity to respond to climate change, and is coordinated with our national security and foreign policy interests. The recommendations should prioritize upholding our stewardship responsibilities and ensuring accountability for all of our actions affecting ocean, coastal, and Great Lakes resources, and be consistent with international law, including customary international law as reflected in the 1982 United Nations Convention on the Law of the Sea.

b. A United States framework for policy coordination of efforts to improve stewardship of the oceans, our coasts, and the Great Lakes. The Task Force should review the Federal Government's existing policy coordination framework to ensure integration and collaboration across jurisdictional lines in meeting the objectives of a national policy for the oceans, our coasts, and the Great Lakes. This will include coordination with the work of the National Security Council and Homeland Security Council as they formulate and coordinate policy involving national and homeland security, including maritime security. The framework should also address specific recommendations to improve coordination and collaboration among Federal, State, tribal, and local authorities, including regional governance structures.

c. An implementation strategy that identifies and prioritizes a set of objectives the United States should pursue to meet the objectives of a national policy for the oceans, our coasts, and the Great Lakes.

2. Within 180 days from the date of this memorandum, the Task Force shall develop, with appropriate public input, a recommended framework for effective coastal and marine spatial planning. This framework should be a comprehensive, integrated, ecosystem-based approach that addresses conservation, economic activity, user conflict, and sustainable use of ocean, coastal, and Great Lakes resources consistent with international law, including customary international law as reflected in the 1982 United Nations Convention on the Law of the Sea.

3. The Task Force shall terminate upon the completion of its duties.

The Task Force's recommendations and frameworks should be cost effective and improve coordination across Federal agencies.

This memorandum covers matters involving the oceans, the Great Lakes, the coasts of the United States (including its

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territories and possessions), and related seabed, subsoil, and living and non-living resources.

This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person. Nothing in this memorandum shall be construed to impair or otherwise affect the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, regulatory, and legislative proposals.

The Chair of the Council on Environmental Quality is hereby authorized and directed to publish this memorandum in the *Federal Register*.

BARACK OBAMA

# # #

05-05-10 DELIBERATIVE PRE-DECISIONAL COMMUNICATION
NOT ADMINISTRATION POLICY -- DO NOT RELEASE

APPENDIX B. INTERAGENCY OCEAN POLICY TASK FORCE MEMBERSHIP LIST

Task Force Chair
White House Council on Environmental Quality
Nancy Sutley
Chair

Department of Agriculture
Robert Bonnie
Senior Advisor to the Secretary

Department of Commerce
Dr. Jane Lubchenco
Undersecretary for Oceans and Atmosphere
NOAA Administrator

Department of Defense
Vice Admiral James Houck
Judge Advocate General of the Navy

Environmental Protection Agency
Peter Silva
Assistant Administrator for Water

Department of Energy
David Sandalow
Assistant Secretary for Policy and International Affairs

Federal Energy Regulatory Commission
John Katz
Deputy Associate General Counsel

Department of Health and Human Services
Dora Hughes
Counselor for Science & Public Health

Department of Homeland Security
Admiral Thad Allen
Commandant, U.S. Coast Guard

Department of the Interior
Laura Davis
Associate Deputy Secretary

Office of the Joint Chiefs of Staff
Major General Darren McDew
Vice Director for Strategic Plans and Policy, Joint Staff

Department of Justice
John Cruden
Acting Assistant Attorney General, Environment and Natural Resources Division

Department of Labor
Megan Uzzell
Senior Advisor to the Secretary

National Aeronautics and Space Administration
Dr. Michael Freilich
Director of the Earth Science Division

National Security Council
Ed Fendley
Director for International Environmental Issues

National Science Foundation
Timothy Killeen
Assistant Director for the Geosciences

Department of the Navy
Robert Work
Under Secretary of the Navy

Department of State
David Balton
Deputy Assistant Secretary for Oceans and Fisheries

Department of Transportation
Katie Thomson
Counselor to the Secretary of Transportation

Office of the Vice President
Terrell McSweeney
Deputy Assistant to VP & Domestic Policy Advisor

White House Office of Energy and Climate Change
Jody Freeman
Counselor for Energy and Climate

White House Office of Information and Regulatory Affairs
Michael Fitzpatrick
Associate Administrator

White House Office of Management and Budget
Sally Ericsson
Associate Director for Natural Resource Programs

White House Office of Management and Budget
Xavier Briggs
Associate Director for General Government Programs

White House Office of Science and Technology Policy
Shere Abbott
Associate Director of Environment

APPENDIX C. PUBLIC ENGAGEMENT

Below is a description of the methods and summary results from the Task Force's public engagement process. In addition, included is a summary of key public comments and how they were addressed by the Task Force in the Final Recommendation.

I. Overview

The Task Force carried out a public engagement process throughout the 180-day period to receive input for consideration as it developed these recommendations. This builds on the comprehensive reports of the U.S. Commission on Ocean Policy and the Pew Oceans Commission, which were based on significant scientific, public, and stakeholder input. CEQ, on behalf of the Task Force, organized and hosted thirty-eight expert roundtables to hear from a broad range of stakeholders and interest groups. The roundtables included representatives from sectors including energy, conservation, recreational fishing, commercial fishing, transportation, agriculture, human health, State, tribal, and local governments, ports, recreational boating, business, and national and homeland security. Task Force representatives attended each roundtable. There was robust participation and the Task Force received many valuable comments and perspectives for its consideration during each session.

On behalf of the Task Force, CEQ also set up a website to accept public comments. The Task Force received approximately five thousand comments from a range of affected parties, including academia, citizens, commercial and recreational interests, non-governmental organizations, and States, tribes, and regional governance structures. Many of the groups commenting represented constituencies of hundreds or thousands of members.

Additionally, the Task Force hosted six regional public meetings with over two thousand public participants, in which Task Force members were available to answer questions and the public was able to voice their concerns and opinions. These meetings took place in the following regions: Alaska (held in Anchorage, Alaska, August 21, 2009); West Coast (held in San Francisco, California, September 17, 2009); East Coast (held in Providence, Rhode Island, September 24, 2009); Pacific Islands (held in Honolulu, Hawaii and via satellite link, September 29, 2009); Gulf Coast (held in New Orleans, Louisiana, and via interactive video link October 19, 2009); and Great Lakes (held in Cleveland, Ohio, October 29, 2009).

The public meetings, roundtables, and website showcased a strong desire and enthusiasm among participants for a national policy that provides clarity and direction regarding how the Nation will better care for the ocean, our coasts, and the Great Lakes. A valuable and wide diversity of interests were represented, and several key themes emerged. While not exhaustive, these include:

- Support for adopting ecosystem-based management as a guiding principle, acknowledging regional differences, and practicing adaptive management in light of concerns about competing uses and growth of industrial uses;

- Support for embracing science-based decision-making and investing in ecosystem-based science, research, ocean observations, and mapping including comprehensive research on the linkages among ecosystem health, human health, economic opportunity, national and homeland security, social justice, and environmental change, including climate change;
- Desire for improved coordination and collaboration across Federal, State, tribal, and local governments, and regional governance structures, and for improved transparency and public participation, while avoiding new layers of bureaucracy and unnecessary costs;
- Support for improving both formal and informal education about the ocean, our coasts, and the Great Lakes;
- Support for ensuring that policies are adequately funded; and
- Support for joining the 1982 United Nations Convention on the Law of the Sea (the Law of the Sea Convention).

II. Summary of Public Comments on the Interim Report of the *Interagency Ocean Policy Task Force* and on the *Interim Framework for Effective Coastal and Marine Spatial Planning*

The Task Force reviewed the public comments received in response to the *Interim Report* and *Interim Framework* and determined whether substantive comments were adequately addressed, merited further consideration and resulting changes, or were more suited for further consideration by the National Ocean Council (NOC), if established, as it implements the National Policy, if adopted.

Comments on the Interim Report of the Interagency Ocean Policy Task Force

Substantive comments on the Interim Report ranged from general support for a national policy and improved Federal coordination, to concerns over the process, and concerns that the Interim Report did not adequately account for economic uses of the ocean, our coasts, and the Great Lakes, or specifically mention the benefits of certain types of activities. There also were comments on governance, and numerous specific comments on the nine priority objectives of the implementation strategy, and other specific recommendations (e.g., reauthorize certain laws). The following summarizes some of the key substantive comments received and how the Task Force addressed them:

1. Overall Tone and Balance

   Comments have suggested that the balance between conservation and ocean uses in the report was skewed too much toward stewardship, and failed to emphasize certain types of uses such as recreational fishing, aquaculture, or renewable energy. The Task Force determined that the overall tone and balance of the recommendations were consistent with the President's direction to recommend a stewardship policy for the ocean, our coasts, and the Great Lakes. Improved stewardship will support not only healthier and more resilient ocean, coastal, and Great Lakes ecosystems and services, but also benefit the economies (e.g., commercial and recreational activities) and communities that rely on them. The Task Force recognizes the

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significant role of recreation and other existing and emerging sustainable uses (e.g., renewable energy, aquaculture) of ocean, coasts, and Great Lakes resources. However, it did not single out individual sectors for discussion in the recommendations. Rather, the recommendations discuss better managing all uses of the ocean, coasts, and Great Lakes in a sustainable manner.

2. Recreational Users

Comments expressed a concern that recreational fishing interests and the unique distinction between recreational and commercial fishing were not adequately represented in the *Interim Report.* Additionally, the Task Force received comments to recognize that recreational users (e.g., anglers, boaters, and other outdoor enthusiasts) not only use and rely on the health of ocean, coastal, and Great Lakes resources, but have a long history of actively participating in their conservation and stewardship.

The Task Force made several changes in the recommendations to distinguish recreational and commercial fishing and to more expressly recognize the importance of access to the ocean, our coasts, and the Great Lakes for recreation. The Task Force recognizes the importance of recreation, including sustainable recreational fishing, and that Americans should continue to enjoy such outdoor experiences, which are also critical to the economic, social, and cultural fabric of our country. Recreational users have a long history of actively participating in the stewardship of the ocean, coastal, and Great Lakes resources. Ensuring healthier oceans, coasts, and Great Lakes will benefit all recreational activities and the communities and economies that rely on them.

3. Ecosystem-Based Management

A range of comments were received concerning the use of ecosystem-based management in the *Interim Report.* Some suggested that the language regarding ecosystem-based management be strengthened while others would like to ensure that ecosystem-based management, while a good principle, not be mandated. The Task Force determined that this principle, which was articulated in the President's June 12, 2009 memorandum, is critical to how we govern and manage our ocean, coasts, and Great Lakes and should remain as one of the nine priority objectives. How ecosystem-based management will be defined and implemented would be further addressed by the NOC as it develops a strategic action plan for this priority objective.

4. Precautionary Approach

A range of comments were received concerning the use of the precautionary approach as one of the National Principles. Application of a precautionary approach, as defined in the recommendations ("[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation"), is consistent with and essential for improved stewardship. Moreover, the United States has already affirmed this exact wording in the 1992

Rio Declaration on Environment and Development. Many comments supported its inclusion while others were concerned it would be used to prevent activities from occurring. These latter comments, however, may have misinterpreted the precautionary approach here as mandating, for example, the prohibition of activities that present an uncertain potential for significant harm unless the proponent of the activity shows that it presents no appreciable risk of harm. The Task Force has retained the precautionary approach as reflected in the Rio Declaration in its final recommendations, as it believes that we must be able to avail ourselves of timely, cost-effective stewardship measures, consistent with the approach articulated in the Rio Declaration. Some comments used the term "precautionary principle," but the United States has long taken the position that precaution is a tool or approach rather than a "principle," given the lack of a single definition or agreed formulation and the differing implications of its various forms.

5. National Ocean Council Membership

Comments were received on the role of the National Oceanic and Atmospheric Administration (NOAA) in the recommended governance structure, particularly that it should have a more prominent role on the NOC. The Department of Commerce would have a seat on the NOC. However, the Task Force recognizes that NOAA (an agency within the Department of Commerce) plays a particularly important role in coastal and ocean research, planning, and management. While the Task Force had always envisioned that NOAA would have a substantial role within the NOC and in the implementation of these recommendations, the Task Force has determined that the final recommendations should be more explicit by clarifying that the NOAA Administrator should also be added as a member of the NOC.

6. State, Tribal, and Local Government Role

A variety of comments were received pertaining to the role of State, tribal, and local governments in the recommended governance structure. Comments advocated for a greater role for State, tribal, and local governments and for more detail regarding the interplay of the Governance Advisory Committee with other entities in the NOC structure. The Task Force addressed these comments in five main areas: (1) changing the name of the Governance Advisory Committee to the Governance Coordinating Committee (GCC) to more accurately reflect its function; (2) modifying the composition of the GCC to include representation from local governments and State legislatures; (3) expressly acknowledging the unique legal relationship with federally recognized American Indian and Alaska Native tribal governments; (4) clarifying GCC functions and its relationship to other governance structure entities; and (5) strengthening coordination and collaboration between the GCC and various levels of the NOC.

7. Transparency and Public Input

   Comments suggested adding more detail on how the NOC will incorporate public input and keep the public informed about its actions. The Task Force addressed these comments throughout the recommendations, including adding new text that expressly identifies the need for the NOC to ensure substantial opportunity for public participation as it develops strategic action plans.

8. Additional Priority Objectives and Specificity of Implementation Strategy

   Comments suggested a range of additional priority objectives, including Community and Cultural Access, Protection of Culture and Traditions, Caribbean and the Pacific Islands, Antarctica, Coral Reefs, Marine Aquaculture, Recreational Fishing, Fisheries Management, Renewable Energy, Marine Transportation Safety, and Collaborative Environmental Problem Solving in Underserved Coastal Communities. While the Task Force strongly considered a wide array of priority objectives, the Task Force determined that the nine priority objectives, with some minor modifications, set out in these recommendations were the most appropriate initial priorities of the NOC. In addition, the NOC may always identify additional or different priority objectives in years to come. In fact, the functions of the NOC include updating and setting national priority objectives, as well as providing National Policy implementation objectives. Comments also advocated for more specificity in the implementation strategy, but the Task Force determined that further clarity and detail is best determined by the NOC and its component bodies.

Comments on the Interim Framework for Effective Coastal and Marine Spatial Planning

Substantive comments on the *Interim Framework* ranged from questioning the overall need for coastal and marine spatial planning (CMSP) to general support for a new, more efficient, ecosystem-based approach to managing sustainable uses of the ocean, our coasts, and the Great Lakes. Some comments also advocated for ensuring that CMSP provides a balance between economic uses and stewardship, while others raised questions or concerns over the relationship of CMSP to existing processes and authorities and specifics of how the process will work. Some comments were similar to those received on the *Interim Report* and are addressed in the previous section. The following summarizes some of the additional key substantive comments received on the Interim Framework and how the Task Force addressed them.

1. Why Coastal and Marine Spatial Planning

   Comments raised a variety of issues regarding the general nature of this effort. For example, it was suggested that the *Interim Framework* did not provide an adequate description of the problem trying to be solved; that existing processes are sufficient and only require improved coordination rather than a new top-down bureaucracy with too much authority vested in the National Ocean Council. Other comments strongly supported the need for CMSP and

the benefits to be derived from more proactive, multi-objective, multi-sectoral planning. Some comments raised concern that many processes in the *Interim Framework* were vague and required greater clarity and definition of terms (e.g., ecosystem-based management).

The recommendations describe a flexible, regionally based approach for the development of CMSP. The NOC would facilitate development of coastal and marine spatial plans (CMS Plans) and provide national guidance to ensure national consistency, as appropriate. The Task Force has made a number of changes to better clarify the processes described in the recommendations. The recommendations also describe that the NOC would provide further clarity through the development of a strategic action plan and national guidance documents, which would be developed with public and stakeholder input.

2. Overarching Goals, Principles, and Nature of Coastal and Marine Spatial Planning

Comments suggested that the *Interim Framework* should have as its primary overarching goal "protection, maintenance, and restoration" as this is a fundamental goal that supports all others (e.g., healthy ecosystems support the full range of ecosystem services). Other comments suggested that the *Interim Framework* should recognize benefits of commercial and recreational uses, and the significant economic benefits to be derived from the responsible production of energy resources, and other economic activities in Federal offshore waters.

The Task Force agrees that healthy ecosystems provide the foundation for the full range of ecological services the ocean, coasts, and Great Lakes provide, including economic, environmental, and societal benefits. CMSP is intended to result in better management of and planning for sustainable multiple uses (e.g., energy, recreation, and commercial and recreational fishing) across sectors as well as to improve conservation of the ocean, coasts, and Great Lakes. The Task Force believes that the recommendations adequately discuss the multi-objective nature of CMSP and the potential economic, environmental, and societal benefits.

3. Integration, Cooperation, and Coordination

Comments requested that the Task Force clarify that CMSP is intended to build off of and incorporate existing plans, processes, and authorities. Comments also requested that the Task Force recognize that certain decisions should be left to, or deference be given to, State decision-makers. There are a number of places throughout the *Interim Framework* (e.g., "Essential Elements of the CMSP Process") that expressly discuss the relationship of CMSP to existing processes. The Task Force has made additional clarifying changes to address these comments.

4. Geographic Scope

There were a number of comments on various aspects of the geographic scope for CMSP, including the treatment of private lands, inland areas, and bays and estuaries. The recommendations exclude private lands from the CMSP planning area; clarifying that the

exclusion applies to all private lands, not only private submerged lands. The Task Force decided to leave the regional planning bodies with the flexibility to include inland areas within the geographic scope, but has recommended that the NOC, in coordination with the GCC, develop guidance for the regional planning bodies to help determine whether to include inland areas. Finally, the Task Force determined to maintain the requirement to include bays and estuaries due to the strong linkages with ocean, coastal, and Great Lakes areas.

5. Development and Implementation of Coastal and Marine Spatial Planning

A number of comments raised questions regarding the role, composition, and operation of the regional planning bodies. The Task Force has maintained the core composition of regional planning bodies to include State, Federal, and tribal authorities, and has further articulated the types of representatives to be considered for inclusion. The Task Force did not add local governments to the regional planning bodies due to the numerous and wide variety of local authorities that could result in very disparate participation and representation across regions. However, the recommendations require regional planning bodies to coordinate with local governments, as appropriate, throughout the process.

Some comments suggested adding a Regional Fishery Management Council (RFMC) representative to the regional planning bodies given their unique quasi-regulatory role under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The Task Force is interested in finding the most effective opportunity for sustained and meaningful engagement with the RFMCs as it is their statutory responsibility to develop fishery management plans and management measures for fisheries which NOAA then reviews and, if approves, implements through regulation. While the Task Force acknowledges the relatively unique role that RFMCs play, it did not want to prescribe a particular method for how RFMCs should be included in the CMSP process without more thoughtful consideration and analysis. The recommendations describe that the regional planning bodies would provide a formal mechanism for consultation with the RFMCs across their respective regions on fishery related issues and that the NOC would further assess if representation on the regional planning bodies is the best method for this engagement. In the future, if other statutorily-mandated or quasi-regulatory groups are identified, the NOC would determine whether a formal mechanism for consultation should be developed for such groups and, if necessary, provide guidance for regional planning bodies on the development of such a process.

Comments questioned how the regional planning bodies would operate, who would lead them, and how decisions would be made. Comments also suggested clarifying that the regions could create sub-regional planning bodies. The Task Force has clarified that the work plan to be developed by each regional planning body would specify the participants, Federal and non-Federal co-lead(s), timing, milestones, etc. The Task Force also clarified that there would be flexibility to develop sub-regional plans provided that these plans are encompassed in the

regional planning body's final CMS Plan. The Task Force recognized that this flexibility may be particularly useful in the Alaska/Arctic and Pacific Islands Regions.

There were a number of comments regarding strengthening involvement of stakeholders, the public, and scientific and technical experts in the CMSP process. The recommendations clarify and strengthen their role in CMSP, including requiring the development of inclusive and transparent stakeholder and scientific participation and consultation mechanisms in each region.

6. Nature of Planning Process and CMS Plans and Adherence to CMS Plans

Comments raised questions about whether CMS Plans would be comprehensive, multi-objective, and multi-sectoral. The Task Force has clarified that while there is flexibility as part of the CMSP process to address different priority issues at certain times, the final CMS Plans would be required to achieve this level of comprehensiveness in order to receive NOC certification. The Task Force also clarified that while it is recognized that CMSP is an iterative process and initial CMS Plans would likely identify gaps in understanding that may limit the ability to make informed decisions at a particular time, these gaps would be identified in the CMS Plan along with an implementation approach to how they would be addressed in future iterations of the CMS Plan.

A number of comments raised questions regarding the binding or non-binding nature of CMS Plans and the requirements to adhere to them. Comments also questioned the scope of the allowance for deviations from CMS Plans. The Task Force has clarified the language regarding the binding nature of CMS Plans to be consistent throughout the document. As it relates to deviations, the existing language allows for deviations from CMS Plans, but requires periodic reviews to determine why they are occurring and to identify remedies to minimize such deviations. The Task Force expects that as agencies gain experience with this process, any deviations would be minimized. The Task Force does not intend this language to be a broad exemption to CMS Plans.

Comments also expressed that the *Interim Framework* does not clearly establish the relationships between CMS Plans and existing regulatory authorities, including the Magnuson-Stevens Fishery Conservation and Management Act, Coastal Zone Management Act, and Outer Continental Shelf Lands Act. The Task Force has added language to better clarify the relationship between CMSP and existing authorities.

Comments suggested that the Task Force consider adding language that addresses what happens if a State opts out or a regional plan does not meet NOC certification requirements. The Task Force has added language clarifying that even if some States or tribes opt out of the CMS Process, the Federal, and participating State and tribal authorities would continue to develop and implement a regional CMS Plan.

7. National Consistency

Comments raised concerns that with nine different regions there could be different standards applied to the same activities (e.g., ballast water), or potential for other significant inconsistencies regarding commerce and other socio-economic sectors. The recommendations make clear that the NOC would develop national guidance and objectives to ensure national consistency and seek to minimize inconsistencies and conflicts across regions for cross-cutting or national issues. Development of this guidance would include opportunities for robust public and stakeholder participation.

8. Scientific Knowledge and Data Integration, Research, Management, and Access

Comments raised concerns over the complexities and resources needed to create a new information management system and encouraged adapting an existing system or search tool as an alternative. Comments also requested that the Interim Framework make clear that State, local, and other data would be included in the system, not only Federal data. Other comments requested a greater emphasis on local and traditional knowledge as data/information sources. These issues have been addressed in the recommendations.

9. Implementation

Comments on the length of the implementation process varied from the timeframe for development of CMS Plans being too short to excessively long. The Task Force determined that given the varied range of comments the phased, flexible approach recommended in the document provides an ambitious, but achievable timeline to develop CMSP in the United States.

10. Resources

While the Task Force is mindful of the national economic situation and budgetary challenges, it is confident that making the investments and improvements in these recommendations will advance the economic interests of the United States and facilitate greater efficiencies across the Federal Government. Recognizing the reality of the limited availability of new resources, Federal agencies would re-evaluate how resources are allocated in light of their statutory and regulatory mandates to further the recommended National Policy. Also, the President's Fiscal Year 2011 Budget Request includes funding that would support priority activities identified in these recommendations, such as coastal and marine spatial planning, geospatial modernization, regional ocean partnerships, water quality improvement, habitat restoration, integrated ecosystem assessments, coastal and estuarine land protection, research and development of ocean sensor technology, and environmental tools to support resilient coastal communities.

5.

Information on the National Ocean Council

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release July 19, 2010

EXECUTIVE ORDER

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STEWARDSHIP OF THE OCEAN, OUR COASTS, AND THE GREAT LAKES

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Section 1. Purpose. The ocean, our coasts, and the Great Lakes provide jobs, food, energy resources, ecological services, recreation, and tourism opportunities, and play critical roles in our Nation's transportation, economy, and trade, as well as the global mobility of our Armed Forces and the maintenance of international peace and security. The Deepwater Horizon oil spill in the Gulf of Mexico and resulting environmental crisis is a stark reminder of how vulnerable our marine environments are, and how much communities and the Nation rely on healthy and resilient ocean and coastal ecosystems. America's stewardship of the ocean, our coasts, and the Great Lakes is intrinsically linked to environmental sustainability, human health and well-being, national prosperity, adaptation to climate and other environmental changes, social justice, international diplomacy, and national and homeland security.

This order adopts the recommendations of the Interagency Ocean Policy Task Force, except where otherwise provided in this order, and directs executive agencies to implement those recommendations under the guidance of a National Ocean Council. Based on those recommendations, this order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests.

This order also provides for the development of coastal and marine spatial plans that build upon and improve existing Federal, State, tribal, local, and regional decisionmaking and planning processes. These regional plans will enable a more integrated, comprehensive, ecosystem-based, flexible, and proactive approach to planning and managing sustainable multiple uses across sectors and improve the conservation of the ocean, our coasts, and the Great Lakes.

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Sec. 2. Policy. (a) To achieve an America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured so as to promote the well-being, prosperity, and security of present and future generations, it is the policy of the United States to:

(i) protect, maintain, and restore the health and biological diversity of ocean, coastal, and Great Lakes ecosystems and resources;

(ii) improve the resiliency of ocean, coastal, and Great Lakes ecosystems, communities, and economies;

(iii) bolster the conservation and sustainable uses of land in ways that will improve the health of ocean, coastal, and Great Lakes ecosystems;

(iv) use the best available science and knowledge to inform decisions affecting the ocean, our coasts, and the Great Lakes, and enhance humanity's capacity to understand, respond, and adapt to a changing global environment;

(v) support sustainable, safe, secure, and productive access to, and uses of the ocean, our coasts, and the Great Lakes;

(vi) respect and preserve our Nation's maritime heritage, including our social, cultural, recreational, and historical values;

(vii) exercise rights and jurisdiction and perform duties in accordance with applicable international law, including respect for and preservation of navigational rights and freedoms, which are essential for the global economy and international peace and security;

(viii) increase scientific understanding of ocean, coastal, and Great Lakes ecosystems as part of the global interconnected systems of air, land, ice, and water, including their relationships to humans and their activities;

(ix) improve our understanding and awareness of changing environmental conditions, trends, and their causes, and of human activities taking place in ocean, coastal, and Great Lakes waters; and

(x) foster a public understanding of the value of the ocean, our coasts, and the Great Lakes to build a foundation for improved stewardship.

(b) The United States shall promote this policy by:

(i) ensuring a comprehensive and collaborative framework for the stewardship of the ocean, our coasts, and the Great Lakes that facilitates cohesive actions across the Federal Government, as well as participation of State, tribal, and local authorities, regional governance structures, nongovernmental organizations, the public, and the private sector;

(ii) cooperating and exercising leadership at the international level;

(iii) pursuing the United States' accession to the Law of the Sea Convention; and

(iv) supporting ocean stewardship in a fiscally responsible manner.

Sec. 3. Definitions. As used in this order:

(a) "Final Recommendations" means the *Final Recommendations of the Interagency Ocean Policy Task Force* that shall be made publicly available and for which a notice of public availability shall be published in the *Federal Register*.

(b) The term "coastal and marine spatial planning" means a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas. Coastal and marine spatial planning identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives. In practical terms, coastal and marine spatial planning provides a public policy process for society to better determine how the ocean, our coasts, and Great Lakes are sustainably used and protected -- now and for future generations.

(c) The term "coastal and marine spatial plans" means the plans that are certified by the National Ocean Council as developed in accordance with the definition, goals, principles, and process described in the Final Recommendations.

Sec. 4. Establishment of National Ocean Council. (a) There is hereby established the National Ocean Council (Council).

(b) The Council shall consist of the following:

(i) the Chair of the Council on Environmental Quality and the Director of the Office of Science and Technology Policy, who shall be the Co-Chairs of the Council;

(ii) the Secretaries of State, Defense, the Interior, Agriculture, Health and Human Services, Commerce, Labor, Transportation, Energy, and Homeland Security, the Attorney General, the Administrator of the Environmental Protection Agency, the Director of the Office of Management and Budget, the Under Secretary of Commerce for Oceans and Atmosphere (Administrator of the National Oceanic and Atmospheric Administration), the Administrator of the National Aeronautics and Space Administration, the Director of National Intelligence, the Director of the National Science Foundation, and the Chairman of the Joint Chiefs of Staff;

(iii) the National Security Advisor and the Assistants to the President for Homeland Security and Counterterrorism, Domestic Policy, Energy and Climate Change, and Economic Policy;

(iv) an employee of the Federal Government designated by the Vice President; and

(v) such other officers or employees of the Federal Government as the Co-Chairs of the Council may from time to time designate.

(c) The Co-Chairs shall invite the participation of the Chairman of the Federal Energy Regulatory Commission, to the extent consistent with the Commission's statutory authorities and legal obligations, and may invite the participation of such other independent agencies as the Council deems appropriate.

(d) The Co-Chairs of the Council, in consultation with the National Security Advisor and the Assistant to the President for Homeland Security and Counterterrorism, shall regularly convene and preside at meetings of the Council, determine its agenda, direct its work, and, as appropriate to address particular subject matters, establish and direct committees of the Council that shall consist exclusively of members of the Council.

(e) A member of the Council may designate, to perform committee functions of the member, any person who is within such member's department, agency, or office and who is (i) an officer of the United States appointed by the President, (ii) a member of the Senior Executive Service or the Senior Intelligence Service, (iii) a general officer or flag officer, or (iv) an employee of the Vice President.

(f) Consistent with applicable law and subject to the availability of appropriations, the Office of Science and Technology Policy and the Council on Environmental Quality shall provide the Council with funding, including through the National Science and Technology Council or the Office of Environmental Quality. The Council on Environmental Quality shall, to the extent permitted by law and subject to the availability of appropriations, provide administrative support necessary to implement this order.

(g) The day-to-day operations of the Council shall be administered by a Director and a Deputy Director, who shall supervise a full-time staff to assist the Co-Chairs in their implementation of this order.

Sec. 5. Functions of the Council. (a) The Council shall have the structure and function and operate as defined in the Final Recommendations. The Council is authorized, after the Council's first year of operation, to make modifications to its structure, function, and operations to improve its effectiveness and efficiency in furthering the policy set forth in section 2 of this order.

(b) To implement the policy set forth in section 2 of this order, the Council shall provide appropriate direction to ensure that executive departments', agencies', or offices' decisions and actions affecting the ocean, our coasts, and the Great Lakes will be guided by the stewardship principles and national priority objectives set forth in the Final Recommendations, to the extent consistent with applicable law. The Council shall base its decisions on the consensus of its members. With respect to those matters in which consensus cannot be reached, the National Security Advisor shall coordinate with the Co-Chairs and, as appropriate, the Assistants to the President for Energy and Climate Change, and Economic Policy, and the employee of the United States designated by the Vice President, subject to the limitations set forth in section 9 of this order, to present the disputed issue or issues for decision by the President.

Sec. 6. Agency Responsibilities. (a) All executive departments, agencies, and offices that are members of the Council and any other executive department, agency, or office whose actions affect the ocean, our coasts, and the Great Lakes shall, to the fullest extent consistent with applicable law:

(i) take such action as necessary to implement the policy set forth in section 2 of this order and the stewardship principles and national priority objectives as set forth in the Final Recommendations and subsequent guidance from the Council; and

(ii) participate in the process for coastal and marine spatial planning and comply with Council certified coastal and marine spatial plans, as described in the Final Recommendations and subsequent guidance from the Council.

(b) Each executive department, agency, and office that is required to take actions under this order shall prepare and make publicly available an annual report including a concise description of actions taken by the agency in the previous calendar year to implement the order, a description of written comments by persons or organizations regarding the agency's compliance with this order, and the agency's response to such comments.

(c) Each executive department, agency, and office that is required to take actions under this order shall coordinate and contribute resources, as appropriate, to assist in establishing a common information management system as defined in the Final Recommendations and shall be held accountable for managing its own information assets by keeping them current, easily accessible, and consistent with Federal standards.

(d) To the extent permitted by law, executive departments, agencies, and offices shall provide the Council such information, support, and assistance as the Council, through the Co-Chairs, may request.

Sec. 7. Governance Coordinating Committee. The Council shall establish a Governance Coordinating Committee that shall consist of 18 officials from State, tribal, and local governments in accordance with the Final Recommendations. The Committee may establish subcommittees chaired by representatives of the Governance Coordinating Committee. These subcommittees may include additional representatives from State, tribal, and local governments, as appropriate to provide for greater collaboration and diversity of views.

Sec. 8. Regional Advisory Committees. The lead Federal department, agency, or office for each regional planning body established for the development of regional coastal and marine spatial plans, in consultation with their nonfederal co-lead agencies and membership of their regional planning body, shall establish such advisory committees under the Federal Advisory Committee Act, 5 U.S.C. App., as they deem necessary to provide information and to advise the regional planning body on the development of regional coastal and marine spatial plans to promote the policy established in section 2 of this order.

Sec. 9. General Provisions. (a) Nothing in this order, the establishment of the Council, and the Final Recommendations shall be construed to impair or otherwise affect:

(i) authority granted by law to an executive department or agency or the head thereof; or

(ii) functions assigned by the President to the National Security Council or Homeland Security Council (including subordinate bodies) relating to matters affecting foreign affairs, national security, homeland security, or intelligence.

(b) Nothing in this order shall be construed to impair or otherwise affect the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(c) In carrying out the provisions of this order and implementing the Final Recommendations, all actions of the Council and the executive departments, agencies, and offices that constitute it shall be consistent with applicable international law, including customary international law, such as that reflected in the Law of the Sea Convention.

(d) This order is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

Sec. 10. Revocation. Executive Order 13366 of December 17, 2004, is hereby revoked.

BARACK OBAMA

THE WHITE HOUSE,
July 19, 2010.

# # #

Meet the National Ocean Council

Posted by NOC Team on July 19, 2010 at 03 23 PM EDT

Find out who represents your new National Ocean Council.

Co-Chairs

White House Council on Environmental Quality
Nancy Sutley, Chair

White House Office of Science and Technology Policy
Dr. John P. Holdren, Director

NOC Members

Department of Agriculture
Tom Vilsack
Secretary

Department of Commerce
Gary Locke
Secretary

Dr. Jane Lubchenco
Undersecretary for Oceans and Atmosphere
NOAA Administrator

Department of Defense
Robert M. Gates
Secretary

Environmental Protection Agency
Lisa P. Jackson
Administrator

Department of Energy
Dr. Steven Chu
Secretary

Federal Energy Regulatory Commission (invitation pending)
Jon Wellinghoff
Chairman

Department of Health and Human Services
Kathleen Sebelius
Secretary

Department of Homeland Security
Janet Napolitano
Secretary

Department of the Interior
Ken Salazar
Secretary

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Fiscal Responsibility
Foreign Policy
Health Care
Homeland Security
Immigration
Poverty
Rural
Seniors & Social Security
Service
Taxes
Technology

Joint Chiefs of Staff
Adm. Mike Mullen
Chairman

Department of Justice
Eric Holder
Attorney General

Department of Labor
Hilda L. Solis
Secretary

National Aeronautics and Space Administration
Charles F. Bolden, Jr.
Administrator

National Science Foundation
Dr. Cora Marrett
Acting Director

Department of State
Hillary Rodham Clinton
Secretary

Department of Transportation
Ray LaHood
Secretary

Office of the Vice President
TBD

Director of National Intelligence
TBD

White House Office of Management and Budget
Peter Orszag
Director

Assistant to the President for National Security
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Obama Administration Establishes National Policy to Protect Oceans, Coasts, and Great Lakes and Creates National Ocean Council to Oversee and Implement New Policy

By Emily Pitlick, John Clements, John Burnes, John Iani, and Jon Simon

On July 19, 2010, President Obama issued an Executive Order creating a national policy to promote stewardship of the ocean, coasts, and Great Lakes, to be implemented by federal agencies under the guidance of a new National Ocean Council (Council). The Order provides for the development of coastal and marine spatial plans (CMS Plans) based on ecosystem management to analyze current and future uses of ocean, coastal, and Great Lakes areas. The CMS Plans would identify areas most suitable for various types of activities and could impact existing and future commercial uses of these areas, such as oil and gas recovery and renewable wind and hydrokinetic projects, commercial and recreational fisheries, and those land-based industries that may degrade water quality and the ocean ecosystem through industrial runoff. The national policy emphasizes the need to provide for enhanced sustainability of the ocean, coastal and Great Lakes ecosystems and resources through science and adaptive management, and emphasizes understanding of the ecosystems' response to climate change and ocean acidification, as well as national security and foreign policy interests.

BACKGROUND

Although the Executive Order refers to the recent Deepwater Horizon oil spill in the Gulf of Mexico, its major driver appears to be the Final Recommendations of the Interagency Ocean Policy Task Force (Task Force), released simultaneously with the Executive Order and which the Executive Order adopts in full. The Task Force is a multi-agency entity led by the Council on Environmental Quality (CEQ) that was created by Executive Order in June 2009 to develop a national policy that ensures the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, including coastal and marine spatial planning (CMSP). Task Force members included two-dozen federal agencies and offices, including the Departments of Agriculture, Commerce, Defense, Justice, the Interior, and Energy, as well as the Environmental Protection Agency (EPA) and the Federal Energy Regulatory Commission (FERC).

The Council, which was recommended by the Task Force, will supersede the existing Committee on Ocean Policy that was created by President George W. Bush in 2004. It will be co-chaired by the Chair of CEQ and the Director of the White House Office of Science and Technology Policy. The Council's other members include the Secretaries of most cabinet-level agencies, such as State, Defense, the Interior, Agriculture, Commerce, Transportation, and Energy, and the heads of independent agencies such as EPA and the National Science Foundation (NSF). FERC, an independent agency in the Executive Branch of the federal government, is invited to participate consistent with its statutory authorities and legal obligations. The Executive Order directs all Council members, or other Executive branch offices whose actions affect the ocean, the coasts and the

Great Lakes, to participate in the CMSP process. Each implicated department, agency or office is also required to prepare an annual report describing its actions over the previous year to implement the Executive Order that includes a description of received written comments regarding that agency's compliance and its response to such comments.

COASTAL AND MARINE SPATIAL PLANNING

The purpose of the CMSP process is to identify areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystems to meet economic, environmental, security and social objectives. The planning process would broaden the scope of considerations in existing permitting for competing offshore uses (e.g., commercial fishing, and oil and gas exploration and development, and recreational purposes like boating and beach access) to permit a more integrated, comprehensive, ecosystem-based, flexible and proactive approach to planning managing these uses and activities.

The planning area includes the territorial sea, the United States' Exclusive Economic Zone (EEZ), and the Continental Shelf, as well as inland bays and estuaries. To make the task more manageable, the entire planning area is divided into nine regional planning areas based on large marine ecosystems: Alaska/Arctic, Caribbean, Great Lakes, Gulf of Mexico, Mid-Atlantic, Northeast, Pacific Islands, South Atlantic, and West Coast. Each of these regions would have a CMS Plan based on region-specific objectives to be developed by a regional planning body composed of federal, state, and tribal authorities relevant to the region, in consultation with the public and scientific and technical experts. The Council would oversee all regions' CMS Plan development and provide a dispute resolution process should conflicts arise. Each CMS Plan would then be certified by the Council for national consistency. Agencies intending to take an action inconsistent with a certified CMS Plan will be required to provide advance notice to the regional planning body and the Council, including justification for non-adherence to the plan.

RELATIONSHIP OF CMS PLANS TO EXISTING AUTHORITIES

The Executive Order creates no new or independent legal authority. CMS Plans will not be considered to be regulations and will not constitute final agency decision-making. Rather, the Council is intended to work within existing authority. The CMS Plans it certifies are intended to *guide* agency decision-making. However, the federal, state, and tribal authorities are anticipated to incorporate components of the CMS Plan into their respective regulations to the extent possible and enforce their regulatory programs consistent with their statutory authorities and the CMSP goals.

TIMELINE FOR IMPLEMENTATION

The new national policy will be developed in four phases, lasting through 2015 at the earliest. A preliminary phase is organization of the Council. During Phase I, the Council is expected to create Strategic Action Plans for CMSP over a year-long period while coordinating with federal agencies, states and federally recognized tribes, and while gathering data for science-based planning. Phase II, expected to begin nine months after the Council is organized and to consist of continued data gathering, initial regional step implementations, and work plan development. Full implementation of the CMSP process, Phase III, could take up to five years after the Council is organized. While Strategic Action Plans are being developed, Federal agencies are to continue to use

their existing processes for project development, but can begin to consider CMSP principles in their decision-making.

IMPLICATIONS

At this preliminary stage of development, the impact of the new national policy and the process to be implemented by the Council is uncertain. Much will depend on the substantive content of the regional CMS Plans that will be adopted, and how well the process works. The goal of the Executive Order is to establish a framework for a better coordinated and informed process for assessing the increasing and often competing uses of the nation's ocean, coastal, and Great Lakes water resources. That process envisions substantial stakeholder, scientific, and public input. On the one hand, increasing input can improve the process by developing a more complete record on which decisions can be based. On the other hand, the determination of which activities are suitable for specific areas may be controversial, and unless reasonable rules are established, the process can easily become more complex and lengthy, or bogged down by disputes that may delay the ultimate decision. Depending on how the Executive Order is implemented, these plans could have substantial impacts on a broad range of coastal development activities including entities operating existing energy projects or proposing to build new projects, fisheries, aquaculture, and commerce and transportation. These may include:

- A need to participate in the public and stakeholder engagement processes that will be used to develop regional CMS Plans, as well as in federal, state, or local rulemaking proceedings to implement regional CMS Plans;

- Additional consultation and data gathering requirements for initial permitting and permit renewals at the federal, state, and local level, including expanded emphasis on potential cumulative effects on "large marine ecosystems;" and

- New restrictions on energy development activities, commercial and recreational fisheries and aquaculture, as well as commerce and transportation, such as the establishment of zones where specific activities are prohibited, and new additional ongoing environmental impact analysis requirements.

FOR ADDITIONAL INFORMATION

For clients with business interests impacted by ongoing federal regulatory and policy developments relating to the use of U.S. waterways and coastal areas, Van Ness Feldman offers significant depth of experience and capabilities. Over half of the firm's 80 lawyers and policy advisors have worked as congressional staff, or at the U.S. Departments of the Interior and Energy, the U.S. Environmental Protection Agency, the Federal Energy Regulatory Commission, and the White House. Our professionals monitor federal regulatory and policy developments on a daily basis, and provide strategic advice to a range of clients. For more information, please contact any of the authors listed on this alert, or your usual Van Ness Feldman point of contact at 202.298.1800 in Washington, D.C. or 206.623.9372 in Seattle, WA.

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6.

Information on the Climate Change Adaptation Task Force

White House Climate Change Adaptation Task Force

In 2009, the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA) initiated the Interagency Climate Change Adaptation Task Force, which includes representatives from more than 20 Federal Agencies. When the President signed the Executive Order on Federal Leadership in Environmental, Energy, and Economic Performance, on October 5, 2009, he called on the Task Force to develop, within one year, Federal recommendations for adapting to climate change impacts both domestically and internationally.

Interim Progress Report

On March 16, 2010, the Task Force released an Interim Progress Report which outlines the Task Force's progress to date and recommends key components to include in a national strategy on climate change adaptation. These six components include:

1. Integration of Science into Adaptation Decisions and Policy
2. Communications and Capacity-building
3. Coordination and Collaboration
4. Prioritization
5. A Flexible Framework for Agencies
6. Evaluation

The Interim Progress Report is available for 60 days of public comment. Submit your comment here.

Workgroups

The Interagency Climate Change Adaptation Task Force formed workgroups to consider the capabilities of the Federal Government to respond to the impacts of climate change on various critical sectors, institutions, and agency mission responsibilities. Five initial workgroups began by reviewing existing policies, operations, procedures, and other tools that affect the Federal Government's response, and will suggest options for improving the government's capacity for adaptation to climate change. The five initial workgroups are focused on the following topics:

- **Agency Adaptation**: Develop recommendations on how agencies should plan and implement adaptation
- **Science Inputs to Policy**: Develop recommendations to couple the production of scientific and technical support to adaptation planning, prioritization, and resilience building within the USG, in the US, and internationally
- **Insurance**: Develop recommendations on opportunities for the United States Government to support insurance and adaptation issues
- **Water Resources Adaptation**: Develop recommendations on how Federal water management agencies should plan and implement adaptation actions related to climate impacts on water resources
- **International Resilience**: Develop recommendations on opportunities for the United States Government to support and lead international adaptation efforts

These workgroups have defined their scope and end products, and have begun initial analysis. Most workgroups have used stakeholder listening sessions to solicit feedback from various government and regional actors on adaptation issues within their respective issue area.

Listening Sessions

The five initial Interagency Climate Change Adaptation Task Force workgroups hosted twenty listening sessions with key stakeholders and experts. The listening sessions were designed to engage the expertise and recommendations of external organizations into the workgroup deliberations early in this review process.

Final Product

October 2010, the Task Force will report to the President on the development of domestic and international dimensions of a U.S. approach to climate change adaptation and what Federal Agencies are doing to support this effort. The Task Force also will recommend additional aspects to consider in the development of a comprehensive national strategy.

Progress Report of the Interagency Climate Change Adaptation Task Force

March 16, 2010

Introduction

The impacts of climate change already are being felt across the United States and the entire world. The U.S. Global Change Research Program 2009 report, *Global Climate Change Impacts in the United States*, summarizes the science of climate change and the impacts of climate change on the United States, now, and some of those expected in the future.[1] These impacts will influence how and where we live and work as well as our cultures, health, and environment. In the years and decades to come, they will grow and affect future generations. It is therefore imperative to take action now to adapt to a changing climate. Given the uncertainty of many specific impacts, we also need to build resilience to help minimize the risks associated with climate change and maximize any opportunities that climate change may create.

Continuing to reduce greenhouse gas emissions is critical to limiting the extent of climate change impacts, and resulting damage. The Obama Administration is committed to creating a clean energy economy and mitigating climate change by reducing emissions. While increased mitigation efforts will reduce the effects of climate change, impacts will continue to occur, reinforcing the need for adaptation and a focus on resilience.

> ***Adaptation*** is defined by the Intergovernmental Panel on Climate Change as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."
>
> ***Resilience*** is defined as "the capacity of a system to absorb disturbance and still retain its basic function and structure."

Adaptation and resilience will require a set of thoughtful, preventative actions, measures and investments to reduce the vulnerability of our natural and human systems to climate change impacts. This will require new approaches and preparation, especially at the local level as regional impacts differ greatly. Adaptation and resilience will require action from all segments of society—the public sector, local to Federal government, the private sector, the nonprofit sector and individuals. This challenge provides Federal, Tribal, State, and local governments with significant opportunities for innovation.

Process

The U.S. Global Change Research Act of 1990 established the U.S. Global Change Research Program (USGCRP) "to understand, assess, predict, and respond to human-induced and natural processes of global change." For more than 20 years, the USGCRP has been effectively delivering on understanding and predicting climate change. To further advance and coordinate Federal agency efforts to assess and respond, the USGCRP is currently conducting a national climate assessment and developing the research and science necessary to support a Federal adaptation strategy.

In parallel and in coordination with USGCRP, the White House Council on Environmental Quality (CEQ), the White House Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA) convened the Interagency Climate Change Adaptation Task Force to begin to develop Federal recommendations for adapting to climate change impacts both domestically and internationally. More than twenty Federal Agencies, Departments and Offices are participating in this Task Force and contributing their operational capabilities and expertise through a series of workgroups, coordinated with USGCRP, on specific topics related to climate change adaptation.[ii] President Obama placed special emphasis on adaptation when he ordered, on October 5, 2009, the establishment of an integrated strategy towards sustainability in the Federal Government. Part of this order referenced the work of the Task Force and called on it to report to him within a year on Agency actions in support of developing the domestic and international dimensions of a U.S. strategy for adaptation to climate change.

Goals of the interagency adaptation work include:

- Forming recommendations toward a national adaptation strategy that uses a set of best practices derived from the best available science and the experience and knowledge of governments and stakeholder groups across the United States and abroad.
- Integrating climate change resilience and adaptive capacity into Federal government operations, and coordinating interagency preparations for climate change impacts with domestic and international activities.
- Broadening the understanding of vulnerability to climate impacts, equipping communities with information to use in local adaptation policies, and learning from communities who have taken steps to adapt.

As required by Executive Order 13514, the Interagency Climate Change Adaptation Task Force will deliver a report to the President in the Fall of 2010. The report will detail the development of domestic and international dimensions of a U.S. strategy for adaptation to climate change, agency actions in support of that strategy development process, and recommendations for any further measures to advance towards a national strategy. The Task Force will not, however, deliver a complete U.S. adaptation strategy to the President.

Five workgroups (on science inputs to adaptation, agency process, water resource management, insurance, and international assistance) are currently reviewing existing policies, operations,

procedures, and other tools that affect the Federal government's ability to respond to and prepare for climate impacts. These workgroups will suggest options for improving the government's adaptive capacity as climate change continues. To date, the workgroups have reviewed relevant literature, analyzed existing agency adaptation activities, and conducted listening sessions with external groups and experts on managing climate impacts and adaptation efforts. Case studies, legislative proposals, and comparisons of other governments' approaches are also being reviewed and considered.

Progress to Date

The Task Force has found that climate change is affecting, and will continue to affect, nearly every aspect of our society and the environment. Some of the impacts are increased severity of floods, droughts, and heat waves, increased wildfires, and sea level rise. Climate change impacts are pervasive, wide-ranging and affect the core systems of our society: transportation, ecosystems, agriculture, business, infrastructure, water, and energy, among others. Climate change already is affecting the ability of Federal agencies to fulfill their missions. As a result of these changes, U.S. government interests, missions and operations must adapt to climate change and build resilience. It is imperative that adaptation to climate change and building resilience both help to manage climate change risks to human well-being and ecosystems and take advantage of the opportunities created by climate change. Both domestically and internationally, the U.S. government must better understand how to build resilience to climate change risks and adapt to its effects in order to make wise investments and effective policies. The U.S. government also will need to help support local, regional and international adaptation and resilience efforts.

The Task Force has found that there already is substantial U.S. government and non-government activity towards adapting and building resilience to climate change risks. Current activities include landscape conservation cooperatives supported by the Department of the Interior, to a comprehensive risk assessment of Gulf Coast transportation infrastructure by the Department of Transportation, to the Environmental Protection Agency's efforts to support local decision-makers through Climate Ready Estuaries and the Climate Ready Water Utilities Working Group, and the Department of Energy's research and development to reduce water intensity of energy technologies. However, there still are significant gaps in the U.S. government's approach to climate change adaptation and building resilience. These include:

- Coherent research programs to identify and describe regional impacts associated with near-term, long-term, and abrupt global climate change
- Relevant climate change and impact information that is accessible and usable by decision-makers and practitioners
- A unified strategic vision and approach
- Understanding of the challenges at all levels of government
- Comprehensive and localized risk and vulnerability assessments
- Organized and coordinated efforts across local, State and Federal agencies

- Strong links between, and support and participation of, Tribal, regional, State, and local partners
- A strategy to link resources, both financial and intellectual, to critical needs
- A robust approach to evaluating and applying lessons learned

A national strategy for climate change adaptation and resilience would help address these gaps. The strategy should emphasize two major changes in the way the U.S. government operates. First, agency climate change adaptation and resilience requires a flexible, forward thinking approach. This represents a shift away from using past conditions as indicators of the future, and a requirement for on-going investigation, revision and adaptive management. Second, responses to climate change challenges and opportunities should be integrated into current plans, processes and approaches of the U.S. government. This integration will allow adaptation and building resilience to become part of existing activities, and to be considered within the context of the broader system of stresses, risks and opportunities.

The approach to developing a national strategy should be guided by a set of principles informed by the Task Force's work to date. The national strategy should emphasize planning and preparation, ensuring the engagement of stakeholders, including States, Tribes, local governments, the private sector and non-government institutions, and understanding and accommodating differing vulnerabilities across people and places. It should include a systemic approach to the problem, considering how a range of risks and opportunities interact, as well as how existing and potential stresses reduce or amplify these risks and opportunities. Environmental sustainability and coordination with greenhouse gas mitigation efforts also are critical to national adaptation efforts.

At a minimum, a national strategy should include the following six elements:

1. **Science Inputs to Adaptation Decisions and Policy.** In making recommendations toward a national strategy, the Task Force may recommend approaches for coordinating, developing, distributing and integrating science, from physical to socioeconomics, into all aspects of adaptation. Managers and planners need to understand how to best access and take advantage of science as improvements are made to guidance, standards, and best practices. Integrating science into the decision-making process will allow us to confront uncertainty about future outcomes with improved information about risks and opportunities.

   Adaptation capacity also can be enhanced through participatory processes, improved communication, and better access to improved science translated for users. Finally, institutional changes are needed to enable the use of science that informs adaptation, including the translation of this science into decision-support tools and policy. The Task Force may develop recommendations on advancing and integrating science for users and increasing coordination with research communities.

2. **Communications and Capacity-building.** A key communications goal is to build awareness and engage relevant stakeholders in developing adaptation approaches and ensuring the success of adaptation efforts. Additional capacity also will be required at multiple levels, within and outside of local, State and Federal governments, which will be essential for sustained adaptation and resilience. The Task Force may develop recommendations on communicating climate change impacts, adaptation, and resilience and on building capacity within the U.S. government, including prioritizing opportunities for additional training and resources.

3. **Coordination and Collaboration.** Adaptation to climate change and building resilience will require collaboration and coordination between U.S. government entities. It is also critical to engage local stakeholders, including States, Tribes, local governments, the private sector and non-government institutions. A formal approach, with clear processes and facilitation, is required to ensure that this coordination and collaboration occurs. The Task Force may develop recommendations for structuring the national adaptation strategy within the Federal government and for increasing and improving coordination and collaboration across the government and with partners. Where appropriate, the Task Force may recommend approaches to address existing policies or public sector programs that work at cross-purposes with efforts to build resilience or adapt to climate change, including those that subsidize behavior or investments that increase vulnerability to climate risks.

4. **Prioritization:** Since climate change has multiple impacts and resources are limited, it will be critical to identify priority areas for a coordinated government response. The Task Force may consider and make recommendations on how to identify priorities; this discussion of how to identify priorities could include such criteria as the presence of co-benefits and resource needs for the areas. Combined with the structural elements of a national adaptation strategy, these priorities will require coordinated planning, and in some cases, collaborative actions. The Task Force has begun work on several areas that may require a coordinated government response, and is developing recommendations for water resource management and for international adaptation and resilience.

    - Recommendations for water resource management may include those addressing: coordinated planning and evaluation for water resources adaptation and resilience; water resources and climate change data; assessing vulnerability of water resources to climate change; water use efficiency; integrated water resources management; and education of water resource managers.

    - Recommendations for international adaptation may include those addressing: increasing the integration of adaptation into existing inter-agency international efforts; increasing coordination among U.S. government agencies on international adaptation and increasing collaboration with international partners to build knowledge, increasing

the harmonization of efforts, more effectively supporting multilateral organizations, and further developing the role of the private sector.

Additional areas will be added as the Task Force continues its work.

5. **A Flexible Framework for Agencies.** U.S. government agencies and entities need a consistent but flexible framework to understand, analyze, and respond to climate change challenges and opportunities. Adapting to climate change and building resilience requires planning within and across agencies. There is no single planning approach appropriate for all agencies, but each should use a consistent framework to facilitate coordination across agencies and allow agencies to leverage common tools and methods. This flexible framework will help agencies identify and address climate vulnerabilities and opportunities and build resilience to climate change.

   The framework includes a set of principles to guide agency adaptation and resilience activities, an approach to climate change adaptation and resilience agency planning, and a proposed set of government-wide priorities to support the effective implementation of the planning framework. Critical components of the planning approach are: building agency skills and capacity; developing an adaptation mandate with success measures; assessing the substantial risks, vulnerabilities, and opportunities posed by climate change; developing adaptation and resilience-building actions; and assessing the results and learning from the process to improve future adaptation and resilience.

   Implementing the framework will require a focus on common tools and information. These tools could include common scenario-based analyses, integrated climate change database management, or new modeling tools that match downscaled climate information with other data collected by individual agencies such as demographics, land use, or energy production. The Task Force may implement agency pilots to further develop and test the framework, and will continue to develop recommendations on the common tools required to support implementation.

6. **Evaluation.** Adaptation to climate change and building resilience must come with a commitment to dynamic engagement, iterative understanding of results, and rigorous evaluation. Though the evidence base for many stressors influenced by climate change is established, assumptions and models for implementation and evaluation have to change as scientific knowledge increases and the climate continues to change. Also, lessons learned and information collected in one effort may contain useful lessons for others.

   Adaptation plans must allow for a "feedback" mechanism, whereby new information, lessons learned, and modified priorities can be incorporated into ongoing adaptation processes. Evaluation and lessons learned will help provide clear guidance for decision-making that enhances adaptation and resiliency. The Task Force may develop recommendations on how to evaluate the success of adaptation and resilience building efforts.

Next Steps

Over the next seven months, the Interagency Climate Change Adaptation Task Force may refine recommendations around structural issues such as improving and integrating science results in developing policy and a framework for Federal agency adaptation, as well as cross-cutting topics, including water resources management and international adaptation. The Task Force also may establish additional workgroups, in cooperation with USGCRP, including those to inform the development of a national strategy in the areas of communications and capacity-building, coordination and collaboration across government and with partners, evaluation and learning, and other priority issues. Through a series of regional outreach meetings and pilot activities, the Task Force will continue moving towards recommendations on the development of a national strategy on climate change adaptation.

This report is available and public comment is being accepted on our website at www.whitehouse.gov/ceq/initiatives/adaptation.

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[i] Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas c. Peterson, (eds.). Cambridge University Press, 2009.

[ii] USDA, DOC, DOD, DOEd, DOE, HHS, DHS, HUD, DOI, DOS, DOT, Treasury, USAID, EPA, NASA, NIC, CEQ, OECC, OSTP, NSC, OMB, CEA, NEC.

Reference Material (File 2)

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7.

Information on the Arctic Marine Shipping Assessment

AMSA Executive Summary with Recommendations

The Arctic is undergoing extraordinary transformations early in the 21st century. Natural resource development, governance challenges, climate change and marine infrastructure issues are influencing current and future marine uses of the Arctic. The Arctic Council, recognizing these critical changes and issues, at the November 2004 Ministerial meeting in Reykjavik, Iceland, called for the Council's Protection of the Arctic Marine Environment (PAME) working group to "conduct a comprehensive Arctic marine shipping assessment as outlined under the Arctic Marine Strategic Plan (AMSP) under the guidance of Canada, Finland and the United States as lead countries and in collaboration with the Emergency Prevention, Preparedness and Response (EPPR) working group and the Permanent Participants as relevant." *The Arctic Marine Shipping Assessment*, or *The AMSA 2009 Report*, is the product of that Arctic Ministerial decision in Reykjavik and was approved at the 2009 Ministerial meeting in Tromsø.

The decision to conduct the AMSA followed the release in 2004 of two relevant Arctic Council reports. First, the Arctic Climate Impact Assessment (ACIA) was a major study that received global attention and reported on the rapid and severe climate change ongoing in the Arctic. One of the key findings of the ACIA was that "reduced sea ice is very likely to increase marine transport and access to resources." The second report, the Arctic Marine Strategic Plan (AMSP), presented the council's strategic goals for protecting the Arctic marine environment. The AMSP called for future application of an ecosystems approach to the Arctic Ocean and for a comprehensive assessment of Arctic marine shipping.

The AMSA is designed to be circumpolar in breadth and also to consider regional and local perspectives. The assessment's central focus is on ships: their uses of the Arctic Ocean, their potential impacts on humans and the Arctic marine environment and their marine infrastructure requirements. The AMSA does not place a

primary focus on determining the operational and economic viabilities of specific marine routes within and across the Arctic Ocean.

The AMSA, led by Canada, Finland and the United States, reached out to a broad community, including the global maritime community consisting of shipping companies, ship designers, shipbuilders, ship classification societies, marine insurers, non-commercial partnerships and shipping associations. With the support of the Permanent Participants (indigenous organizations) of the Arctic Council, town hall meetings were held in selected Arctic communities in Canada, Iceland, Norway and the United States to listen to issues and concerns about future Arctic marine activity. The AMSA linked directly with experts of PAME for marine environmental protection issues and overall guidance and leadership of the AMSA. Two additional Arctic Council working groups were also consulted: the Emergency Prevention, Preparedness and Response (EPPR) working group on spill response and marine infrastructure requirements; and the Sustainable Development Working Group (SDWG) on issues related to the human dimension.

All ship types are considered in the AMSA under the general topic of Arctic shipping: tankers, bulk carriers, offshore supply vessels, passenger ships, tug/barge combinations, fishing vessels, ferries, research vessels and government and commercial icebreakers. The result of the AMSA data survey effort produced a comprehensive estimate of how many ships (less naval vessels) operated in the Arctic for a given year. This survey represents an historic capture of information from the Arctic states that can be used as a long-term database against which to measure future Arctic marine traffic levels. In addition, more than 185 experts participated directly in the work of the AMSA. Thirteen major AMSA workshops were held from July 2006 through October 2008 on a broad range of relevant topics, including scenarios of future Arctic navigation, indigenous marine use, Arctic marine incidents, environmental impacts, marine infrastructure, Arctic marine technology and the future of the Northern Sea Route and adjacent seas. The AMSA workshops provided extensive information for developing the report sections.

Synopsis of the Assessment Findings

The AMSA 2009 Report is focused on current and future Arctic marine activity. The results of this comprehensive assessment are a range of key findings linked to the main topics identified. These findings are listed in full throughout *The AMSA 2009 Report* at the end of each section. Presented here is a synopsis, or review, of the AMSA findings for each section.

Arctic Marine Geography, Climate and Sea Ice: Arctic sea ice has been observed to be decreasing in extent and thickness during the second half of the 20th century and early 21st century. Global Climate Model simulations indicate a continuing retreat of sea ice, but also show that the winter sea ice cover will remain. There is a possibility of an ice-free Arctic Ocean for a short period in summer perhaps as early as 2015. This would mean the disappearance of multi-year ice, as no sea ice would survive the summer melt season. It is highly plausible there will be greater marine access and longer seasons of navigation, except perhaps during winter, but not necessarily less difficult ice conditions for marine operations.

History of Arctic Marine Transport: There is a long history of Arctic marine transport conducted primarily around the ice-free periphery of the Arctic Ocean. Year-round navigation has been maintained since 1978-79 in the ice-covered western regions of the Northern Sea Route (between the port of Dudinka on the Yenisei River and Murmansk). Previous Arctic marine transport studies for the Northern Sea Route, Canadian Arctic, Alaska's coastal seas and other regions have significant relevance to developing any future regulatory framework for the Arctic Ocean. Most of these past studies involved public-private partnerships and close international cooperation.

Governance of Arctic Shipping: The Law of the Sea as reflected in the *United Nations Convention on the Law of the Sea* (UNCLOS) provides a fundamental framework for the governance of Arctic marine navigation and allows coastal states the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered waters (Article 234). The International Maritime Organization (IMO) is the competent UN agency with responsibility for issues related to the global maritime industry. IMO has been proactive in developing voluntary *Guidelines for Ships Operating in Arctic Ice-covered Waters*, which continue to evolve. The International Association of Classification Societies (IACS) has also developed non-mandatory Unified Requirements for their members that address ship construction standards of the *Polar Classes*, which are defined in the IMO Guidelines. There are no uniform, international standards for ice navigators and for Arctic safety and survival for seafarers in polar conditions. And, there are no specifically tailored, mandatory environmental standards developed by IMO for vessels operating in Arctic waters. Mandatory measures, drawn up in accordance with the provisions of customary international law as reflected in UNCLOS, would be an effective way to enhance marine safety and environmental protection in Arctic waters. Expanded Arctic marine traffic increases the possibility of, for example, introducing alien species and pathogens from ballast water discharge and hull fouling.

Current Marine Use and the AMSA Shipping Database: There were approximately 6,000 individual vessels, many making multiple voyages, in the Arctic region during the AMSA survey year; half of these were operating on the Great Circle Route in the North Pacific that crosses the Aleutian Islands. Of the 6,000 vessels reported, approximately 1,600 were fishing vessels. Nearly all shipping in the

Arctic today is destinational, conducted for community re-supply, marine tourism and moving natural resources out of the Arctic. Regions of high concentrations of Arctic marine activity occur along the coasts of northwest Russia, and in the ice-free waters off Norway, Greenland, Iceland and in the U.S. Arctic. Significant increases in cruise ships, a majority not purpose-built for Arctic waters, have been observed in the summer season around Greenland within the past decade. There have been recent marine operations in the ice-covered central Arctic Ocean for scientific exploration and marine tourism.

Scenarios, Futures and Regional Futures to 2020: Arctic natural resource development (hydrocarbons, hard minerals and fisheries) and regional trade are the key drivers of future Arctic marine activity. However, there are many other factors and uncertainties of importance including governance, Arctic state cooperation, oil prices, changes in global trade, climate change variability, new resource discoveries, marine insurance industry roles, multiple use conflicts and Arctic marine technologies. Future Arctic marine activity will include many non-Arctic stakeholders, multiple users in Arctic waterways and potential overlap of new operations with indigenous uses. Arctic voyages through 2020 will be overwhelmingly destinational, not trans-Arctic. A lack of major ports, except for those in northern Norway and northwest Russia, and other critical infrastructure will be significant limitations for future Arctic marine operations. The Bering Strait region, ringed with indigenous communities and a highly productive ecosystem with many species of marine mammals, fish and seabirds, may require formally established vessel routing measures. Offshore hydrocarbon developments may lead to increased marine traffic in the Bering Strait region. For the Canadian Arctic, the Northwest Passage is not expected to become a viable trans-Arctic route through 2020, but destinational shipping is anticipated to increase. Marine transportation of oil from the Pechora Sea to Europe is considered technically and economically feasible; the volume of oil and gas may be as high as 40 million tons per year by 2020 on the western Northern Sea Route.

Human Dimensions: Marine shipping is one of many factors impacting Arctic communities. There may be some positive economic impacts to increased shipping. However, Arctic residents express concern for the social, cultural and environmental effects of such expansion. The possibility of oil spills is a major concern and hunters are especially concerned about the disruption of marine species and their hunting practices. The costs and benefit of Arctic shipping will likely be unevenly distributed among and within communities and regions. Constructive and early engagement of local residents in planned Arctic marine development projects can help to reduce negative impacts and to increase positive benefits. Importantly, many local Arctic residents today depend heavily on marine resources for subsistence and the local economy; over-the-ice travel and boat transport allow the use of large marine areas during much of the year. Such life in the Arctic is dependent on movement over the ice and ocean and sea ice is integral to this movement.

Environmental Considerations and Impacts: The most significant threat from ships to the Arctic marine environment is the release of oil through accidental or illegal discharge. Additional potential impacts of Arctic ships include ship strikes on marine mammals, the introduction of alien species, disruption of migratory patterns of marine mammals and anthropogenic noise produced from marine shipping activity. Changes in Arctic sea ice will not only provide for possible longer seasons of navigation, but may also result in increased interaction between migrating species and ships. Black carbon emissions from ships operating in the Arctic may have regional impacts by accelerating ice melt. Other ship emissions during Arctic voyages, such as SOx and NOx, may have unintended consequences for the Arctic environment and these emissions may require the implementation of additional IMO environmental regulations.

Arctic Marine Infrastructure: There is a general lack of marine infrastructure in the Arctic, except for areas along the Norwegian coast and northwest Russia, compared with other marine regions of the world with high concentrations of ship traffic. Gaps in hydrographic data exist for significant portions of primary shipping routes important to support safe navigation. In addition, for safe operations in the Arctic there is a need for the same suite of meteorological and oceanographic data, products and services as in other oceans, plus comprehensive information on sea ice and icebergs. Except in limited areas of the Arctic, there is a lack of emergency response capacity for saving lives and for pollution mitigation. There are serious limitations to radio and satellite communications and few systems to monitor and control the movement of ships in ice-covered waters. The current lack of marine infrastructure in all but a limited number of areas, coupled with the vastness and harshness of the environment, makes conduct of emergency response significantly more difficult in the Arctic.

The Arctic Marine Shipping Assessment Recommendations

The focus of the AMSA is marine safety and marine environmental protection, which is consistent with the Arctic Council's mandates of environmental protection and sustainable development. Based on the findings of the AMSA, recommendations were developed to provide a guide for future action by the Arctic Council, Arctic states and many others. The AMSA recommendations are presented under three broad, inter-related themes that are fundamental to understanding the AMSA: Enhancing Arctic Marine Safety, Protecting Arctic People and the Environment, and Building Arctic Marine Infrastructure. It is recognized that implementation of these recommendations could come from the Arctic states, industry and/or public-private partnerships.

I. Enhancing Arctic Marine Safety

A. Linking with International Organizations: That the Arctic states decide to, on a case by case basis, identify areas of common interest and develop unified positions and approaches with respect to international organizations such as: the International Maritime Organization (IMO), the International Hydrographic Organization (IHO), the World Meteorological Organization (WMO) and the International Maritime Satellite Organization (IMSO) to advance the safety of Arctic marine shipping; and encourage meetings, as appropriate, of member state national maritime safety organizations to coordinate, harmonize and enhance the implementation of the Arctic maritime regulatory framework.

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---Support the updating and the mandatory application of relevant parts of the *Guidelines for Ships Operating in Arctic Ice-covered Waters* (Arctic Guidelines); and,

---Drawing from IMO instruments, in particular the Arctic Guidelines, augment global IMO ship safety and pollution prevention conventions with specific mandatory requirements or other provisions for ship construction, design, equipment, crewing, training and operations, aimed at safety and protection of the Arctic environment.

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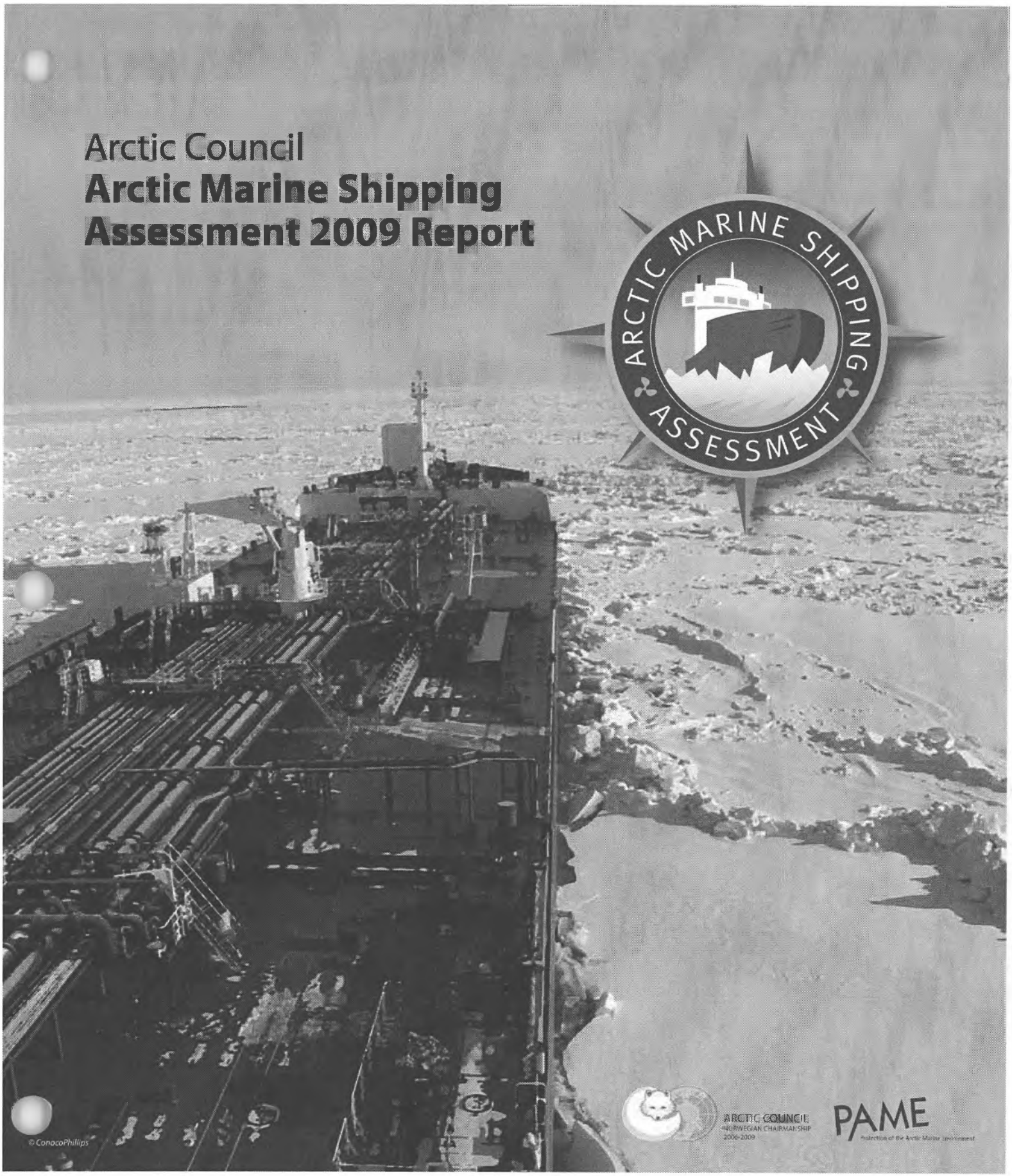
III. Building the Arctic Marine Infrastructure

A. Addressing the Infrastructure Deficit: That the Arctic states should recognize that improvements in Arctic marine infrastructure are needed to enhance safety and environmental protection in support of sustainable development. Examples of infrastructure where critical improvements are needed include: ice navigation training; navigational charts; communications systems; port services, including reception facilities for ship-generated waste; accurate and timely ice information (ice centers); places of refuge; and icebreakers to assist in response.

B. Arctic Marine Traffic System: That the Arctic states should support continued development of a comprehensive Arctic marine traffic awareness system to improve monitoring and tracking of marine activity, to enhance data sharing in near real-time, and to augment vessel management service in order to reduce the risk of incidents, facilitate response and provide awareness of potential user conflict. The Arctic states should encourage shipping companies to cooperate in the improvement and development of national monitoring systems.

C. Circumpolar Environmental Response Capacity: That the Arctic states decide to continue to develop circumpolar environmental pollution response capabilities that are critical to protecting the unique Arctic ecosystem. This can be accomplished, for example, through circumpolar cooperation and agreement(s), as well as regional bilateral capacity agreements.

D. Investing in Hydrographic, Meteorological and Oceanographic Data: That the Arctic states should significantly improve, where appropriate, the level of and access to data and information in support of safe navigation and voyage planning in Arctic waters. This would entail increased efforts for: hydrographic surveys to bring Arctic navigation charts up to a level acceptable to support current and future safe navigation; and systems to support real-time acquisition, analysis and transfer of meteorological, oceanographic, sea ice and iceberg information.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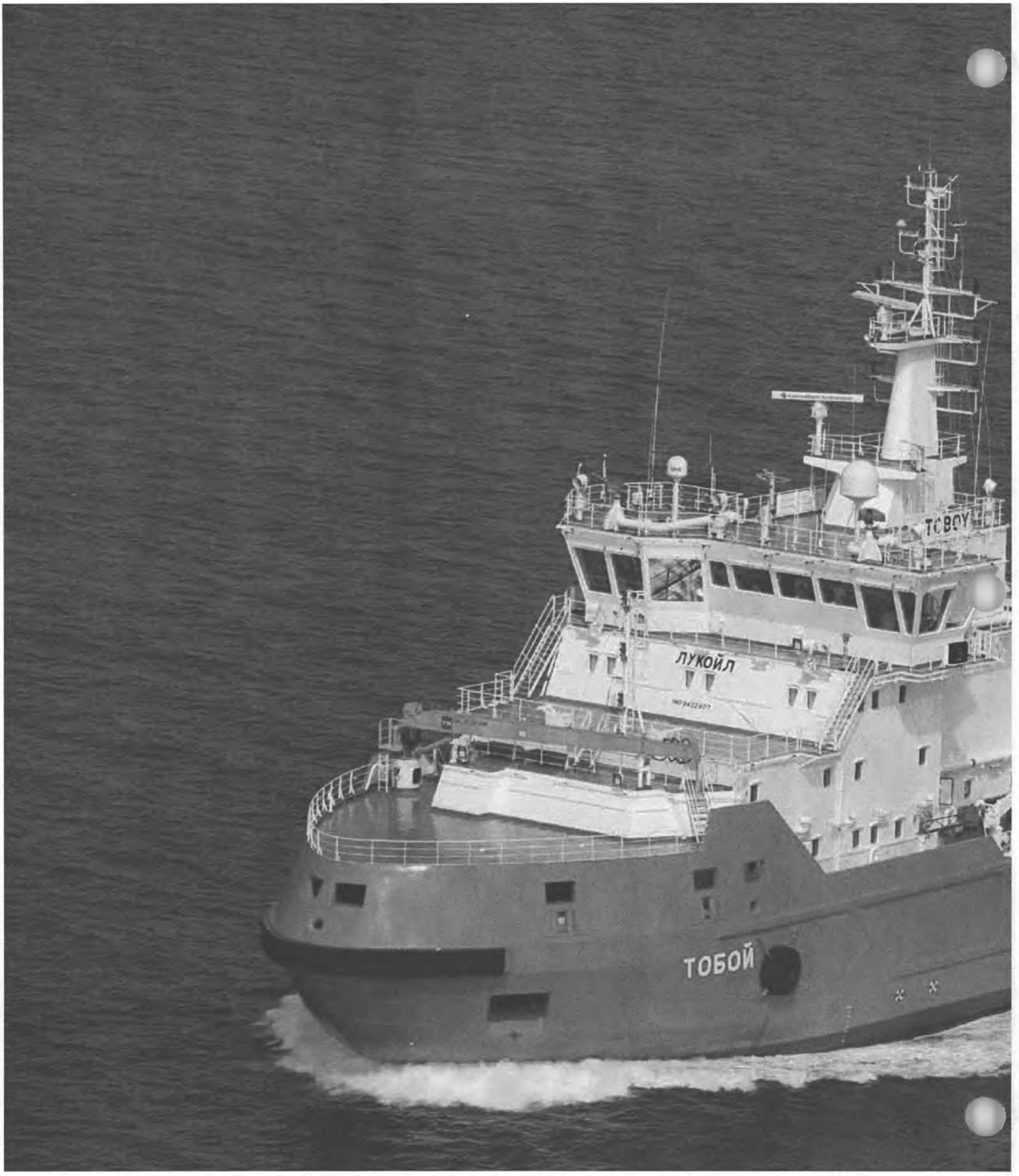
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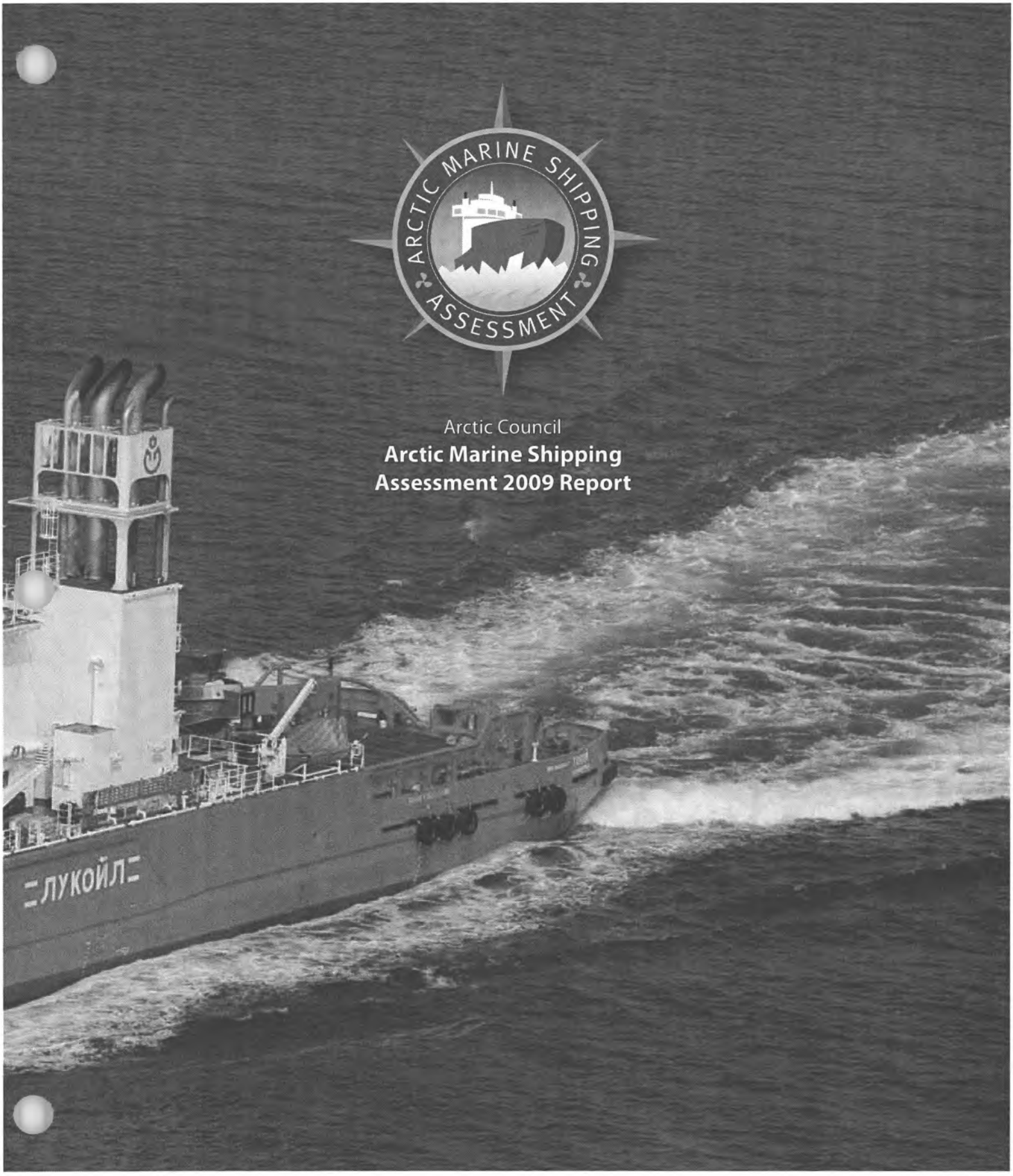
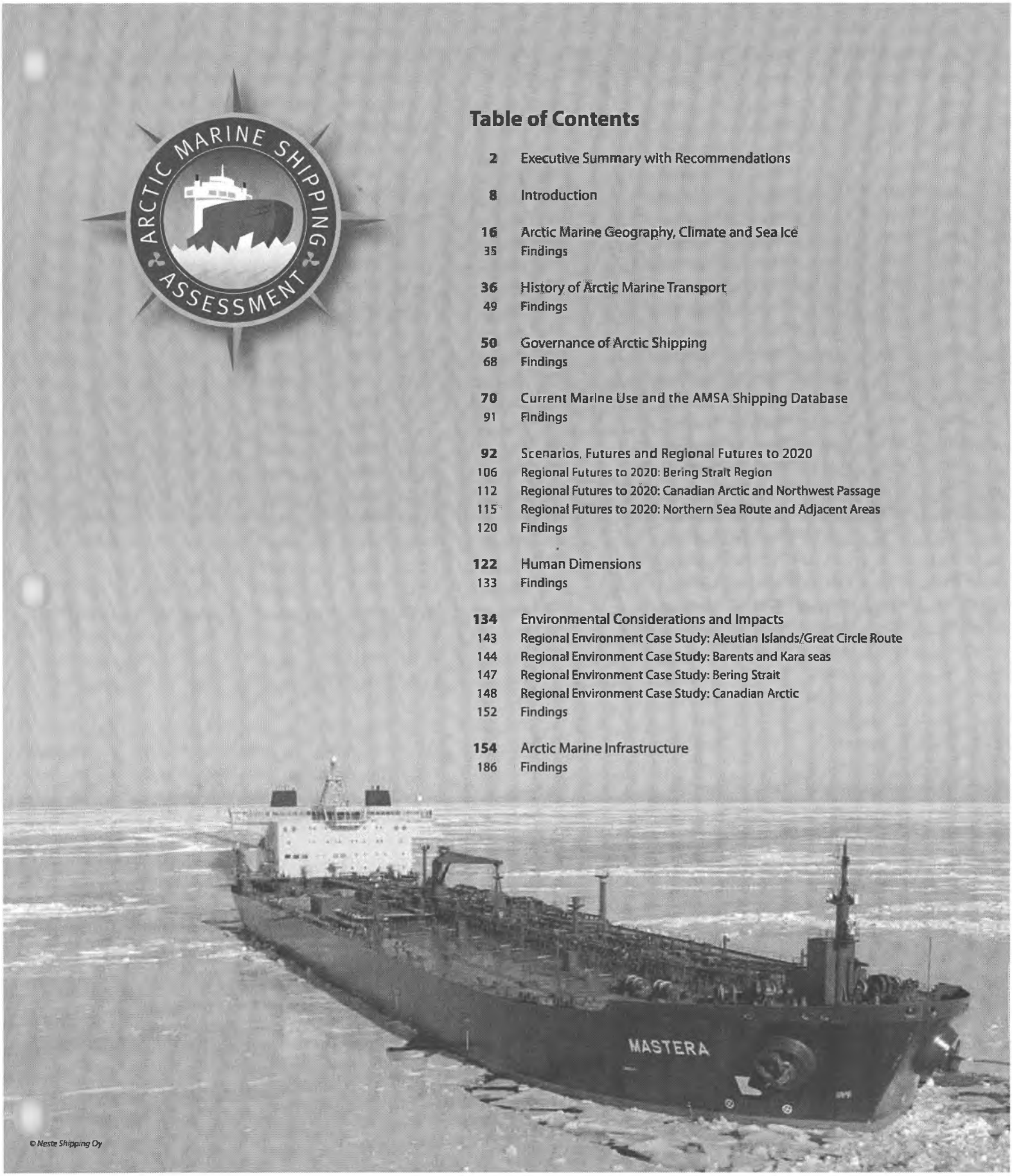


Arctic Council

Arctic Marine Shipping Assessment 2009 Report

Guide to Acronyms and Abbreviations

ACRONYM	DEFINITION
ACIA	Arctic Climate Impact Assessment
AIS	Automatic Identification System
AMAP	Arctic Monitoring and Assessment Programme (Arctic Council working group)
AMSA	Arctic Marine Shipping Assessment
AMVER	Automated Mutual-Assistance Vessel Rescue System
ARCOP	Arctic Operational Platform
ATON	Aid to Navigation
AWPPA	*Arctic Waters Pollution Prevention Act* (Canada)
CCG	Canadian Coast Guard
CFC	chlorofluorocarbon
CH4	methane
CNIIMF	Central Marine Research & Design Institute (Russian Federation)
CO	carbon monoxide
CO2	carbon dioxide
COLREG	*Convention on the International Regulations for Preventing Collisions at Sea, 1972*
DEW	Distant Early Warning Line
DWT	deadweight tonnage
ECDIS	Electronic Chart Display and Information System
EEZ	Exclusive Economic Zone
EPPR	Emergency Prevention, Preparedness and Response (Arctic Council working group)
EU	European Union
GCM	Global Climate Model
GHG	greenhouse gas
GIS	Geographic Information System
GPS	Global Positioning System
HF	high frequency
IAATO	International Association of Antarctic Tour Operators
IACS	International Association of Classification Societies
ICC	Inuit Circumpolar Council
IHO	International Hydrographic Organization
IMO	International Maritime Organization
INSROP	International Northern Sea Route Programme
IPCC	Intergovernmental Panel on Climate Change
kW	kilowatt (1,000 watts)
LME	Large Marine Ecosystem
LNG	liquefied natural gas
LPG	liquefied petroleum gas
M/V	Motor Vessel
MARPOL 73/78	*International Convention for the Prevention of Pollution from Ships, 1973 as Modified by the Protocol of 1978 Relating Thereto*
MF	medium frequency
MMT	million metric ton
MPA	marine protected area
NEP	Northeast Passage
NGO	non-governmental organization
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration (U.S.)
NOx	nitrogen oxide
NSR	Northern Sea Route
NWP	Northwest Passage
PAME	Protection of the Arctic Marine Environment (Arctic Council working group)
POP	persistent organic pollutant
ppm	parts per million
PSSA	Particularly Sensitive Sea Area
RACON	radar beacon
RORO	roll on, roll off (type of cargo ship)
SAR	search and rescue
shp	shaft horsepower
SOLAS	*International Convention on Safety of Life at Sea, 1974*
SOx	sulfur oxide
STCW	*International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978*
TDW	tonnage draft weight
TEU	twenty-foot equivalent (measure used in container shipping)
UNCLOS	*United Nations Convention on the Law of the Sea, 1982*
USCG	United States Coast Guard
VHF	very high frequency
VTS	Vessel Traffic Service
WMO	World Meteorological Organization



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AMSA Executive Summary with Recommendations

The Arctic is undergoing extraordinary transformations early in the 21st century. Natural resource development, governance challenges, climate change and marine infrastructure issues are influencing current and future marine uses of the Arctic. The Arctic Council, recognizing these critical changes and issues, at the November 2004 Ministerial meeting in Reykjavik, Iceland, called for the Council's Protection of the Arctic Marine Environment (PAME) working group to "conduct a comprehensive Arctic marine shipping assessment as outlined under the Arctic Marine Strategic Plan (AMSP) under the guidance of Canada, Finland and the United States as lead countries and in collaboration with the Emergency Prevention, Preparedness and Response (EPPR) working group and the Permanent Participants as relevant." *The Arctic Marine Shipping Assessment*, or *The AMSA 2009 Report*, is the product of that Arctic Ministerial decision in Reykjavik and was approved at the 2009 Ministerial meeting in Tromsø.

The decision to conduct the AMSA followed the release in 2004 of two relevant Arctic Council reports. First, the Arctic Climate Impact Assessment (ACIA) was a major study that received global attention and reported on the rapid and severe climate change ongoing in the Arctic. One of the key findings of the ACIA was that "reduced sea ice is very likely to increase marine transport and access to resources." The second report, the Arctic Marine Strategic Plan (AMSP), presented the council's strategic goals for protecting the Arctic marine environment. The AMSP called for future application of an ecosystems approach to the Arctic Ocean and for a comprehensive assessment of Arctic marine shipping.

The AMSA is designed to be circumpolar in breadth and also to consider regional and local perspectives. The assessment's central focus is on ships: their uses of the Arctic Ocean, their potential impacts on humans and the Arctic marine environment and their marine infrastructure requirements. The AMSA does not place a

primary focus on determining the operational and economic viabilities of specific marine routes within and across the Arctic Ocean.

The AMSA, led by Canada, Finland and the United States, reached out to a broad community, including the global maritime community consisting of shipping companies, ship designers, shipbuilders, ship classification societies, marine insurers, non-commercial partnerships and shipping associations. With the support of the Permanent Participants (indigenous organizations) of the Arctic Council, town hall meetings were held in selected Arctic communities in Canada, Iceland, Norway and the United States to listen to issues and concerns about future Arctic marine activity. The AMSA linked directly with experts of PAME for marine environmental protection issues and overall guidance and leadership of the AMSA. Two additional Arctic Council working groups were also consulted: the Emergency Prevention, Preparedness and Response (EPPR) working group on spill response and marine infrastructure requirements; and the Sustainable Development Working Group (SDWG) on issues related to the human dimension.

All ship types are considered in the AMSA under the general topic of Arctic shipping: tankers, bulk carriers, offshore supply vessels, passenger ships, tug/barge combinations, fishing vessels, ferries, research vessels and government and commercial icebreakers. The result of the AMSA data survey effort produced a comprehensive estimate of how many ships (less naval vessels) operated in the Arctic for a given year. This survey represents an historic capture of information from the Arctic states that can be used as a long-term database against which to measure future Arctic marine traffic levels. In addition, more than 185 experts participated directly in the work of the AMSA. Thirteen major AMSA workshops were held from July 2006 through October 2008 on a broad range of relevant topics, including scenarios of future Arctic navigation, indigenous marine use, Arctic marine incidents, environmental impacts, marine infrastructure, Arctic marine technology and the future of the Northern Sea Route and adjacent seas. The AMSA workshops provided extensive information for developing the report sections.

Synopsis of the Assessment Findings

The AMSA 2009 Report is focused on current and future Arctic marine activity. The results of this comprehensive assessment are a range of key findings linked to the main topics identified. These findings are listed in full throughout *The AMSA 2009 Report* at the end of each section. Presented here is a synopsis, or review, of the AMSA findings for each section.

Arctic Marine Geography, Climate and Sea Ice: Arctic sea ice has been observed to be decreasing in extent and thickness during the second half of the 20th century and early 21st century. Global Climate Model simulations indicate a continuing retreat of sea ice, but also show that the winter sea ice cover will remain. There is a possibility of an ice-free Arctic Ocean for a short period in summer perhaps as early as 2015. This would mean the disappearance of multi-year ice, as no sea ice would survive the summer melt season. It is highly plausible there will be greater marine access and longer seasons of navigation, except perhaps during winter, but not necessarily less difficult ice conditions for marine operations.

History of Arctic Marine Transport: There is a long history of Arctic marine transport conducted primarily around the ice-free periphery of the Arctic Ocean. Year-round navigation has been maintained since 1978-79 in the ice-covered western regions of the Northern Sea Route (between the port of Dudinka on the Yenisei River and Murmansk). Previous Arctic marine transport studies for the Northern Sea Route, Canadian Arctic, Alaska's coastal seas and other regions have significant relevance to developing any future regulatory framework for the Arctic Ocean. Most of these past studies involved public-private partnerships and close international cooperation.

Governance of Arctic Shipping: The Law of the Sea, as reflected in the *United Nations Convention on the Law of the Sea* (UNCLOS), provides a fundamental framework for the governance of Arctic marine navigation and allows coastal states the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered waters (Article 234). The International Maritime Organization (IMO) is the competent UN agency with responsibility for issues related to the global maritime industry. IMO has been proactive in developing voluntary *Guidelines for Ships Operating in Arctic Ice-covered Waters,* which continue to evolve. The International Association of Classification Societies (IACS) has also developed non-mandatory Unified Requirements for their members that address ship construction standards of the *Polar Classes*, which are defined in the IMO Guidelines. There are no uniform, international standards for ice navigators and for Arctic safety and survival for seafarers in polar conditions. And, there are no specifically tailored, mandatory environmental standards developed by IMO for vessels operating in Arctic waters. Mandatory measures, drawn up in accordance with the provisions of customary international law as reflected in UNCLOS, would be an effective way to enhance marine safety and environmental protection in Arctic waters. Expanded Arctic marine traffic increases the possibility of, for example, introducing alien species and pathogens from ballast water discharge and hull fouling.

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H. Reducing Air Emissions: That the Arctic states decide to support the development of improved practices and innovative technologies for ships in port and at sea to help reduce current and future emissions of greenhouse gases (GHGs), Nitrogen Oxides (NOx), Sulfur Oxides (SOx) and Particulate Matter (PM), taking into account the relevant IMO regulations.

III. Building the Arctic Marine Infrastructure

A. Addressing the Infrastructure Deficit: That the Arctic states should recognize that improvements in Arctic marine infrastructure are needed to enhance safety and environmental protection in support of sustainable development. Examples of infrastructure where critical improvements are needed include: ice navigation training; navigational charts; communications systems; port services, including reception facilities for ship-generated waste; accurate and timely ice information (ice centers); places of refuge; and icebreakers to assist in response.

B. Arctic Marine Traffic System: That the Arctic states should support continued development of a comprehensive Arctic marine traffic awareness system to improve monitoring and tracking of marine activity, to enhance data sharing in near real-time, and to augment vessel management service in order to reduce the risk of incidents, facilitate response and provide awareness of potential user conflict. The Arctic states should encourage shipping companies to cooperate in the improvement and development of national monitoring systems.

C. Circumpolar Environmental Response Capacity: That the Arctic states decide to continue to develop circumpolar environmental pollution response capabilities that are critical to protecting the unique Arctic ecosystem. This can be accomplished, for example, through circumpolar cooperation and agreement(s), as well as regional bilateral capacity agreements.

D. Investing in Hydrographic, Meteorological and Oceanographic Data: That the Arctic states should significantly improve, where appropriate, the level of and access to data and information in support of safe navigation and voyage planning in Arctic waters. This would entail increased efforts for: hydrographic surveys to bring Arctic navigation charts up to a level acceptable to support current and future safe navigation; and systems to support real-time acquisition, analysis and transfer of meteorological, oceanographic, sea ice and iceberg information.

INTRODUCTION

The Arctic is regarded as containing some of the last physically undisturbed marine spaces on earth. Early in the 21st century, the Arctic has also been undergoing extraordinary environmental and developmental changes. Long known as a storehouse of untapped natural resources, high commodity prices and a growing worldwide demand in recent years have the Arctic poised as a significant contributor to the global economy. Increasing regional and coastal marine transport to support the exploration and extraction of oil, gas and hard minerals, coupled with the increasing presence of the global marine tourism industry, have brought a complex set of users to the maritime Arctic. The potential impacts of these new marine uses - social, environmental, cultural and economic - are unknown, but will be significant for Arctic indigenous people and the marine environment already undergoing significant changes due to climate change.

Simultaneous with the globalization of the Arctic, marine access in the Arctic Ocean has been changing in unprecedented ways driven by global climate change. Arctic sea ice is undergoing an historic transformation - thinning, extent reduction in all seasons and substantial reductions in the area of multi-year ice in the central Arctic Ocean - which has significant implications for longer seasons of navigation and new access to previously difficult to reach coastal regions. The international scientific community has already taken advantage of these changes through pioneering voyages in the central Arctic Ocean. The same sea ice retreat also has important influences on the regional, Arctic marine ecosystems and future fisheries. Taken together, these changes present increased demands on the existing legal and regulatory structures challenged to meet the needs for enhanced marine safety and environmental protection in the face of increasing Arctic marine activity. Such challenges will

require unprecedented levels of cooperation among the eight Arctic states and broad engagement with many non-Arctic stakeholders within the global maritime industry.

Actions Leading to a Shipping Assessment

The Arctic Council anticipated the need to evaluate current and future increasing use of the Arctic Ocean. In 2002 at the Council's third Ministerial meeting in Inari, Finland, the ministers recognized "that existing and emerging activities in the Arctic warrant a more coordinated and integrated strategic approach to address the challenges of the Arctic coastal marine environment." The ministers agreed to "develop a strategic plan for the protection of the Arctic marine environment under leadership by the Protection of the Arctic Marine Environment (PAME) working group." The Arctic Marine Strategic Plan (AMSP) was developed by PAME and approved by the Arctic Council in 2004. Four strategic goals were outlined in the AMSP: reduce and prevent pollution in the Arctic marine environment; conserve Arctic marine diversity and ecosystem functions; promote the health and prosperity of all Arctic inhabitants; and advance sustainable Arctic marine resource use. The AMSP addressed the need for future application of an ecosystem approach to management of the Arctic marine environment and also called for a comprehensive assessment of Arctic marine shipping.

In November 2004, the Arctic Council released a major study, the Arctic Climate Impact Assessment (ACIA), which received global attention. The ACIA found that the Arctic: is extremely vulnerable to observed and projected climate change; is today experiencing some of the most rapid and severe climate change on Earth; and will experience accelerated climate change during the 21st century. Widespread physical, ecological, social and economic changes, many of which have already begun, were projected. Of particular relevance to marine use and Arctic transport, one of ACIA's 10 Key Findings (#6) stated: "Reduced sea ice is very likely to increase marine transport and access to resources."

Consistent with the work of the AMSP and the ACIA, the Arctic Council Ministers in November 2004 in Reykjavik asked PAME to "conduct a comprehensive Arctic marine shipping assessment as outlined in the Arctic Marine Strategic Plan (AMSP) under the guidance of Canada, Finland and the United States as lead countries and in collaboration with the Emergency Prevention, Preparedness and Response (EPPR) working group of the Arctic Council and Permanent Participants as relevant." AMSA data gathering and planning began in summer 2005.

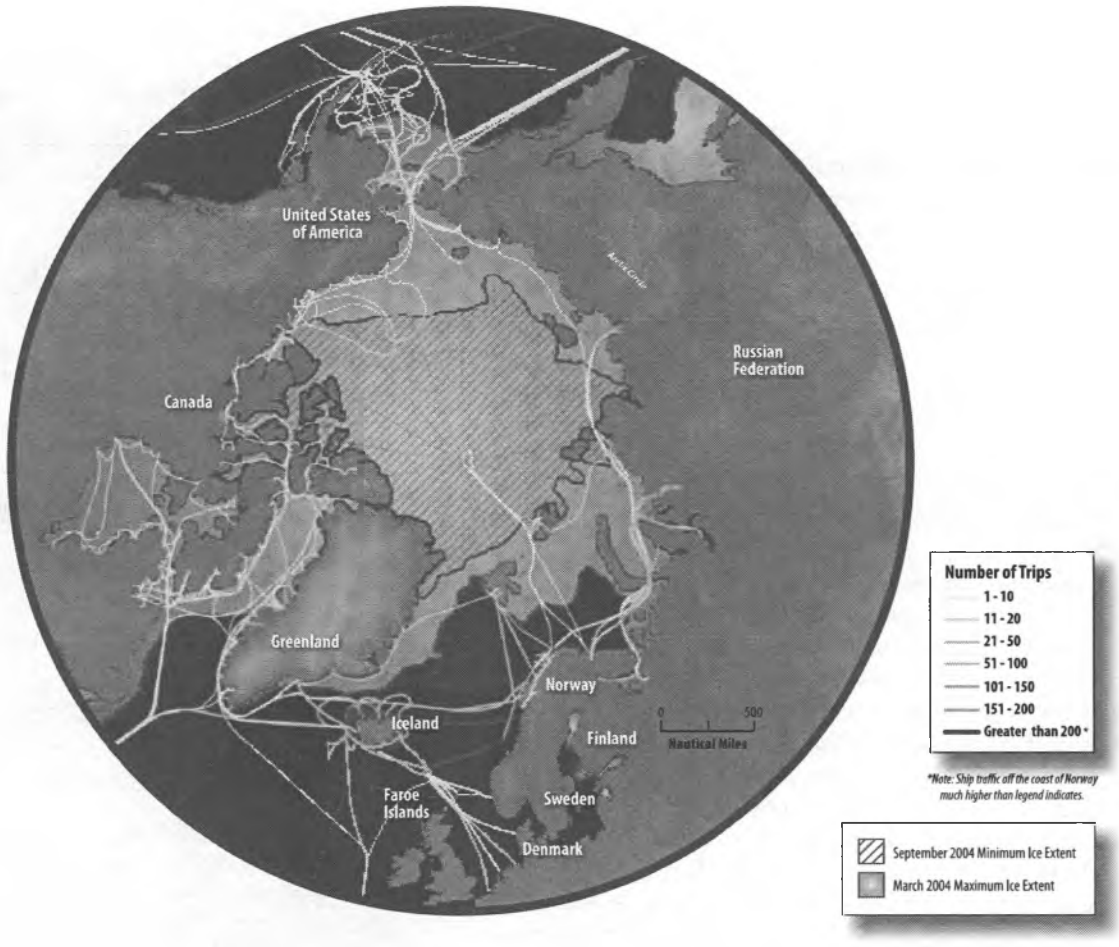
Arctic Council

The Ottawa Declaration of 1996 formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic states, with the express involvement of Arctic indigenous communities and other Arctic inhabitants on common Arctic issues, especially issues of sustainable development and environmental protection in the Arctic.

The Arctic Council is comprised of Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America.

In addition to the member states, the council created the category of Permanent Participants in order to provide for the active participation of, and full consultations with, Arctic indigenous representatives within the council. Open equally to Arctic organizations of indigenous people with a majority of Arctic indigenous constituency, the Permanent Participants represent a single indigenous people resident in more than one Arctic state, or more than one Arctic indigenous people resident in a single Arctic state. The following organizations are Permanent Participants of the Arctic Council: Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit Circumpolar Council, Saami Council and Russian Arctic Indigenous Peoples of the North.

Working groups of the Arctic Council execute the programs and projects mandated by the Arctic Council ministers. Each working group, with its supporting scientific and technical expert groups, holds meetings at regular intervals throughout the year, ahead of the meetings of Senior Arctic Officials and Arctic Council Ministers. The six working groups include: Arctic Contaminants Action Program; Arctic Monitoring and Assessment Programme; Conservation of Arctic Flora and Fauna; Emergency Prevention, Preparedness and Response; Protection of the Arctic Marine Environment; and Sustainable Development Working Group.



Map 1.1 Shipping traffic in the Arctic for survey year 2004. *Source: AMSA*

Focus and Conduct of the Assessment

The focus of the AMSA is marine safety and marine environmental protection, which is consistent with the Arctic Council's mandates of environmental protection and sustainable development. The AMSA was designed to be circumpolar in breadth, but also considers regional and local perspectives where impacts, particularly on Arctic communities, are considered to be greatest. However, the overall scope of the AMSA focuses on ships and their infrastructure needs and impacts in the Arctic Ocean.

The AMSA lead countries (Canada, Finland and the United States) recognized early in the planning the importance of contributions from the broader, global maritime community. Therefore, the AMSA reached out to such key stakeholders as non-Arctic states (examples include the United Kingdom and Germany), shipping companies, ship designers, shipbuilders, ship classification societies, non-commercial partnerships, marine insurers and non-governmental environmental organizations. With the assistance of the Permanent Participants of the Arctic Council, town hall meetings were organized in selected Arctic communities to listen to issues and concerns about future Arctic marine activity. AMSA also linked with the Arctic Council working group experts of the Emergency Prevention, Preparedness and Response (EPPR) working group on issues related to spills, and response infrastructure requirements, and with the Sustainable Development Working Group (SDWG) on issues related to the human dimension.

The AMSA covers all types of marine transport under the general topic of "shipping": tankers, bulk carriers, offshore supply vessels, passenger ships, tug/barge combinations, fishing vessels, ferries, research vessels and government and commercial icebreakers. Knowing the sum of the voyages completed by these different ships will help to understand the potential environmental impacts (especially from discharges and emissions) of Arctic marine shipping operations. An AMSA Database Survey, requesting these ship types, was sent to the Senior Arctic Officials of the Arctic states in February 2006 to obtain the official shipping statistics of each state for the survey year 2004. The objective was to create the first baseline database of all ships (less naval vessels) operating in the Arctic during a single year. Each Arctic state defined its own Arctic waters for the purpose of the AMSA data collection effort. The AMSA data effort yielded an historic survey that provides a comprehensive estimate for how many ships had operated in the Arctic for the survey year.

More than 185 experts participated directly in AMSA. Thirteen major AMSA workshops were held from July 2006 through October 2008; workshop topics included: scenarios of future Arctic navigation; indigenous marine use; Arctic marine incidents; environmental impacts; Arctic marine infrastructure; and the future of the Russian Federation's Northern Sea Route. AMSA town hall meetings were held in northern communities in Canada, Iceland, Norway and the United States. AMSA leads and team members conducted outreach and presented AMSA topics at 56 professional venues throughout the world during 2005-2008.

A large number of source documents were collected from the following activities: the results of the AMSA workshops, reports of the AMSA town hall meetings, the AMSA Data Survey, special reports created by maritime experts, and reviews of AMSA topics drafted by lead and contributing authors. These documents, referred to collectively as the AMSA Research Documents, will be found on the PAME and Arctic Council websites. The AMSA Research Documents represent a significant body of work and, while they have not been reviewed by the Arctic Council, the documents provided the background for drafting the AMSA 2009 Report, which was approved by the Arctic Council Ministers at the 2009 Ministerial meeting in Tromsø, Norway.

Modes of Arctic Marine Transport

In addition to the ship types to be addressed in the assessment, four modes, or types of voyages undertaken in the Arctic Ocean, were identified. They are:

Destinational transport, where a ship sails to the Arctic, performs some activity in the Arctic and sails south. Examples include: large cruise ships sailing from southern ports to the west coast of Greenland in summer; LNG and oil tankers sailing from ports in northern Norway and northwest Russia to world markets; and an icebreaker from Europe conducting scientific operations in the central Arctic Ocean in summer.

Intra-Arctic transport, a voyage or marine activity that stays within the general Arctic region and links two or more Arctic states. A key example is the marine route between the port of Churchill, Manitoba, Canada on Hudson Bay and Murmansk, Russia, touted as an "Arctic-bridge" between the two continents. Two other examples include an Icelandic fishing vessel working in Greenlandic waters, and tug-barge traffic operating between Canada's Northwest Territories and the U.S. Beaufort Sea off the Alaskan coast.

Trans-Arctic transport or navigation, voyages which are taken across the Arctic Ocean from Pacific to Atlantic oceans or vice versa. These are full voyages between the major oceans using the Arctic Ocean as a marine link. There are several options for trans-Arctic navigation.

Cabotage, to trade or marine transport in coastal waters between ports within an Arctic state. A prime example is the year-round traffic between the port of Dudinka on the Yenisei River and Murmansk - Russian-flag ships carrying nickel plates processed at the industrial complex in Norilsk to Murmansk for further distribution to Russian and international markets. Other examples are the summer sealift of cargoes to Canadian Arctic communities from southern Canadian ports and the delivery of consumer goods to Russian Arctic communities using the Northern Sea Route.

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185+
Number of international experts who worked on the AMSA.

The Origin of the AMSA

The Arctic Council Ministers in November 2004 in Reykjavik asked PAME to "conduct a comprehensive Arctic marine shipping assessment as outlined in the Arctic Marine Strategic Plan (AMSP) under the guidance of Canada, Finland and the United States as lead countries and in collaboration with the Emergency Prevention, Preparedness and Response (EPPR) working group of the Arctic Council and Permanent Participants as relevant."

Protection of the Arctic Marine Environment: PAME

PAME is an example of the international cooperation that is a hallmark of the Arctic Council: while the PAME Secretariat is based in Akureyri, Iceland, its chairmanship in the spring of 2009 is held by Canada.

Increased economic activity and significant changes due to climatic processes are resulting in increased use, opportunities and threats to the Arctic marine and coastal environments. These predicted changes require more integrated approaches to address both existing and emerging challenges of the Arctic marine and coastal environments.

PAME's mandate is to address policy and non-emergency pollution prevention and control measures related to the protection of the Arctic marine environment from both land and sea-based activities, including coordinated action programs and guidelines complementing existing legal arrangements.

According to the Arctic Marine Strategic Plan, PAME aims to improve knowledge and respond to emerging knowledge of the Arctic Marine Environment. The AMSA is the primary action item for this objective. The plan also calls on PAME to determine the adequacy of applicable international/regional commitments and promote their implementation and compliance; and facilitate partnerships, program and technical cooperation and support communication, reporting and outreach both within and outside the Arctic Council.

At the 2004 Arctic Council ministers meeting in Iceland, the Reykjavik Declaration asked the PAME work group "to conduct a comprehensive Arctic marine shipping assessment as outlined in the Arctic Marine Strategic Plan (AMSP) under the guidance of Canada, Finland and the United States as lead countries and in collaboration with the Emergency Prevention, Preparedness and Response (EPPR) working group of the Arctic Council and Permanent Participants as relevant."

Emergency Prevention, Preparedness and Response: EPPR

The EPPR Secretariat rotates with the chairmanship of the Arctic Council and ... such is located in the spring of 2009 at the Norwegian Coastal Administration, Department for Emergency Response, Norway.

Harsh conditions and lack of infrastructure in much of the Arctic create a higher vulnerability to emergencies than in more temperate climates. Consequently, prevention, preparedness and response must be adapted to Arctic conditions. Accordingly, international cooperation in this area is of major importance.

The mandate of the EPPR working group is to deal with the prevention, preparedness and response to environmental emergencies in the Arctic. Members of the working group exchange information on best practices and conduct projects (for example, development of guidance and risk assessment methodologies, response exercises, training, etc.). EPPR is not a response agency. In 2004, EPPR was directed by the Arctic Ministers to expand its mandate to include natural disasters.

Ongoing EPPR projects address oil pollution spill response in the face of increased Arctic shipping and development; technological support of radiological and other hazard assessments; and natural disaster response, particularly catastrophic river flooding.

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The Assessment Report Structure

The AMSA 2009 Report is designed to educate and inform the Arctic Council, the Arctic community, the global maritime industry and the world at large about the current state of Arctic marine use and future challenges. The topics presented in the report include:

- Arctic Marine Geography, Climate and Sea Ice
- History of Arctic Marine Transport
- Governance of Arctic Shipping
- Current Marine Use and AMSA 2004 Database
- Scenarios, Futures and Regional Futures to 2020
- Human Dimensions
- Environmental Considerations and Impacts
- Arctic Marine Infrastructure

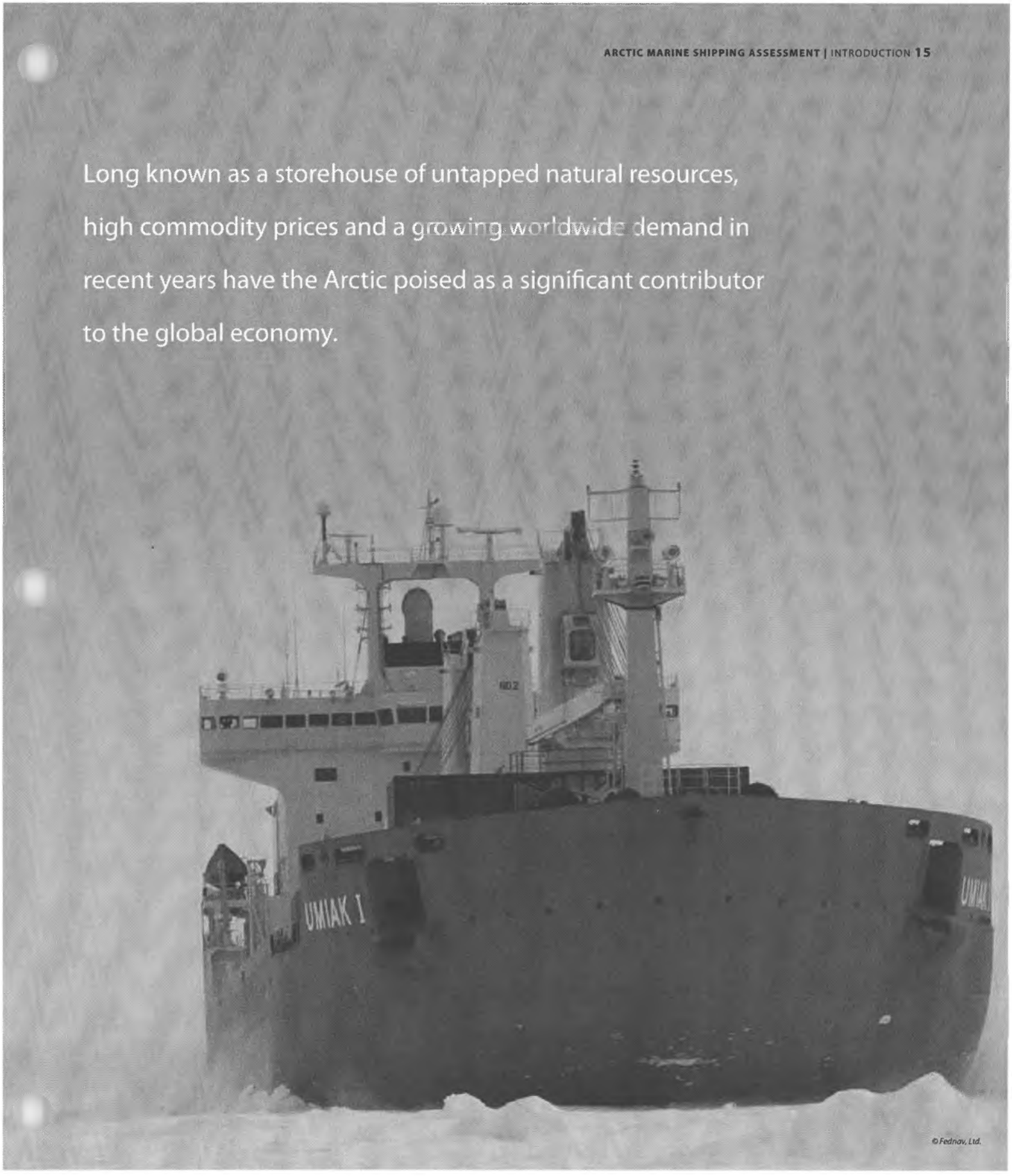
The initial sections on Arctic marine geography and Arctic marine transport history provide background and context for the subsequent sections. The complex geography of the Arctic Ocean and its surrounding coastline influences all aspects of Arctic marine operations. The history section emphasizes that industrial and commercial uses of the Arctic Ocean date back to the 17th century. There is also a rich history of marine operations in the Russian and Canadian Arctic regions, around Svalbard and Greenland, and off Alaska. Governance is identified in the AMSA as one of the key uncertainties and drivers of future Arctic marine navigation, and this section provides a critical overview and current state of international and coastal state governance of Arctic marine activities. The section on current marine use provides a comprehensive and historic baseline of Arctic marine activity early in the 21st century, developed principally from the AMSA Data Survey.

AMSA scenario workshops in 2007 and 2008 identified natural resource development and trade as key drivers and uncertainties. Two regional AMSA studies - for the Bering Strait and Canadian Arctic, as well as outcomes of ARCOP and INSROP - all emphasize oil and gas and hard minerals development as important indicators for future Arctic marine transport requirements.

The human dimension section communicates the results of the AMSA town hall meetings and identifies important concerns and issues of the Arctic indigenous people. Impacts are also highlighted in the environmental considerations section where ship types and their specific impacts are characterized. The final section of the report on Arctic infrastructure identifies the Arctic Ocean as a region with limited infrastructure in most areas, lacking communications, response capability, salvage and other basic services that are readily available to the maritime community in lower latitudes.

The Arctic Marine Shipping Assessment is a comprehensive study and evaluation of Arctic marine activity today and the future. The AMSA 2009 Report highlights a single set of findings and recommendations important to the future protection of Arctic people and the marine environment. The AMSA team of experts has also provided for each section in the report a list of non-negotiated research opportunities that can be considered by the Arctic research community and organizations such as the International Arctic Science Committee. The AMSA Report is a strategic guide for understanding the complexity and multiple factors that will determine the future of Arctic shipping operations.

Long known as a storehouse of untapped natural resources, high commodity prices and a growing worldwide demand in recent years have the Arctic poised as a significant contributor to the global economy.



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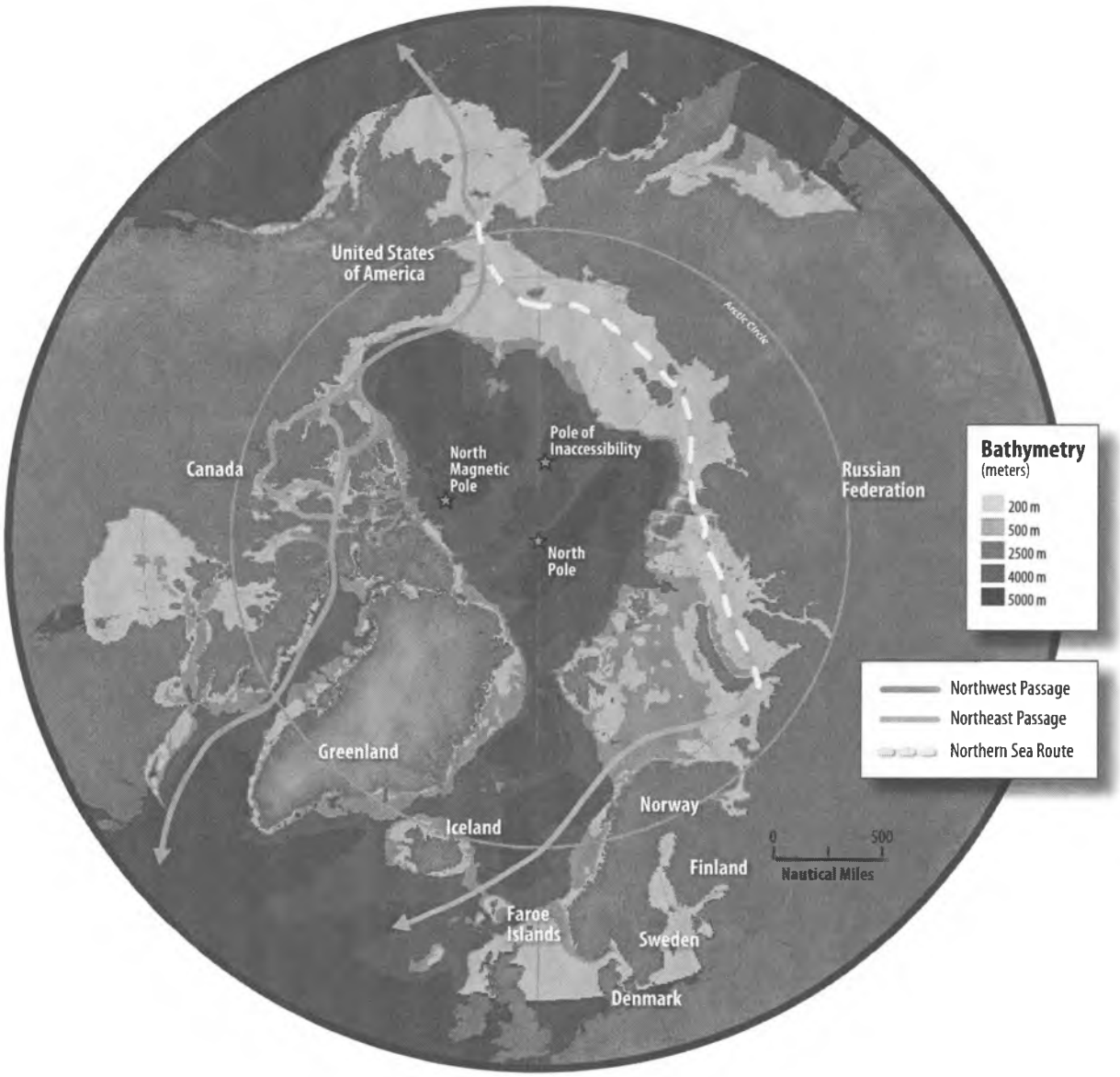
ARCTIC MARINE GEOGRAPHY, CLIMATE AND SEA ICE

Arctic Marine Geography

Our Earth has two polar regions, each with a large marine environment, that are vital to the well-being of the planet: Antarctica and the Arctic. Unlike Antarctica, though, which is a continent surrounded by an ocean, the Arctic is an ocean surrounded by continents. The Arctic Ocean, at 14.056 million km², is the smallest of the world's five oceans (Table 2.1). It is mostly an enclosed sea that has limited exchange of deep water with other oceans. Compared to the Mediterranean Sea, the Arctic has a much greater exchange of water, and it is more than 5.6 times larger. Consequently, the International Hydrographic Organization along with the International Maritime Organization recognizes the Arctic Ocean as one of the five major components of the world ocean that covers almost 71 percent of the Earth's surface. More importantly, the Arctic Ocean is the least sampled of the world's oceans and many areas remain where few, if any, soundings have been recorded. The implications of this lack of basic marine information are profound for charting hydrography and for basic Arctic navigation.

The Arctic is bordered by numerous coastal seas, all of which are seasonally covered with sea ice. Working from Greenland eastwards, the waters adjacent to the Arctic basin itself are Greenland Sea, Norwegian Sea, Barents Sea, White Sea, Kara Sea, Laptev Sea, East Siberian Sea and Chukchi Sea - all fronting on the Eurasia continental land mass. The Bering Sea, the Beaufort Sea, the waters within the Canadian Archipelago including those of the Northwest Passage, Hudson Bay and Hudson Strait, Lincoln Sea, Baffin Bay, Davis Strait and Labrador Sea are all bordering on the North American continent. Most Arctic marine activity, such as fishing, offshore hydrocarbon development and ship transits, takes place in these coastal seas.

Bathymetrically, the Arctic marine area is relatively shallow (Map 2.1) with broad continental shelves. The shelf extends 100 to 200 kilometers from the United States and Canada, and more than 1,000 kilometers in places extending north from the Russian Federation. Depths over the shelves average between 100 and 200 meters but are variable, especially as the continental landmasses and islands are approached. At the continental slopes, the break between the shelf and the deep ocean basin, depths are between 300 and 500 meters.



Map 2.1 The Arctic marine area. *Source: AMSA*

4,000 meters +
The depth of the Arctic Ocean at the North Pole.

	Size (million km²)	Percentage of Earth's Total Surface	Greatest Depth (m)	Average Depth (m)
Pacific	155.557	30.5	10,911	4,300
Atlantic	76.762	20.8	8,605	3,300
Indian	65.556	14.8	7,258	3,900
Southern	20.327	4.0	7,235	4,000-5,000
Arctic	14.056	2.8	5,160	1,050

Table 2.1 Arctic Ocean compared to other oceans. *Source: AMSA*

Country	Closest Point to the North Pole	Distance to Pole (km)
Greenland (Denmark)	Kaffeklubben Island, Perry Land	707
Iceland	Kolbeinsey, Eyjafjorour	2552
Norway	Rossoya Sjuoyane, Svalbard	1024
Russian Federation	Cape Fligely, Rudolf Island, Franz Josef Land	911
USA	Point Barrow, Alaska	2078
Canada	Cape Columbia, Ellesmere Island	769

Table 2.2 Distances from nearest land of Arctic states to the North Pole. *Source: AMSA*

There are two major deep basins - the Eurasia and Amerasia - separated by the Lomonosov Ridge stretching from the East Siberian Sea to the Lincoln Sea. The ridge is an underwater mountain chain rising, on average, 3,000 meters above the abyssal plain. On the Eurasian side of the Lomonosov Ridge, the basin is again split into two by the Nansen-Gakkel Arctic Mid-Ocean Ridge. Between the Lomonosov and Nansen-Gakkel Ridges lies the Pole Abyssal Plain in which is found the geographical North Pole at 90 degrees north. The depth of water at the pole is well over 4,000 meters. On the Amerasia side of the Lomonosov Ridge there are also two basins - the Makarov and Canada - separated by the Alpha and Mendeleev ridges. Of the two basins, the Canada Basin is the largest.

Major islands and island archipelagos fringe the Arctic marine area and they help frame the marine routes, legal regimes and navigational options in the Arctic Ocean. The largest island is Greenland at 2,166,086 km². The largest archipelago is the Canadian Archipelago with more than 36,000 islands including Baffin (507,451 km²), Victoria (217,291 km²) and Ellesmere (196,236 km²), which are among the world's largest 10 islands. The next largest single island fringing on the Arctic marine area is Iceland (103,000 km²). On the west, the Arctic Ocean is bounded by Svalbard (Norway) of which Spitsbergen is the largest island; Franz Josef Land (Russian Federation) with 191 islands; Novaya Zemlya (Russian Federation) with two major islands (Severny at 47,079 km² and Yuzhny at 33,246 km²); Severnaya Zemlya (Russian Federation) consisting of four major islands and 70 smaller ones; and New Siberian Islands (Russian Federation) with the Anzhu Islands and the Lyakhovskiye Islands. Between the New Siberian Islands group and the Bering Strait lies Wrangel Island (7,300 km²). Given these fringing islands, the distance from the nearest land to the North Pole is as little as 707 kilometers (382 nautical miles) (Table 2.2), but this distance is different for each Arctic nation. Of interest to the marine world is the approximate 2,100 nautical mile (1134 kilometer) distance (direct) from the Bering Strait to the North Pole to Fram Strait (between Greenland and Svalbard). All other distances along the coastal routes within the Arctic basin are longer.

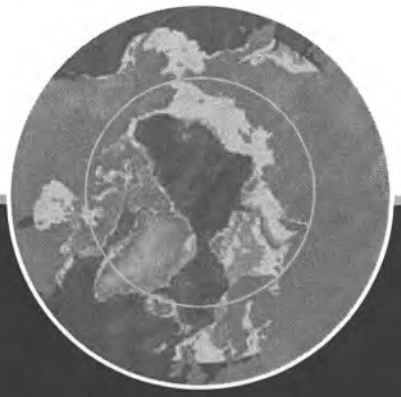
Although technically not on the edge of the Arctic Ocean, the Aleutian Islands in the Pacific Ocean provide the southern limit of the Bering Sea, which links through the Bering Strait into the Chukchi Sea and the Arctic Ocean. A global maritime trade route - the North Pacific's Great Circle Route - intersects with the Aleutian Islands and thousands of large ships pass north and south of these islands on voyages between the west coast of North America and Asian ports each year.

The water connections linking the Arctic and the Pacific and Atlantic oceans are limited. The narrow and shallow Bering Strait (85 kilometer width; 30-50 meter depth) is the only link between the Arctic and the Pacific. There are more and wider passages between the Arctic and the Atlantic. Davis Strait between Canada and Greenland links Baffin Bay with the Labrador Sea and the North Atlantic. At its narrowest point Davis Strait is about 300 kilometers wide; at its widest it is over 950 kilometers. Between Greenland and Iceland lies Denmark Strait (290 kilometers wide at its narrowest). The widest passage is the Norwegian Sea at about 1,100 kilometers separating Iceland from Norway.

These water passages between the Arctic Ocean and its northern coastal seas allow exchanges of water vital to the Arctic's climate and marine ecosystems. By far the greatest exchange of water takes place between the Arctic and the Atlantic. Relatively warm dense salty water, as part of the North Atlantic Current originating in the Gulf of Mexico and Caribbean Sea, enters the Norwegian Sea continuing into the Barents Sea. This warmer water means that the Southern Barents Sea is not generally ice-covered, a significant factor in the regulation and control of marine traffic in this northwest

corner of Europe that is by latitude located in the Arctic region. After much mixing and cyclonic (counter-clockwise) circulation, cold, less salty water exits between Svalbard and Greenland and Greenland and Iceland. This exiting water consists not only of the modified North Atlantic waters but, more importantly, continental river water from Eurasia, especially from the Ob', Yenisei and Lena rivers of the Russian Federation; freshwater from the Mackenzie River in Canada; and Pacific water which entered through the Bering Strait. The driving engine conveying the Pacific water and the river waters eastward is the Beaufort Gyre north of Alaska and western Canada. This gyre - a clockwise circulation of relatively fresh, less dense water - is driven by prevailing winds. When winds shift and the current lessens some water escapes and is caught up in the Trans Polar current, eventually linking with the outflow water into the Atlantic Ocean. Cold waters also exit from the Arctic to the Atlantic through Baffin Bay, Davis Strait and Hudson Strait.

An important geographical limit and a defining line is the Arctic Circle (66 degrees 33 minutes north). At this latitude places receive continuous light for 24 hours per day once a year and as one moves poleward the number of days of continuous light increases until at the North Pole continuous light is experienced for six months



Arctic Circle

The Arctic Circle is the circle of latitude at 66 degrees 33 minutes N (2606 kilometers/1619 miles from the North Pole) that encloses a northern area about 8 percent of Earth's surface. The Arctic Circle is the southern limit of the midnight sun, where north of the circle there is at least one day each year when the sun does not set.

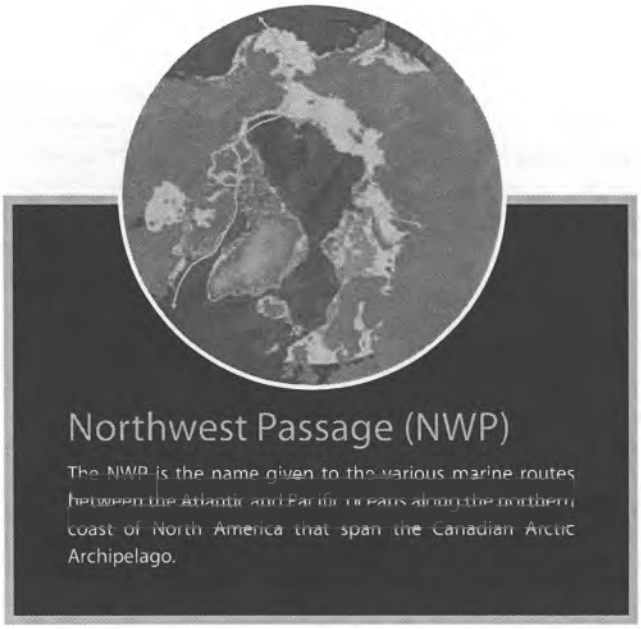
© Canadian Coast Guard

between the Vernal (March 21) and Autumnal equinoxes (September 21). Conversely, continuous dark is experienced at the pole for the other six months and decreasingly in time as one moves south. Significant for marine operations is that much of the central Arctic Ocean is shrouded in winter darkness with very low temperatures for half the year. This seasonal or diurnal cycle in the polar environment, while highly influential in the rhythmic behavior and adaptation of Arctic communities and animal populations, has broad implications for maritime use throughout the Arctic Ocean and its coastal seas.

The Canadian Maritime Arctic and Northwest Passage

The Canadian maritime Arctic is located across the north of Canada from the Beaufort Sea in the west to Baffin Bay in the east, and south to 60 degrees north latitude. The Canadian Arctic Archipelago stretches longitudinally about 1,900 kilometers from mainland Canada to the northern tip of Ellesmere Island. From west to east, it covers a distance of about 2,400 kilometers from Banks Island (west side) to Baffin Island (east side). The size of this roughly triangular area, including land and ocean, is approximately 2.1 million km², about the size of Greenland. As mentioned previously, it comprises approximately 36,000 islands, making it one of the most complex geographies on Earth. The area is sparsely populated along the coastline. The largest settlement is Iqaluit, Baffin Island, at 6,100 people; the entire Baffin region includes most of the eastern and northern portion of the Archipelago including all of Baffin Island. The most northern settlement is Grise Fjord on Ellesmere Island. Resolute on Cornwallis Island and the shores of Barrow Strait are an important staging area for air and marine traffic.

The Archipelago serves as a major impediment to shippers seeking a link between the Atlantic and Pacific oceans or for internal shipment of resources or community supplies. There are five recognized routes or passages, with variations, through the Archipelago (Table 2.3). They make up the much searched for Northwest Passage, which occupied European adventurers for more than 400 years. The NWP is the name given to the various marine routes between the Atlantic and Pacific oceans along the northern coast of North America that span the Canadian Arctic Archipelago. The



first complete ship transit of the NWP took place from 1903-06 by Norwegian explorer Roald Amundsen following Route 3b (Table 2.3). In 1940-42 the first eastward passage, using Route 4, was made by the *St. Roch* commanded by RCMP Sergeant Henry Larsen. This trip was followed in 1944 by a westward passage following Route 1, marking the first time the Northwest Passage had been navigated in a single season.

All passages have common eastern and western approaches. In the east, ships must proceed through the Labrador Sea, Davis Strait and Baffin Bay - the exception is for Route 5, which requires a transit through Hudson Strait. In the western approaches ships proceed through the Bering Sea, Bering Strait, the Chukchi Sea and the Beaufort Sea before deciding which route to follow. In general, the operating season is short - from late July to mid-October - depending on the route and year. Of the various passages, routes 1 and 2 are considered deep water ones, while the others have limiting shoals and rocks restricting the draft of vessels to less than 10 meters.

The Arctic Ocean is the least sampled of the world's oceans and many areas remain where few, if any, soundings have been recorded.

Water Routes of the Northwest Passage

Route	Routing (East to West)	Physical Description	Of Note
1	Lancaster Sound – Barrow Strait – Viscount Melville Sound – Prince of Wales Strait – Amundsen Gulf.	**Lancaster Sound:** 80 km wide, 250 km long, deep at over 500 m. **Barrow Strait:** 50 km wide, 180 km long, deep, string of islands west of Resolute disrupts clear navigation. **Viscount Melville Sound:** 100 km wide, 350 km long, experiences multi-year ice from M'Clure Strait. **Prince of Wales Strait:** minimum width of less than 10 km about half way through the Strait. 230 km long, limiting depth of 32 m. **Amundsen Gulf:** irregular shape, 90 km wide entrance, approximately 300 km long.	Suitable for deep draft navigation; the route followed by *St. Roch* in 1944 on westerly transit and the *SS Manhattan* in 1969.
2	Same as 1 but substitute M'Clure Strait for Prince of Wales Strait and Amundsen Gulf. Collectively Lancaster Sound – Barrow Strait – Viscount Melville Sound is known as Parry Channel.	**M'Clure Strait:** 120 km wide at east end, 275 km long to Beaufort Sea, deep at over 400 m, experiences multi-year ice from Arctic Ocean.	*SS Manhattan* attempted this route in 1969 but was turned back. Russian icebreaker *Kapitan Klebnikov* succeeded in a passage in 2001. In September 2007 was clear of Arctic pack ice for a limited time since satellite photos have been available; there was more ice in 2008.
3A	Lancaster Sound – Barrow Strait – Peel Sound – Franklin Strait – Larsen Sound – Victoria Strait – Queen Maud Gulf – Dease Strait – Coronation Gulf – Dolphin and Union Strait – Amundsen Gulf.	**Lancaster Sound and Barrow Strait:** see Route 1. **Peel Sound:** 25 km wide, deep at over 400 m at south end. **Franklin Strait:** 30 km wide. **Larsen Sound:** depths vary between 30 and 200 meters. **Victoria Strait:** 120 km wide, at southern end is blocked by Royal Geographical Society Islands, worst ice conditions along the mainland coast of Canada. **Queen Maud Gulf:** eastern entrance 14 km wide, but widens into an irregular area with width of up to 280 km before narrowing to 14 km at entrance to Dease Strait; numerous islands, reefs and shoals. **Dease Strait:** 14 – 60 km wide, 160 km long. **Coronation Gulf:** over 160 km long, many islands. **Dolphin and Union Strait:** 80 km wide at Amundsen Gulf, 150 km long, caution should be exercised in passage, several soundings of less than 10 m have been recorded. **Amundsen Gulf:** see Route 1.	Of the 3A, 3B and 4 routes, this is considered the best option but with a draft limit of 10 m.
3B	A variation of 3A. Rather than following Victoria Strait on the west side of King William Island, the route passes to the east of the island following James Ross Strait – Rae Strait – Simpson Strait.	**James Ross Strait:** 50 km wide, but restricted by islands, extensive shoaling. **Rae Strait:** 20 km wide, with limiting depths of between 5-18 m in mid channel. **Simpson Strait:** about 3 km wide at narrowest point, most hazardous navigation area in 3B route.	The route of Roald Amundsen. Also route of the *MS Explorer*, in 1984, the first cruise ship to navigate the Northwest Passage.
4	Similar to 3A. Rather than following Peel Sound on the west side of Somerset Island, the route passes to the east of the island through Prince Regent Inlet and Bellot Strait.	**Prince Regent Inlet:** 80 km wide, free of islands, deep. **Bellot Strait:** short and very narrow, strong currents, limiting depth of 22 m.	Route of *St. Roch* in 1940-42 on easterly transit.
5	Hudson Strait – Foxe Channel – Foxe Basin – Fury and Hecla Strait – Gulf of Boothia – Bellot Strait – remainder via routes 3A, 3B or 4.	**Hudson Strait:** 100 km wide, 650 km long, deep, also serves as entrance to Hudson Bay and Churchill port. **Foxe Channel:** 130 km wide, deep, with limiting shoal in the middle that can be avoided. **Foxe Basin:** very large, many islands in northern end. **Fury and Hecla Strait:** 160 km long, very narrow with fast current. **Gulf of Boothia:** very large waterway connecting to Prince Regent Inlet to the north (see route 4). No problems for navigation except at exit of Fury and Hecla Strait where Crown Prince Frederick Island is to be avoided.	Not generally considered a viable commercial passage for moderate to deep draft ships.

Table 2.3 Adopted from Pharand (1988) with additional material from Sailing Directions, Arctic Canada, Vol. 3, 5th edition, 1994 and Canadian Arctic Shipping Assessment, Transport Canada, 2007.

The Nature of Ice at Sea

Several forms of floating ice may be encountered at sea. The most extensive is that which results from the freezing of the sea surface, namely sea ice; but mariners must also be concerned with "ice of land origin" - icebergs, ice islands, bergy bits and growlers. Both icebergs and sea ice can be dangerous to shipping and always have an effect on navigation.

- Young ice: newly formed sea ice less than 30 centimeters thick. It forms extensively in the autumn as ocean surface temperatures fall below freezing and on leads that open in mid-winter due to shifts in the pack ice. It is not a significant safety hazard for most Arctic vessels although, when placed under pressure by winds or currents, it can impede progress.

- First-year ice: can easily attain a thickness of 1 meter but rarely grows beyond 2 meters by the end of the winter. It is relatively soft due to the inclusions of brine cells and air pockets and will not generally hole an ice-strengthened ship operated with due caution. Under pressure from winds or currents, first-year ice can impede progress to the point where even powerful vessels can become beset for hours or even days.

- Old ice: If first-year ice survives the summer melt season, it is then classified as old ice (subdivided into second-year and multi-year ice). It is typically 1 to 5 meters thick and is extremely hard. During the summer melt process, the brine cells and air pockets that characterize first-year ice drain out the bottom of the ice, leaving a clear, solid ice mass that is harder than concrete. Even ice-strengthened vessels are at risk of being holed by old ice. When under pressure, old ice can stop the most powerful icebreakers.

- Icebergs: are large masses of floating ice originating from glaciers. They are very hard and can cause considerable damage to a ship in a collision. Ice islands are vast tabular icebergs originating from floating ice shelves. Smaller pieces of icebergs are called bergy bits and growlers and are especially dangerous to ships because they are extremely difficult to detect.

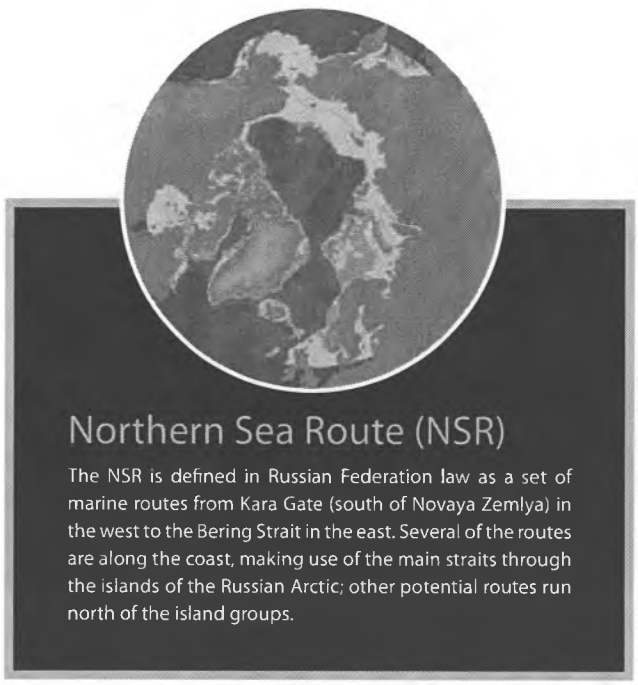
© Canadian Coast Guard

The Russian Maritime Arctic and Northern Sea Route

The physical environment of the northern coast of Eurasia - the Russian maritime Arctic - presents unique challenges to the mariner and to modern ship technology and systems. Shallow waters generally characterize the length of the coastline from the Norwegian-Russian border in the west (in the Barents Sea) to the Bering Strait. The average depths of the East Siberian and Chukchi seas are 58 meters and 88 meters respectively, making the entire coastal region in the east quite shallow for all marine operations. The average depth of the Laptev Sea is 578 meters (its northern limit extends into the Arctic Ocean basin); however, 66 percent of its area along the coast is in depths of 100 meters or less. The Kara Sea has an average depth of 90 meters and the Barents Sea is relatively shallow along the coast (10-100 meters) in the southeastern region and slopes to depths of 200-300 meters to the northwest. From the early years of exploration in the 17th century to today's offshore development and use of shipping routes, the consistently shallow bathymetry of this broad Arctic coast has been a key facet in all maritime affairs.

The Northern Sea Route is defined in Russian law as the set of Arctic marine routes between Kara Gate in the west and the Bering Strait. A number of narrow straits represent a significant constraint to navigation along the NSR. Yugorskiy Shar Strait is located along the south coast of Vaygach Island and is the southernmost entrance from the Barents to Kara seas (21 nautical miles long, 13-30 meters deep). Kara Gate is the main shipping strait between the Barents and Kara seas (18 nautical miles long, minimum depth of 21 meters) and shipping uses an established traffic separation scheme. Vilkitskiy Strait separates Severnaya Zemlya from the northernmost extremity of the Eurasian land mass, Cape Chelyuskin. This is a key NSR strait between the Kara and Laptev seas (60 nautical mile length, 100-200 meter depths), but it is ice-covered except for a short period in some summer seasons. Shokalskiy Strait is located in Severnaya Zemlya north of Vilkitskiy Strait and is a second possible shipping route between the Kara and Laptev seas (80 nautical miles long, minimum depth of 37 meters).

In the eastern reaches of the NSR, Dmitry Laptev Strait, oriented east-west, is the southernmost passage between the New Siberian Islands and the Russian mainland, linking the Laptev and East Siberian seas. This strait is 63 nautical miles long and has depths of 12-15 meters; however, the eastern approach has only depths of 10 meters or less, restricting traffic to ships with less than a 6.7 meter draft. Sannikov Strait is a second passage through the New Siberian Islands linking the Laptev and East Siberian seas (160 nautical miles long, minimum depths of 13 meters). From a navigation perspective, the low surrounding New Siberian Islands make visual and radar observations difficult to obtain, especially during long periods of reduced visibility. Long Strait separates Wrangel Island from the Russian mainland and links the East Siberian and Chukchi seas (a 120-nautical mile southern route along the coast with 20 meter minimum depths; a 160-nautical mile northern route with 33 meter minimum depths).



Northern Sea Route (NSR)

The NSR is defined in Russian Federation law as a set of marine routes from Kara Gate (south of Novaya Zemlya) in the west to the Bering Strait in the east. Several of the routes are along the coast, making use of the main straits through the islands of the Russian Arctic; other potential routes run north of the island groups.

Several marine route distances are notable: from Murmansk to the Bering Strait is 3,074 nautical miles; and the Northern Sea Route from Kara Gate to the Bering Strait is 2,551 nautical miles. The Dudinka to Murmansk marine route that is maintained year-round is 1,343 nautical miles, while it is approximately 500 nautical miles between the offshore region of the Pechora Sea (site of new oil terminals) in the southeast corner of the Barents Sea and Murmansk. Compared with the Canadian Arctic, the Russian maritime Arctic has many more viable ports located along the length of the NSR. Primary NSR ports from west to east include: Amderma, Dikson, Yamburg (Ob' Gulf), Dudinka (north Yenisei River), Igarka (south Yenisei River), Khatanga (Khatanga River on the Laptev Sea), Tiksi (Tiksi Gulf near the Lena River), Zeleny Mys (Kolyma River) and Pevek.

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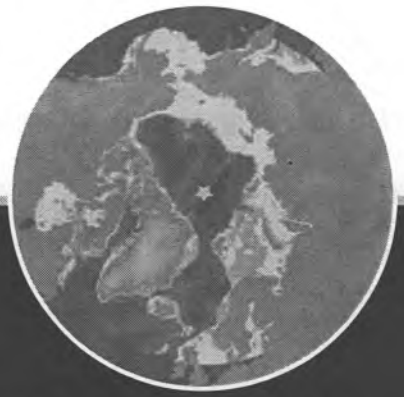


Geographic North Pole

The Geographic North Pole, the Earth's northernmost point, is located at the northern end of the Earth's axis of rotation. The latitude of the Geographic North Pole is 90 degrees N and it is the point where all the meridians of longitude and all 24 of the world's time zones converge.

Arctic Climatology

One defining threshold of the Arctic environment that is often used is set by the 10°C July isotherm. This isotherm marks the southern Arctic boundary where the monthly mean temperature in July is below 10°C. This limit also closely corresponds to the northern limit of the treeline. Because of the mix of landmasses, water and ice in the northern latitudes the isotherm pushes north above the Arctic Circle in all of Eurasia, but is south of the Arctic Circle in much of central and eastern Canada, southern Greenland and the Aleutian Islands. For example, the mean monthly July temperature at Honningsvåg, Norway (latitude 70° 58′ N) is 10.3°C; at Murmansk, Russia (latitude 68° 58′ N) it is 13.4°C. However, at Inukjuak, Quebec, Canada on the east side of Hudson Bay (58° 27′ N) the average July temperature is only 9.4°C; at Paamiut, Greenland on the south west coast (62° 00′ N) it is 5.5°C.

In January, mean temperatures everywhere within the Arctic Circle are all below 0°C, varying from about -5°C along the north coast of Norway to greater than -35°C in central Greenland, the northern part of the Canadian Archipelago and in northern Siberia. The average January temperature at the North Pole is estimated at between -30 and -35° C; however, this is difficult to know given that no permanent recording station exists at the pole. Over virtually all of the Arctic Ocean mean winter air temperatures are not as cold as they are in fringing continental land masses in Siberia, Alaska and Canada.

Precipitation, generally, is light within the Arctic at less than 250 millimeters per annum. Only along exposed coastal regions in southern Baffin Island, western Greenland and northern Scandinavia are amounts greater than this regularly experienced. The main component of the precipitation in the central and high Arctic is snow, but it too is light, at less than 25 centimeters per annum. Although light, snow tends to be blown in all regions and accumulates in drifts and around structures; in marine environments drifting snow accumulates along ice edges and other features on the sea ice creating considerable additional barriers to normal navigation. Almost all snow disappears nearly everywhere in the summer, except in glacier areas.

One of the factors explaining the climatic patterns and annual weather events in the Arctic is the distribution of high and low pressure systems through the year. In winter two semi-permanent low pressure areas set up in the region: one over Iceland and the

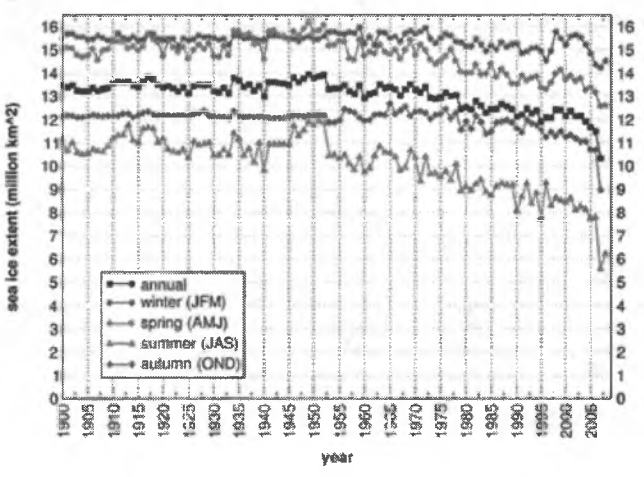
North Atlantic extending into the Barents Sea, the other over the Gulf of Alaska in the North Pacific. In contrast, high pressure areas are established over Siberia and the Yukon in Canada. The pressure differences bring about frequent and intense cyclonic storms moving generally from west to east. In summer, the lows weaken, the Siberian high disappears and the Canadian high shifts north over the Canadian Archipelago. As a result, pressure gradients are less and cyclonic activity declines, providing a fairly benign Arctic marine environment for voyages and regional operations. By October, the winter configuration begins to take effect and storminess increases with declining temperatures. Again, the seasonality of the polar environment, in this case the overall annual weather patterns over the Arctic Ocean, is a critical, strategic aspect for planning current and future marine transport systems throughout the Arctic basin.

Arctic Sea Ice: Changing Operating Conditions in the Arctic Ocean

Introduction

The Arctic sea ice cover is undergoing an extraordinary transformation that has significant implications for marine access and shipping throughout the Arctic basin. The Arctic Climate Impact Assessment, released by the Arctic Council at the Iceland Ministerial meeting in November 2004, documented that Arctic sea ice extent has been declining for the past five decades. Research has also

Graph 2.1 Northern Hemisphere sea ice extent. *Source: J. Walsh, W. Chapman*



Future Arctic navigation and all marine activity will depend on more frequent, reliable and near real-time sea ice thickness measurements.

indicated that sea ice thickness has been decreasing during the same period, and the area of multi-year ice has also been declining in the central Arctic Ocean.

Global Climate Models used in the ACIA and the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4 released in 2007) simulate a continuous decline in sea ice coverage through the 21st century. One ACIA model showed it is plausible that during mid-century, the entire Arctic Ocean could be ice-free for a short period in the summer, a finding that garnered significant media attention.

Recent research (2006-2008) has indicated this plausible ice-free state of the Arctic sea ice cover may occur as early as 2040, if not sooner. It is important to note that despite the remarkable, ongoing changes in Arctic sea ice and some uncertainty surrounding the output of the GCMs, no research and none of the GCM simulations have indicated that the winter sea ice cover of the Arctic Ocean will disappear during this century.

This fact alone - that there will always be an Arctic sea ice cover to contend with - has important implications for all future Arctic marine activity and for the development of ship standards and measures to enhance Arctic marine safety and environmental protection. The resulting sea ice conditions for future Arctic marine operations will be challenging and will require substantial monitoring and improved regional observations. This new Arctic Ocean of increasing marine access, potentially longer seasons of navigation and increasing ship traffic requires greater attention and stewardship by the Arctic states and all marine users.

In assessments of ongoing and projected climate change, Arctic sea ice is a critical and highly visible element. Observed sea ice extents derived from satellite passive microwave data for 1979-2006 indicate a decrease or annual loss of 45,000 km² of ice (3.7 percent decrease per decade). The same data analysis shows negative ice extent trends for each of the four seasons and each of the 12 months; the decline in summer extent (6.2 percent decrease per decade) is larger than in winter (2.6 percent decrease per decade).

Interestingly, the five smallest September ice-covered areas for the Arctic Ocean during the modern satellite record (1979-2008) have occurred in the five most recent seasons (2004-2008). Map 2.2 shows the sea ice coverage derived from satellite at the time of minimum extent of Arctic sea ice on September 16, 2007.

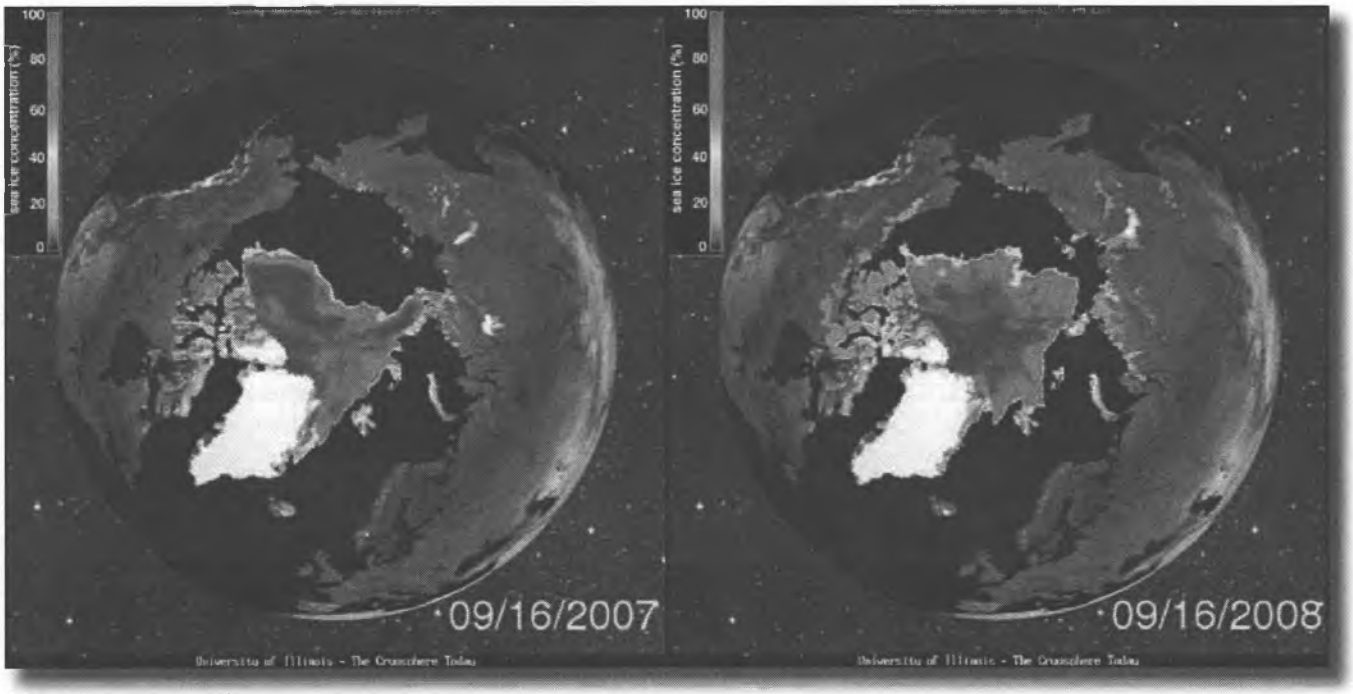
This snapshot represents the minimum coverage of Arctic sea ice in the satellite era of observations. Striking are several notable features: the largely ice-free areas across the Russian Arctic coastal seas (north of the Eurasian coast), except for a small region in the western Laptev Sea; an ice edge that has retreated north of Svalbard and well north in the Beaufort and Chukchi seas; several ice-free passages through the Canadian Archipelago; and a large area of the central Arctic Ocean that previously has not been observed open or without even a thin ice cover.

These extraordinary changes in the summer ice cover of the Arctic Ocean, represented by a single, iconic satellite image for September 16, 2007, are major factors in the potential lengthening of the navigation season in regional Arctic seas, particularly in the summer. It should be noted though that during the same timeframe, the Fram Strait contained more ice than normal, underscoring the regional variability of sea ice extent.

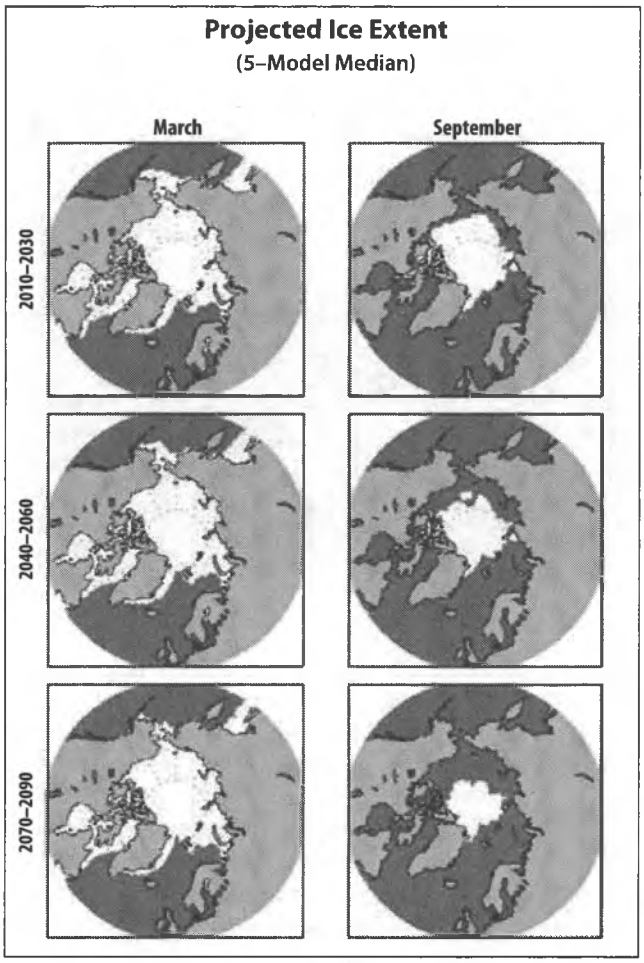
Arctic Climate Impact Assessment

The ACIA, approved by the eight Arctic countries, was called for by the Arctic Council and the International Arctic Science Committee. The assessment found that the Arctic is extremely vulnerable to observed and projected climate change and its impacts. The Arctic is now experiencing some of the most rapid and severe climate change on earth. During the 21st century, climate change is expected to accelerate, contributing to major physical, ecological, social and economic changes, many of which have already begun. Changes in Arctic climate will also affect the rest of the planet through increased global warming and rising sea levels. Of direct relevance to future Arctic marine activity, and to the AMSA, is that potentially accelerating Arctic sea ice retreat improves marine access throughout the Arctic Ocean.

The assessment confirmed, using a wealth of current Arctic research, that declining Arctic sea ice is a key climate change indicator. During the past five decades the observed extent of Arctic sea ice has declined in all seasons, with the most prominent retreat in summer. While the ACIA models have now been surpassed by more capable GCMs, each of the five GCMs used in the ACIA did project a continuous decline in Arctic sea ice coverage throughout the 21st



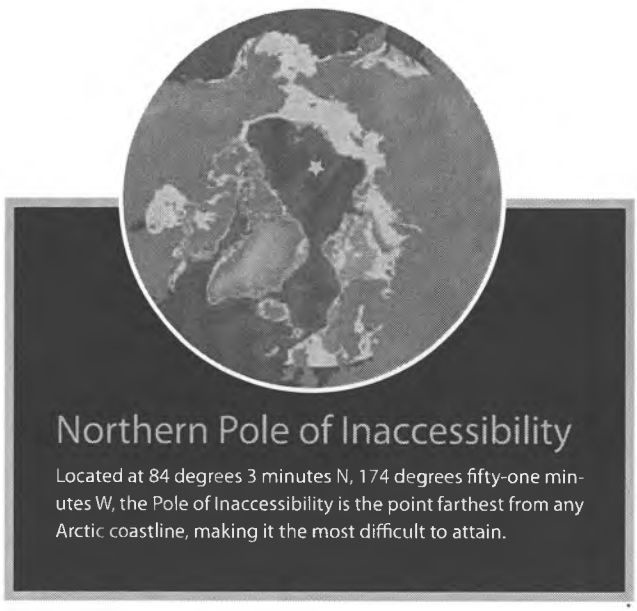
Map 2.2 Satellite images of summer sea ice cover. *Source: University of Illinois – The Cryosphere Today*



Map 2.3 Arctic sea ice simulations for the 21st century.
Source: Arctic Climate Impact Assesment

century (Map 2.3). From a strategic planning perspective, this is a key factor for evaluating future Arctic marine transport systems. As noted previously, one of the models simulates a summer ice-free Arctic Ocean by 2050, a future scenario of great significance for Arctic shipping and offshore development. Such a physical occurrence would mean that multi-year ice could possibly disappear in the Arctic Ocean. All of the next winter's ice would be first-year: no ice will have survived a winter season (and be able to gain strength and thickness).

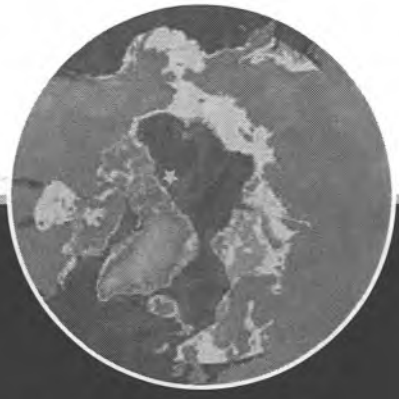
GCM projections to 2100 suggest that in the summer the Arctic sea ice will retreat further and further away from most Arctic coasts, potentially increasing marine access and extending the season of navigation in nearly all Arctic regional seas. One critical limitation of the GCMs is that they are not useful for determining the state of sea ice in the Northwest Passage region. Their spatial resolution is much too coarse to be applied to the complicated geography of the Canadian Arctic Archipelago.



In the ACIA, the only reliable observed data for the region comes from the Canadian Ice Service and this information, archived since the late 1960s, shows a mean negative trend of sea ice coverage in the Canadian Arctic, but very high year-to-year variability. The ACIA models, however, could be applied very crudely to the more open coastal seas of the Russian Arctic. The ACIA sea ice projections for Russia's Northern Sea Route indicated longer periods of ice-free conditions which could translate into a longer navigation season throughout the 21st century.

The ACIA confirms that the observed retreat of Arctic sea ice is a real phenomenon. The GCM projections to 2100 show extensive open water areas during the summer around the Arctic basin. Thus, it is highly plausible there will be increasing regional marine access in all the Arctic coastal seas. However, the projections show only a modest decrease in winter Arctic sea ice coverage; there will always be an ice-covered Arctic Ocean in winter although the ice may be thinner and may contain a smaller fraction of multi-year ice. The very high, inter-annual variability of observed sea ice in the Northwest Passage and non-applicability of the GCMs to the region prevent an adequate assessment of this complex region.

It is important to note that despite the remarkable, ongoing changes in Arctic sea ice and some uncertainty surrounding the output of the GCMs, no research and none of the GCM simulations have indicated that the winter sea ice cover of the Arctic Ocean will disappear during this century.



North Magnetic Pole

The North Magnetic Pole is a non-stationary pole in the Arctic to which compass needles point from any direction. The magnetic field at this point points straight down or is at right angles to the Earth's surface. The position of the Pole continues to wander and is currently northwest of the Canadian Arctic.

Although the ACIA projections indicate an increasing length of the navigation season for the Northern Sea Route (20-30 days per year in 2004, to 90-100 days by 2080), detailed quantification of this changing marine access also tested the limitations of the ACIA GCMs. Since the work of the ACIA, advances and refinements in the models may allow them to provide more robust strategic information on the length of time regions remain ice-free and year-to-year regional sea ice variabilities. There is a definite need for improved Arctic regional models to adequately assess future changes in sea ice extent and thickness, and their considerable implications for expanded marine use of the Arctic Ocean. And, there is a significant need for more sea ice observations to improve the calibration and validation of the GCMs.

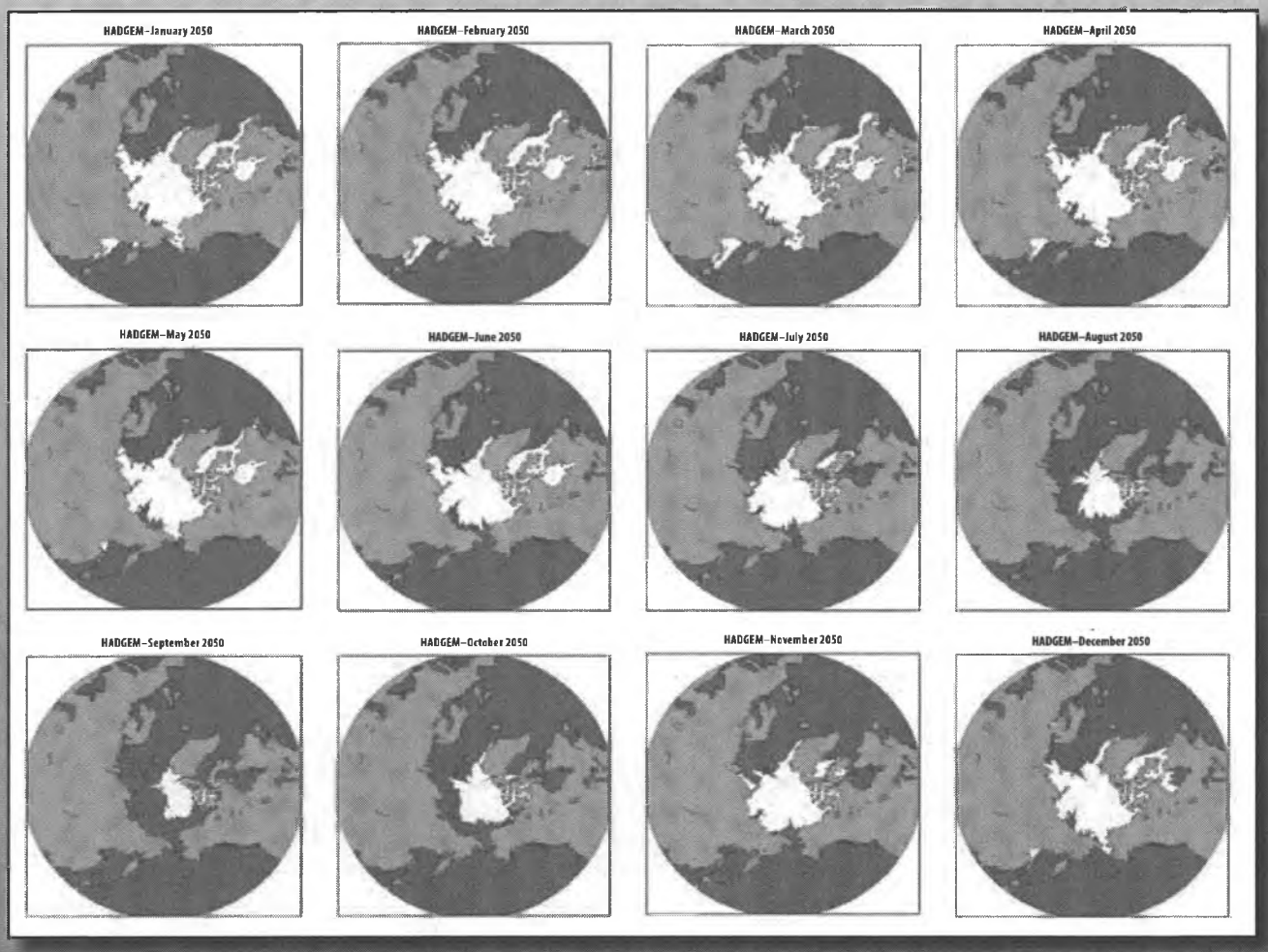
The final ACIA report lists 10 major findings that are essentially the key impacts of climate change on Arctic people and the environment. The ACIA key finding #6 states, "Reduced sea ice is very likely to increase marine transport and access to resources." One of the follow-on Arctic Council activities addressing this ACIA finding is the AMSA.

Intergovernmental Panel on Climate Change Fourth Assessment and Beyond

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization of the United Nations Environment Programme. IPCC is an intergovernmental body that provides scientific and technical information to policy makers. The 2007 IPCC 4th Assessment report indicated the lack of comprehensive sea ice data prior to the satellite era. However, observed data analyses have been able to confirm a sustained decline in Arctic sea ice since the early 1970s, notably during the summer melt season. The report also comments that the accuracy of satellite-derived ice concentration is usually 5 percent or better; errors of up to 10-20 percent can occur during the melt season as the passive microwave sensors measure the thin surface layers of melt water on the sea ice surface. Of critical importance to future navigation, the assessment also summarizes the information on the remarkable decrease in multi-year ice throughout the Arctic Ocean.

The possibility of an ice-free Arctic Ocean, even for a brief period, was advanced as an intriguing outcome of the ACIA. Recent analyses of GCM sea ice simulations using models from the IPCC AR4 (applying global warming scenarios) show near-complete loss of Arctic sea ice in September for 2040 to beyond 2100. However, additional research also indicates abrupt reductions in sea ice coverage during the 21st century are a common feature in many of the GCM simulations. Whether these periods of accelerated summer sea ice retreat might provide windows of opportunity for improved marine navigation is unknown. However, these research results and recent model inter-comparisons show the many uncertainties that remain in simulating the future ice cover of the Arctic Ocean.

Map 2.4 Hadley Centre Arctic Sea Ice Simulations, 2050. *Source: IPCC4 - 2050*



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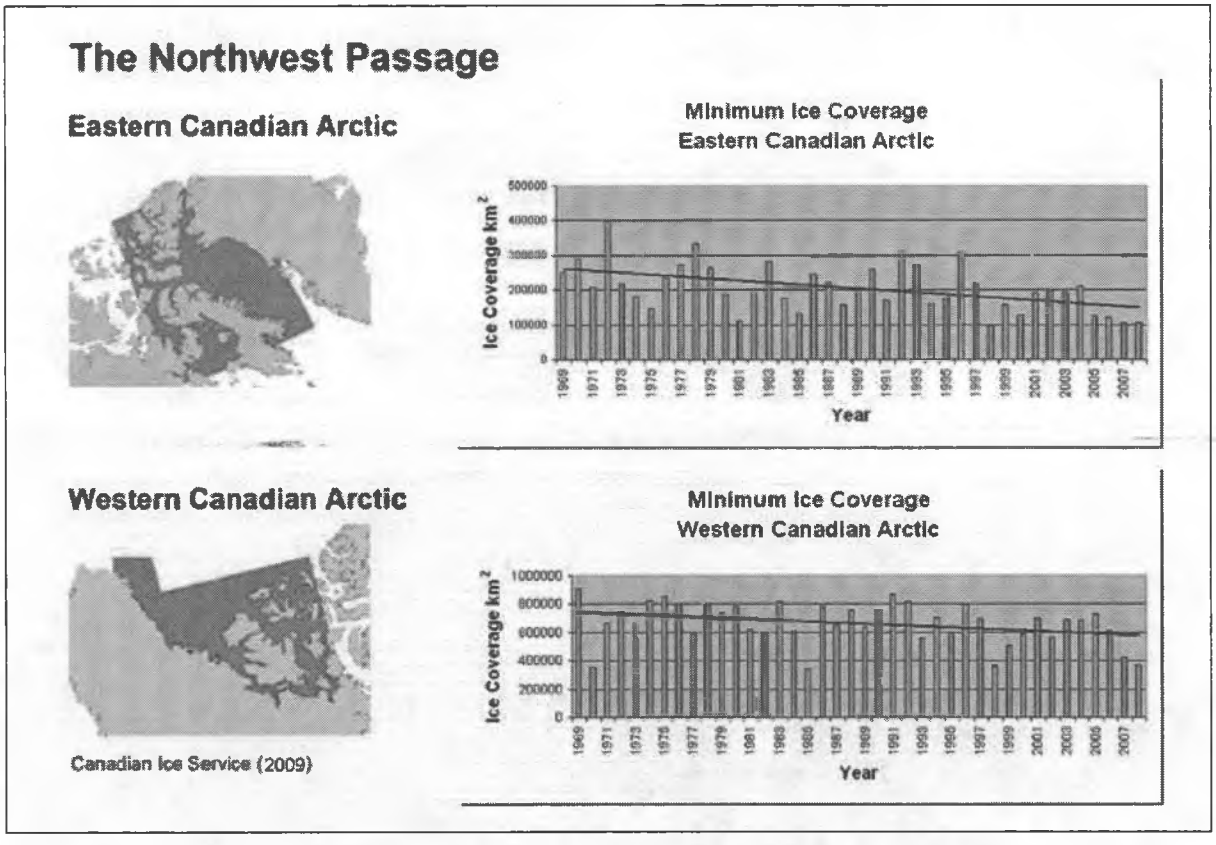
Further research on the performance of the IPCC AR4 models (Map 2.4) reveals that none of the GCMs have negative trends for sea ice as large as the observed sea ice coverage trend for the period 1953-2006 (7.8 percent per decade reduction). The observed trend is three times larger than the multi-model mean of a 2.5 percent per decade loss. This is an extraordinary development that also means the current summer sea ice minima are as much as 30 years ahead of the mean of the model simulations. With continued greenhouse gas emissions, it is highly plausible that the Arctic Ocean could become completely ice-free for a short summer period much earlier than 2040.

Just as important to ship navigation, these simulations indicate large areas of the coastal Arctic seas to be ice-free for longer periods in the spring and autumn months. Arctic marine access continues to increase in nearly all the scenarios posed by the ACIA and the more recent IPCC assessments.

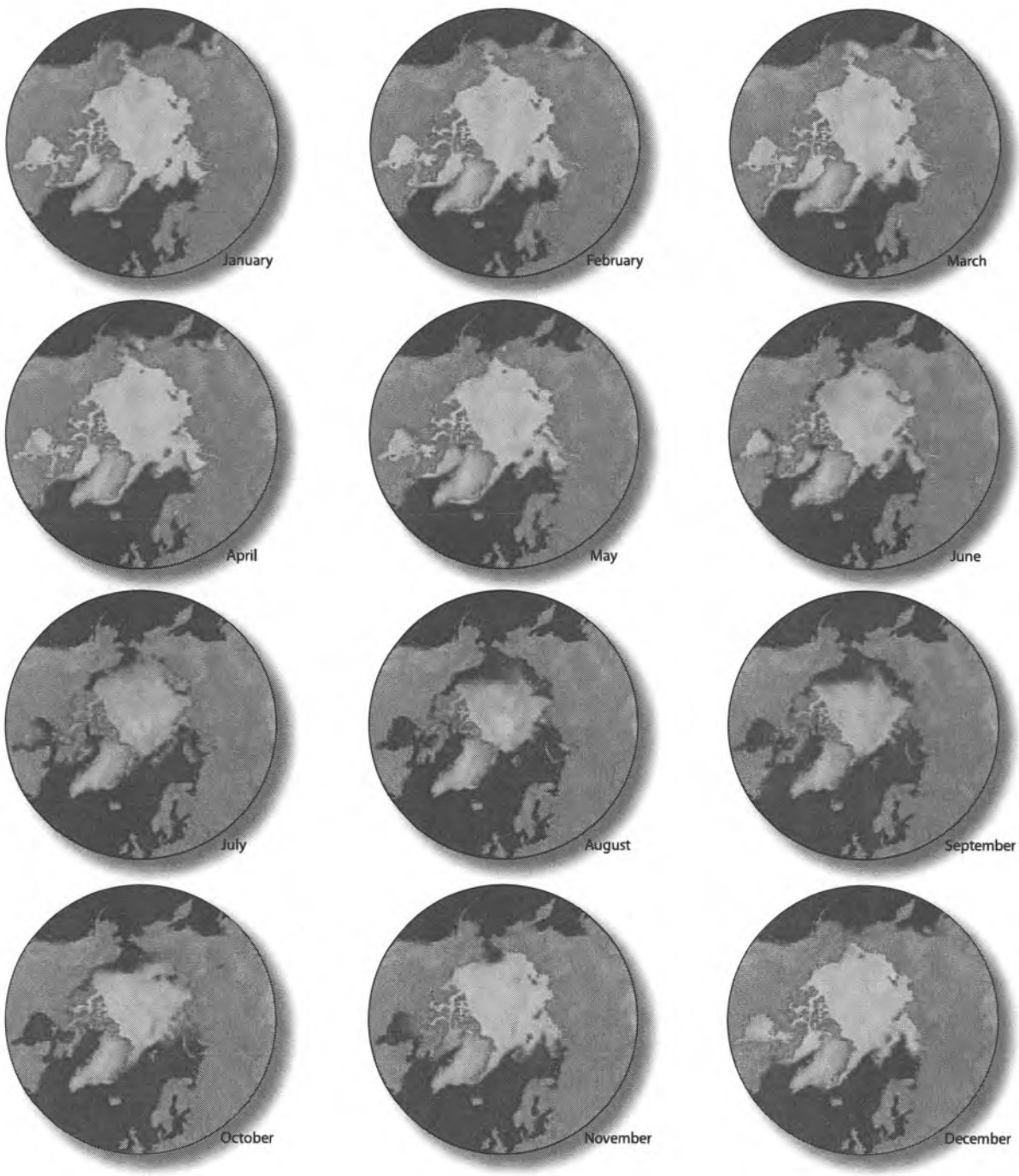
Additional Sea Ice Trends and Research

Earlier observations from aircraft and ships, and three decades of daily satellite observations, suggest that the September 2007 minimum sea ice extent (Map 2.2) was the lowest since the early 1950s; however, the September 2008 minimum extent indicated a slightly larger area of sea ice coverage. The Arctic sea ice cover is at a maximum extent in March and this maximum coverage has also been observed to decrease at approximately 2 percent per decade during the period 1979-2008. These extent reductions have been observed in all seasons of a year, but perhaps more significant have been observations of a rapid decline of thick, multi-year sea ice in the central Arctic Ocean. A study of satellite data for winter during 1978-1998 revealed that the multi-year sea ice cover had declined by 7 percent per decade. A second trend analysis for 25 years of summer ice minima (1978 to 2003) reports a decline of multi-year sea

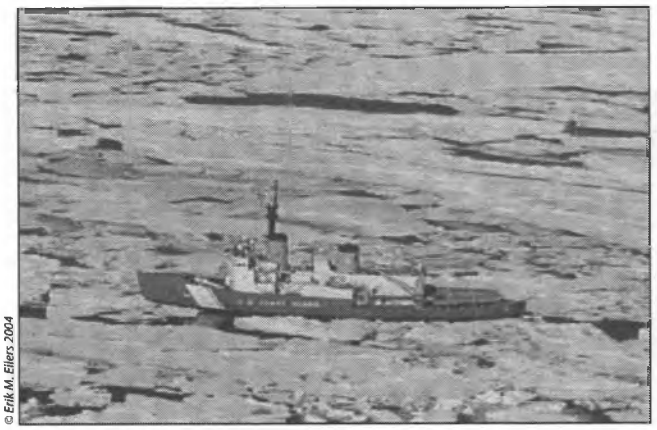


Graph 2.2 Sea ice variability in the Canadian Arctic and Northwest Passage. *Source: Canadian Ice Service*

Monthly Arctic Sea Ice Extent and Coverage, 2004



Map 2.5 Sea ice depictions for the AMSA shipping survey year of 2004. *Source: AMSA*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ice as high as 9.2 percent per decade. One important result of these trends should be a decrease in the presence of multi-year ice in the Arctic's coastal seas where seasonal navigation and marine activity are highest.

Arctic sea ice thicknesses have been much more difficult to monitor and evaluate during recent decades. Direct measurements of first-year sea ice in the Arctic coastal seas by the Arctic and Antarctic Research Institute in St. Petersburg, the Russian Federation, along the Russian Arctic, generally yield 1-2 meter thicknesses. For the central Arctic Ocean, thicknesses of multi-year sea ice can be as high as 4-5 meters. One pioneering study using sea ice draft data acquired on submarine cruises (data from 1958-1976 compared with cruise data for 1993-1996) indicated a decrease in thickness at the end of the melt season for the central Arctic Ocean from 3.1 to 1.8 meters. This represented a volume decrease of 40 percent and a widespread decrease in sea ice draft. This 40 percent reduction was adjusted to 32 percent in a subsequent study once additional submarine tracks were added.

One key issue is that future sampling of Arctic sea ice thickness requires enhanced monitoring systems for more effective spatial and temporal measurements. Modern measurement systems such as electromagnetics, upward looking sonars and satellites have been developed that are improving thickness observations. Future Arctic navigation and all marine activity will depend on more frequent, reliable and near real-time sea ice thickness measurements.

Sea Ice Regional Trends

Canadian Maritime Arctic and Northwest Passage

The observed record of minimum sea ice extent for the eastern and western regions of the Canadian Arctic is illustrated in Graph 2.2. Although the observations for both regions show negative trends for the period 1969-2008, the year-to-year variability in coverage is quite extreme. Both regions also exhibit large differences for a given year; for example, in 1991 the western Canadian Arctic showed one of the highest or largest ice coverage areas, while in the eastern region a more normal coverage area at the summer minimum was observed. These regional variabilities create a challenge for seasonal operations. While these observations indicate an overall decrease in the ice cover of the waterways that comprise the Northwest Passage, the two key variabilities - year-to-year and spatial - create challenges for planners judging risk and the reliability of an Arctic marine transportation system for the long-term.

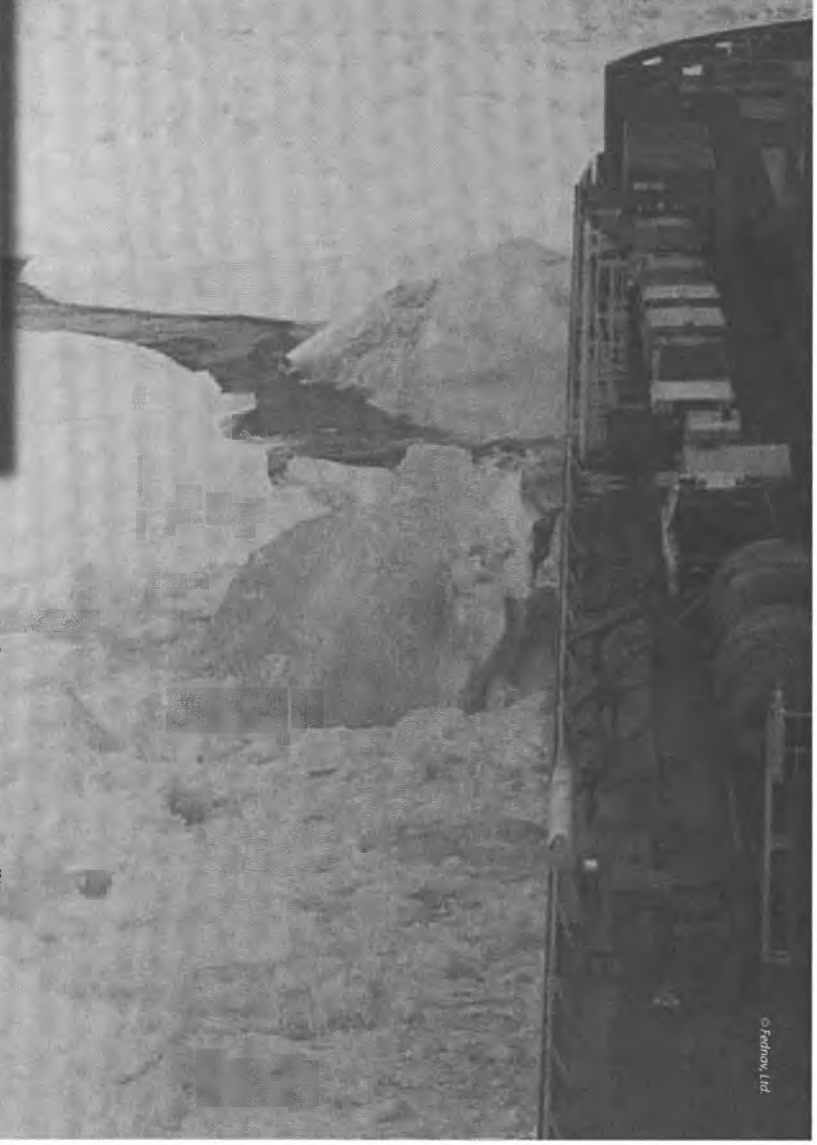
The five models used in the ACIA revealed that the last regions of the Arctic Ocean with sea ice coverage in summer would be in the northern waterways of the Canadian Archipelago and along the northern coast of Greenland. The flow of more mobile multi-year ice through these waterways presents another potential challenge to marine operations. Enhanced satellite monitoring (with high resolution imagery) of this complex region will be a necessity if expanded marine operations beyond summer are to be realized.

The five models used in the ACIA revealed that the last regions of the Arctic Ocean with sea ice coverage in summer would be in the northern waterways of the Canadian Archipelago and along the northern coast of Greenland.

Research Opportunities

- Research to improve regional models for increased understanding and enhanced forecasting of regional Arctic sea ice variability. New regional models should include ice thickness, snow cover and ice ridging, all key parameters of importance to Arctic navigation.
- Comprehensive analyses of current and future Global Climate Model simulations of Arctic sea ice extent to quantitatively assess the range of plausibly ice-free and partially ice-covered conditions.
- Considering the ongoing development of the Sustained Arctic Observing Network (SAON), develop and contribute a set of parameters to be observed and more observations that will be relevant to enhancing marine safety and marine environmental protection.
- Continued data analysis and updating of the International Bathymetric Chart of the Arctic Ocean (IBACO) with a long-term goal to create a comprehensive, integrated digital database of all bathymetric information for the Arctic Ocean.

The physical environment of the northern coast of Eurasia - the Russian maritime Arctic - presents unique challenges to the mariner and to modern ship technology and systems.



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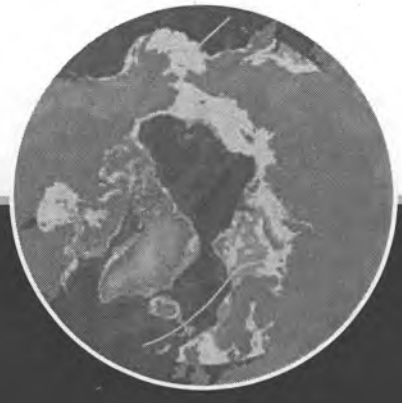
Russian Maritime Arctic and Northern Sea Route

Map 2.2 indicates that a nearly ice-free summer passage could have been made in 2007 and 2008 from Kara Gate through to the Bering Strait along the length of the Northern Sea Route except for sea ice in the western Laptev Sea. Passive microwave satellite observations of sea ice in the Russian Arctic seas from 1979 to the present show large reductions in sea ice extent in summer and reductions in winter extent in the Barents Sea. All of the ACIA model simulations and more recent IPCC AR4 model simulations confirm that large summer ice edge retreats should occur in the Laptev, East Siberian and western Chukchi seas. With a continued shrinkage of the fraction of multi-year sea ice in the central Arctic Ocean, it is plausible that fewer multi-year ice floes may be observed along the navigable eastern passages of the Northern Sea Route.

Long-term fast ice thickness measurements of the four Russian marginal seas (Kara, Laptev, East Siberian and Chukchi seas) have been analyzed for trends using 65-year observational records (1930s to 1990s). Long-term trends are small and inconclusive: the trends are small (approximately 1 centimeter per decade); the trends for the Kara and Chukchi seas are positive and the trends for the Laptev and East Siberian seas negative.

A review of recent assessments, observations and studies indicate that there remains much to understand about the present and future trends in Arctic sea ice. The operating conditions for Arctic ships will remain challenging, particularly in winter. It is also highly plausible that Arctic sea ice will be more mobile, particularly in spring, summer and autumn, as the cover continues to retreat from Arctic coastlines. Arctic coastal seas may experience increased ridging of seasonal sea ice, potentially creating more difficult operating conditions for marine navigation. The observed records of sea ice extent in the Canadian and Russian Arctic areas display high inter-annual variabilities. Such year-to-year variability poses a serious challenge to risk and the overall reliability of Arctic marine transport systems. Three key conclusions with direct relevance to Arctic shipping include:

- Arctic sea ice has been observed to be diminishing in extent and thinning for five decades. Also, model simulations indicate a continuing retreat of Arctic sea ice throughout the 21st century. However, no research indicates Arctic sea ice will disappear completely and a substantial winter sea ice cover will remain.
- Even a brief ice-free period in summer for the Arctic Ocean would mean the disappearance of multi-year sea ice in the central Arctic Ocean. Such an occurrence would have significant implications for design, construction and operational standards of all future Arctic marine activities.
- Observed sea ice trends and GCM simulations show coastal Arctic regions to be increasingly ice-free, or nearly ice-free, for longer summer and autumn seasons. Longer open water seasons increase the potential for greater coastal erosion, which can impact support infrastructure for Arctic development and marine transportation.



Northeast Passage (NEP)

The NEP is defined as the set of sea routes from northwest Europe around North Cape (Norway) and along the north coast of Eurasia and Siberia through the Bering Strait to the Pacific.

Regarding future needs, a key requirement is the development of high resolution, regional sea ice models that can provide more robust and realistic forecasting of marine operating conditions. There is also a critical requirement for more real-time sea ice observations, especially ice thickness measurements, to support all future Arctic marine uses. The national ice centers and ice services are critical providers of such sea ice information and greater international collaboration among the centers will enhance the development of more integrated products. New satellite sensors hold the promise of providing greater, near real-time ice thickness information for Arctic ships that are underway on future voyages.

A global maritime trade route - the North Pacific's Great Circle Route - intersects with the Aleutian Islands and thousands of large ships pass north and south of these islands on voyages between the west coast of North America and Asian ports each year.

Findings

1] Arctic sea ice coverage (extent) has been decreasing since the 1950s in all seasons. Observations of sea ice in the central Arctic Ocean have also indicated thinning during the past four decades. However, there remains a significant, year-to-year variability in regional sea ice coverage.

2] Global Climate Model simulations indicate a continuing "retreat" of Arctic sea ice through the 21st century. Observed sea ice trends and GCM simulations show coastal Arctic regions to be increasingly ice-free or nearly ice-free for longer summer and autumn seasons. Importantly, all simulations indicate that an Arctic sea ice cover remains in winter.

3] Recent sea-ice model simulations indicate the possibility of an ice-free Arctic Ocean for a short period of time in summer by earlier than mid-century. The key implication for this physical change will be the near (or complete) disappearance of multi-year sea ice.

4] Future sea ice conditions remain uncertain. It is highly plausible that Arctic sea ice will be more mobile in partially ice-covered coastal seas, particularly in spring, summer and autumn. Coastal seas may experience an increase and greater frequency of ice ridging and shorter periods of coastal fast ice.

5] The resolutions of GCM simulations are much too coarse for adequate coverage of the complex geographies of the Canadian and Russian Arctic. GCM Arctic sea ice simulations also lack robustness to provide detailed information on future marine operating conditions such as the length of the navigation season, "residence time" of ice-free conditions, frequency of leads and ridges and more.

6] Recent GCM Arctic sea ice simulations have not replicated the observed sea ice reductions from the 1950s to today. For example, the model simulations have not shown the drastic decrease of observed sea ice extent during recent years.

7] Climate change as indicated by Arctic sea ice retreat is a facilitator of marine access. It is highly plausible there will be greater marine access and longer seasons of navigation, except perhaps during winter, but not necessarily less difficult ice conditions for marine operations.

HISTORY OF ARCTIC MARINE TRANSPORT

The Arctic Ocean and adjacent seas have been used by mariners since the beginning of time. Historical Arctic marine transport activities reflect continuous indigenous marine use, expeditions and explorations, community supply/re-supply and expanding use by the global shipping community.

The first Arctic explorers were the indigenous people. Though most of their journeys remain undocumented, indigenous people have been traveling and exploring Arctic waters for thousands of years in search of food, supplies and settlement areas. They remain the original explorers and founders of the region.

Early Western marine transport in the Arctic was driven by searches for the Northwest Passage and Northeast Passage (Table 3.1). With the passages discovered, the focus shifted from searching to improving marine routes. Many notable Arctic voyages occurred and the scope of Arctic marine shipping advanced such that vessels even ventured to the then elusive North Pole. Advances in ship design, construction and operation, coupled with advancements in infrastructure, crew training and governance, have led to massive improvements in Arctic shipping.

This section will review briefly the rich history of the search and development of the Northwest Passage through the Canadian Archipelago, the Northeast Passage and later the Northern Sea Route along the northern coastline of Russia, as well as the history of Arctic tourism that can be found throughout the Arctic today.

Northwest Passage

The first European Arctic explorer was the Greek navigator Pytheas who sailed northward in 325 B.C. and is credited with having reached the vicinity of Iceland and perhaps even Greenland. In the late 9th century (aided by a period of worldwide climatic warming), the Norwegians found and colonized Iceland. Later Icelandic explorers found and colonized Greenland, and explored the northeast coast of North America.

It was not until the 1490s that Europeans began to investigate the possibility of a Northwest Passage (NWP) in order to find a more direct route to the Orient and the lucrative trade with India, Southeast Asia and China. In 1497, John Cabot sailed from Bristol in *Matthew* in an unsuccessful search for the passage.

Canadian place names reflect some of the many attempts that followed, with most via Hudson Bay, including Martin Frobisher, John Davis, Henry Hudson and Luke Foxe. In 1778, James Cook made the first attempt at locating the NWP from the west. In the 1800s, the Royal Navy explored the labyrinth of islands and channels that is now the Canadian Arctic Archipelago. In 1845, Sir John Franklin's ships, the *Erebus* and *Terror*, sailed north into Baffin Bay and disappeared. The Royal Navy mounted a massive search during the following decade for Franklin and his 129 men and as a result, the entire archipelago was explored.

It wasn't until 1906 that Norwegian explorer Roald Amundsen in his 47 ton sloop *Gjoa* emerged in the Pacific to become the first vessel to complete the NWP. Amundsen took three winters to complete the voyage and credit for his survival through the harsh Canadian winters goes to the Inuit. The first complete transit from west to east was completed in 1942 by the Canadian ship *St. Roch*. Captain Henry Larsen made the return trip from east to west in only 86 days and became the first vessel to transit the NWP in one season. Transits of the NWP after the *St. Roch* remained fairly sporadic until the 1970s.

In the period from 1945 to 1969, national security was the primary driver for navigation in the passage: the Canadian icebreaker *HMCS Labrador* became the first ship after the *St. Roch*, as well as the first armed Canadian ship to successfully complete transit of the NWP. Three years later, the *Labrador* escorted three U.S. Coast Guard icebreakers - *Storis, Spar and Bramble* - on part of the journey from west to east through the NWP.

From the 1969 voyage of the American oil tanker *Manhattan* (discussed later in this section) to the end of the 1980s, more than 30 complete transits of the passage were undertaken by a variety of vessels, as the focus shifted from national security to economic

Date	Event
Since time immemorial	Indigenous people are the original explorers, founders and settlers
325 B.C.	Greek astronomer / geographer / navigator Pytheas sails northward to Iceland
850 A.D.	The Vikings of Scandinavia sail northward and colonize Iceland
981	Viking, Erik "the Red" Thorwaldson, sails westward and discovers Greenland. Vikings colonize southeastern parts of Greenland
11th century	Russian settlers and traders on the coasts of the White Sea, the Pomors, had been exploring routes in the region
1490	John Cabot first proposes existence of a NWP
1500's	Whalers explore from Baffin Island to Novaya Zemlya
1576	Martin Frobisher lands in what becomes known as Frobisher Bay
1596	William Barents discovers Spitsbergen and seeks NEP
1610-11	Henry Hudson expedition survives Arctic winter
1615	Robert Bylot, with William Baffin as pilot, explores Hudson and Baffin bays
1648	Cossack Semen Dezhnev sailed east from the mouth of Kolyma to the Pacific, thus proving that there was no land connection between Asia and North America
1726	First Northern Expedition, with Vitus Bering in command, discovers Bering Strait while seeking NEP
1733-43	The Great Northern Expedition takes place with Vitus Bering in command
1778	James Cook makes the first serious attempt at locating the NWP from the west
1831	John Ross reaches magnetic North Pole
1845	John Franklin's lost expedition proves existence of NWP
1854	Robert McClure receives the Admiralty's prize for 'discovering' the NWP
1878-79	Nordenskjold in the *Vega* becomes the first known vessel to achieve a transit of the NEP
1893	Fridjof Nansen's ship *Fram* proves the existence of Arctic current
1903-06	Roald Amundsen in the *Gjoa* successfully completes the first transit of the NWP by ship
1932	Soviet expedition led by Otto Schmitt was the first to sail in one season transit the NSR
1940-42	Henry Larsen in the *St. Roch* was the second vessel to transit the NWP, the first to do so from west to east
1944	*St. Roch* is the first vessel to make a one-season transit (in only 86 days going east to west)
1977	*Arktika* is the first surface vessel to reach the North Pole

Table 3.1 Significant early history of Arctic marine transport. *Source AMSA*

The first European Arctic explorer was the Greek navigator Pytheas who sailed northward in 325 B.C.

development. The bulk of the transits were Canadian vessels involved in the search for hydrocarbon resources offshore in the Canadian shelf in the Beaufort Sea. Also included in the period were tankers carrying fuel for the various explorations and bulk carriers transporting ore from the Nanisivik mine on Strathcona Sound. The year 1993 saw the Government of Canada spearhead an initiative bringing together various international shipping companies and Arctic coastal states in an attempt to develop a shared set of international standards that could govern the operation and construction of vessels that would function in Arctic waters.

Growing population in the 21st century, together with increases in community re-supply and oil and gas development, has led to a greater demand for shipping in the region. The uncertainty of the NWP due to seasonality, ice conditions, complex archipelago, draft restrictions, choke points, lack of adequate charts, insurance and other costs prohibits the likelihood of regularly scheduled trans-Arctic voyages; yet destinational shipping is anticipated to increase incrementally in the Canadian Arctic. Although community growth will drive a steady increase in the demand for seasonal re-supply activity, the primary areas of increased activity will be resource-driven (See page 112).

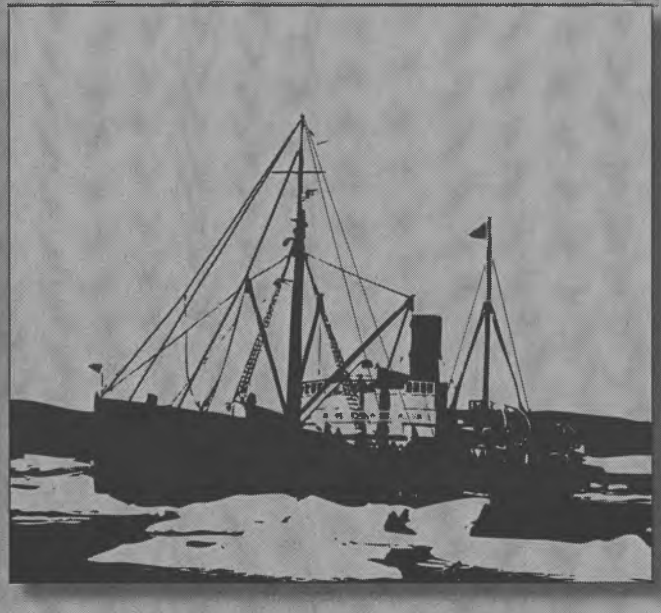
Cold War Marine Activity: Construction of the DEW Line

The Distant Early Warning (DEW) Line was a linked chain of 63 communication and radar systems, spanning 3,000 miles - from Alaska's northwest coast to Baffin Island's eastern shore opposite Greenland - set up to detect incoming Soviet bombers during the Cold War. It was located entirely within the Arctic Circle, with 42 of the 63 sites situated on Canadian territory.

Between 1954 and 1957, the DEW Line was constructed, and more than 300 ships plied Arctic waters during the two summer navigation seasons carrying more than 300,000 tonnes of cargo. This initiative allowed access into the Canadian Arctic through three major sealifts: the West Coast Sea Lift, the East Coast Sea Lift and the Inland Sea Lift.

Hudson Bay Company Voyages

In terms of commercial shipping, the most impressive record of voyages in ice-infested waters, both in terms of length and its successes, is that of the annual voyages by the ships of the Hudson's Bay Company. For 243 years, from 1670 to 1913, 600 voyages were made from London, England, to trading posts in Hudson Bay, Canada. Of the ships involved in the 600 voyages, 18 were wrecked (the majority of these was not sunk by ice; most either ran aground or foundered in open water). In 1912, the steel-hulled steamer *Nascopie*, which sailed out of Montreal, replaced the ships sailing annually from London. In her first year, the *Nascopie* ran aground in uncharted waters, underlining the achievements of the Hudson's Bay Company's earlier captains who safely made 582 voyages from London through the icy waters of Hudson Strait to its various posts in the Bay, and back.



39,251
Whaling voyages from 1610-1915.

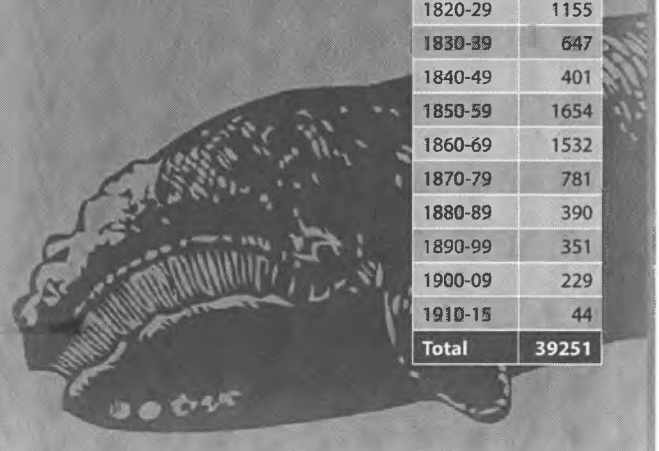
Whaling

Undoubtedly the most massive, sustained activity in terms of Arctic marine shipping was that of whaling. Between 1610-1915, a little more than 39,000 voyages were undertaken in the Arctic in pursuit of the bowhead whale. This activity focused on four main areas: the Svalbard/Greenland Sea area, Davis Strait and Baffin Bay, Hudson Bay, and the Bering, Chukchi and Beaufort seas. The main participating nations were the Netherlands, Germany, Britain and the United States.

This activity was pursued mainly in ice-infested waters and the number of ships and men lost was extremely high. At the same time, the whaling industry resulted in the accumulation of a vast amount of specialized knowledge of patterns of ice distribution and of ship-handling in ice knowledge upon which the Royal Navy, for example, [illegible] by appointing usually two whaling captains as ice-pilots on board each of the vessels engaged in the search for the missing Franklin expedition in 1848-1855.

Table 3.2 Total Arctic Whaling Voyages

1610-19	242
1620-29	149
1630-39	178
1640-49	246
1650-59	487
1660-69	1007
1670-79	1558
1680-89	2522
1690-99	1518
1700-09	2175
1710-19	1944
1720-29	3001
1730-39	2336
1740-49	1996
1750-59	2419
1760-69	2339
1770-79	2341
1780-89	2104
1790-99	1385
1800-09	865
1810-19	1255
1820-29	1155
1830-39	647
1840-49	401
1850-59	1654
1860-69	1532
1870-79	781
1880-89	390
1890-99	351
1900-09	229
1910-15	44
Total	39251



Many of the ships lacked ice-capability, a fact that often resulted in shorn propeller blades and hull punctures. Beyond retroactive measures, such as adding a nickel-aluminum-bronze alloy propeller or steel sheathing, the American Military Sea Transportation Service engaged in a construction program that saw the building of ships designed specifically for operation in an Arctic environment. A new class of tankers included construction features that were standard for Arctic vessels, such as cargo booms and a secondary wheelhouse.

Largely as a result of American interest in the North, Canada was driven to acquire icebreakers and cultivate a greater navigational ability in Arctic waters. Increases to Canada's Arctic vessel capacity, in the early-to-mid 1950s, took the form of the *CGS d'Iberville* (1952) and the *HMCS Labrador* (1954).

The U.S. fleet was split into two task forces. The first - with three icebreakers, a pair of tankers, 27 cargo ships and nearly two-dozen support craft - sailed east and around Point Barrow, bringing with it supplies that would be delivered to the Northern Transportation Company. The second and larger task force comprised seven icebreakers, a dozen tankers, 14 support vessels, four passenger ships and 31 cargo ships. In 1957, the U.S. Coast Guard sent three icebreakers on a complete transit through the passage with partial Canadian icebreaker support, in a successful attempt to gauge whether ships could escape to the east when iced-in on the west.

Cold War operations, especially the creation of the DEW Line, played a unique role in Arctic shipping. Knowledge gained - from design modifications, crew competency, vessel maneuverability in ice, infrastructure and governance concerns - continues to be expanded upon.

Manhattan

The *SS Manhattan* became the first commercial ship to break through the NWP. Even though the *Manhattan* carried no cargo on the initial NWP voyage (the tanks were filled with water to simulate loading), the ship picked up a symbolic barrel of oil in Alaska, returning to New York a merchant hero. The voyage prompted passionate discussions in Canada about sovereignty, followed by the passage of the *Arctic Waters Pollution Prevention Act* (AWPPA). Information gleaned from the two *Manhattan* Arctic voyages - test trials in ice - proved extremely valuable to future icebreaking designs (See page 40).

The discovery of a major new oil field on Alaska's North Slope at Prudhoe Bay in the spring of 1968 signaled the start of a new era of oil transportation technology. Two of the three

The Manhattan was successful as a large model test ship, as the vessel broke thicker ice than any ship in history.

companies involved, ARCO and BP, intended to build a pipeline over Alaska's Brooks Range to deliver the crude to an ice-free port in Valdez for tanker shipment south. But because of traditional tanker "flexibility credits" and the possibility of delivering crude direct to both U.S. west and east coasts, a small group in the third company, Humble Oil and Refining (now ExxonMobil) persuaded parent company Standard Oil of New Jersey, to make a study of icebreaking tankers.

In 1969, four shipyards, an international team of maritime experts and three major oil companies pitted their considerable technical, creative and financial resources together to attain the goal of taking a tanker through the infamous NWP. For this voyage the *Manhattan* had to undergo extensive refit to convert this merchant vessel into an icebreaking tanker. The conversion, lasting eight months (from December 1968 to August 1969) with work being split among four shipyards, cost $US28 million (the entire experiment, with two test voyages originally estimated at $US10-15 million, eventually ended up, 21 months later, costing $US58 million).

The *Manhattan* set sail in August of 1969 with 126 on board (45 crew members, journalists, U.S. politicians, Canadian parliamentarians, scientists, naval architects, marine engineers, etc.) for the 4,400-mile journey. Of key importance and significance were the escorting icebreakers accompanying the *Manhattan*, especially the Canadian icebreakers *John A. MacDonald* and later the *Louis S. St. Laurent*. In this voyage the *Manhattan* was successful as a large model test ship, as the vessel broke thicker ice than any ship in history.

In its second voyage the following April, the multi-year ice was so tough that the ship couldn't enter the passage but went instead to Pond Inlet where further icebreaking tests were carried out. Following the two voyages, a model of the *Manhattan* was built and tested in Wartsilla's new ice model basin in Finland. Built specifically to support the *Manhattan* voyage, the basin opened the door for ice technology exchange between Soviet and Finnish scientists, a lesser-known part of the *Manhattan* legacy.

Map 2.1 The route followed by the *SS Manhattan*. *Source: AMSA*

Lessons Learned from the *Manhattan* Voyage

What had clearly been learned in the 1969 voyage were several basic Arctic icebreaking truths:

- A large mass moving at decent speed (our "model") could break very tough multi-year ice and ridges, but it would need real backing power to prevent getting stuck, an absolute "must" if un-escorted tankers were to succeed.
- Maneuverability in ice is very difficult for a "parallel body" merchant ship shape even with bow bulges.
- Geared steam turbine machinery with new propellers and shafts could withstand the severe shocks that broken ice floes going through the propellers often caused.
- In near open water conditions, growlers and bergy bits were able to cause major structural damage in non-reinforced parts of the ship's hull.
- Success of icebreaking tankers would be very much in the hands of a ship's crew, even with reconnaissance by aircraft and side-looking radar, to find preferable routes though the ice.

Most important was the conclusion supported by all who participated in the *Manhattan* voyage was that it is technically and economically feasible to use non-escorted large icebreaking merchant ships for the routes explored, and most likely also for the Northern Sea Route.

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M/V Arctic

Within the same time period as Beaufort Sea activity, another important Arctic marine story, that of *M/V Arctic*, was taking place. The *M/V Arctic* was built in 1978 at a shipyard on the Great Lakes, and subsequently has a relatively narrow maximum allowable beam of 22.9 meters as required for passage through the Great Lakes lock system. Coupled with a required deadweight and draft limitation, this resulted in a 38,500 ton vessel having a rather high length to beam ratio of 9.2. This is far from ideal for an Arctic vessel, since it limits maneuverability in close ice. However, the ship is still a workhorse in the Canadian Arctic, more than 30 years later. The *M/V Arctic's* operations have mostly been stand-alone, with no dedicated icebreaker support, as is the commercial Canadian Arctic marine tradition. The ship was upgraded extensively in 1986 with a new flat Melville bow and increased hull strength. The original geared diesel, deeply immersed, single ducted CPP propulsion system was unaltered. These modifications allowed *M/V Arctic* to extend its operating field and season. The ship serviced the Nanisivik and Polaris mines in the high Arctic for nearly 20 years until 2002, and then the Raglan mine in northern Quebec and Voisey's Bay mine in Labrador. The ship also transported the first Arctic oil to market from Bent Horn on Cameron Island in 1985 and continued that operation until 1996.

Research and development has been constant through many projects over the years, and for three decades the ship has provided valuable ship performance data on vessel design, hull strength and trafficability. Of particular importance to future Arctic transportation, *M/V Arctic* has always been a test platform for the development of advanced ice navigation systems that have integrated the latest remote sensing technologies with bridge navigation equipment.

The Great Northern Expedition

In Russian history, the Great Northern Expedition refers to a wide enterprise initially conceived by tsar Peter I the Great. The tsar had a vision for the 18th century Russian navy to map the Northern Sea Route to the East. This vast and far-reaching endeavor was sponsored by the Admiralty College in St. Petersburg. In 1725, Russian explorers under the leadership of Captain Vitus Bering, a Dane serving in the Russian navy, made the first expedition voyage on *Sviatoy Gavriil* starting in Kamchatka and going north to the strait that now bears his name.

The major sailing of the Great Northern Expedition was undertaken between 1733 and 1743 through a series of voyages led by Aleksei Chirikov. The goal of the expedition was to find and map the eastern reaches of Siberia, and to hopefully continue on to the western shores of North America to map them as well.

The important achievements of the expedition included the discovery of Alaska, the Aleutian Islands, the Commander Islands and Bering Island, as well as a detailed cartographic assessment of the northern and northeastern coast of Russia and the Kuril Islands. The expedition also refuted definitively the legend of a land mass in the north Pacific. It also included ethnographic, historic and scientific research into Siberia and Kamchatka. When the expedition failed to round the northeast tip of Asia, the dream of finding an economically viable Northeast Passage, alive since the 16th century, was at an end.

With more than 3,000 people directly and indirectly involved, the Second Kamchatka expedition was one of the largest expedition projects in history. The total cost of the undertaking, completely financed by the Russian state, reached the estimated sum of 1.5 million rubles, an enormous amount for the period. This corresponded to one-sixth of the income of the Russian state for the year 1724. Because of its complexity and scale, the voyages became known as the Great Northern Expedition.

Despite the extreme hardships and numerous deaths, mainly from scurvy, the Great Northern Expedition represented a remarkable accomplishment in terms of organization, perseverance and courage. More so, it resulted in an outstanding compilation of knowledge. In tangible terms, the expedition resulted in 62 maps and charts of the Arctic coast and Kamchatka. It is interesting to contrast the general chart of the Russian Arctic resulting from the Great Northern Expedition with what was known of the Arctic coast of North America at the same date (by then William Baffin's voyages and Baffin Bay had long been forgotten and the only part of the Arctic coast reliably known and charted was that of the Hudson Bay and Strait).

The quest for a new route to reach China and India from the Atlantic via north of the Russian coastline spanned more than five centuries, beginning in the 15th century with English, Dutch and Russian navigators.

Northeast Passage

The quest for a new route to reach China and India from the Atlantic via north of the Russian coastline spanned more than five centuries, beginning in the 15th century with English, Dutch and Russian navigators sailing along the northern coast of Russia and far into the Arctic seas.

Early explorers of the area included Willem Barents and Olivier Brunel. Under the auspices of the Russian tsar Peter I the Great, Semyon Dezhnyov is likely to have sailed the region in 1648 and Vitus Bering is known to have sailed northward through the Bering Strait in 1728.

In Russia, the idea of a possible seaway connecting the Atlantic and the Pacific was first put forward by the diplomat Gerasimov in 1525. However, Russian settlers and traders on the coasts of the White Sea, the Pomors, had been exploring parts of the route as early as the 11th century. By the 17th century they established a continuous sea route from Arkhangelsk as far east as the mouth of Yenisei.

In 1648, the most famous expedition, led by Fedor Alekseev and Semyon Dezhnev, sailed east from the mouth of Kolyma to the Pacific and doubled the Chukchi Peninsula, thus proving that there was no land connection between Asia and North America.

Eighty years after Dezhnev, in 1725, another Russian explorer, Danish-born Vitus Bering on *Sviatoy Gavriil* made a similar voyage in reverse, starting in Kamchatka and going north to the strait that now bears his name. It was Bering who gave their current names to the Diomede Islands, discovered and first described by Dezhnev. Bering's explorations in 1725–30 were part of a larger scheme initially devised by Peter the Great and known as the Great Northern (or Kamchatka) expedition. The Second Great Northern Expedition took place between 1735-42. The Northeast Passage (NEP) was not traversed by anyone until Baron Adolf Erik Nordenskjöld of Sweden accomplished the feat in 1878-79 aboard the *Vega*.

Coupled with the ongoing search for a NEP, voyages using the Kara Sea route to Western Siberia played a pivotal role in Arctic marine transport. Two expeditions achieved transits of a substantial part of the NEP, including Fridjof Nansen's *Fram* (1893-1896) and the Baron Eduard Toll expedition on board *Zarya* (1900-1903). *Maud,* commanded by Roald Amundsen (1918-1920), was the fourth ship to complete a transit of the NEP and, as a result, Amundsen achieved the distinction of being the first person to circumnavigate the Arctic Ocean, since he had now linked up with the track of his voyage in the *Gjoa*.

The first one-season transit route was not accomplished until 1934, when Glavsevmorput (Glavnoye Upravleniye Severnogo Morskogo Puti or GUSMP - Chief Administration of the NSR) mounted a successful attempt with the icebreaker *Fedor Litke*.

The crew of the *Fram*. *Source: The National Library of Norway, Picture Collection*

The Northern Sea Route

The Northern Sea Route, or NSR, stretching from the Kara Gate in the west to the Bering Strait in the east, was highly developed by the Soviet Union as an important national waterway, peaking in 1987 with 331 vessels on 1,306 voyages. The western end of the NSR (Kara Sea) has been maintained for year-round navigation since 1978-79 with ships sailing between Murmansk and Dudinka on a regular basis.

The history of commercial use of the NSR can be distinguished by four distinct stages: exploration and settlement (1917-1932); organization of regular navigation coupled with the development of fleet and ports (1932-early 1950s); transformation of the newly developed NSR into a regular operating transportation line during the summer-autumn periods (early 1950s-late 1970s); and finally, efforts to establish year-round shipping (late 1970s-present).

During the first stage, 1917-1932, the NSR was utilized for community re-supply, in addition to sporadic attempts at regional exploitation of resources such as furs, wood, fish, salt, coal, whaling and sealing. In 1932, a Soviet expedition led by Otto Yulievich Schmidt was the first to sail from Arkhangelsk to the Bering Strait in the same summer without wintering en route. The Northern Sea Route was officially open and exploitation began in 1935. Advanced Soviet navigational skills, technological capability and experience in ice navigation were unrivaled and traffic in the Arctic continued to grow. From 1917-1934 there were only two sinkings out of the 178 round-trip voyages across the Kara Sea to import finished goods to, and export timber from Igarka, along the Yenisei River in central Russia.

From 1932-1953, administration of the Russian Arctic marine activity rested with the Chief Administration of the Northern Sea Route (CANSR), a direct arm of the Council of Peoples Commissars of the Soviet Union, with its goal "to develop the NSR from the White Sea to the Bering Strait, to equip it, to keep it in good order, and to secure the safety of shipping along it." Major additions were made to the Arctic fleet, which carried 100,000 to 300,000 tons of cargo annually and employed 40-150 ships per year.

In 1940, the German vessel *Komet*, an armed raider disguised as a merchant ship, was the first foreign ship in more than 20 years to be granted passage, and it was the last foreign transit for another 50 years. When the Soviet Union entered the war in 1941, the route became important for bringing Allied supplies into the country. In the four seasons of 1942-1945, 120 ships transported approximately 450,000 tons of relief supplies, which amounted to half the freight turnover for the NSR during this period.

In 1953 CANSR became a department under the Ministry of Merchant Marine in Moscow and for 17 years the infrastructure was improved to provide the capability for both summer and autumn shipping. In 1959, the Soviets launched the world's first nuclear-powered surface ship, the icebreaker *Lenin*, extremely significant as it expanded the range of travel in isolated regions.

After CANSR became the Administration of the Northern Sea Route (ANSR) in 1970, the emphasis became year-round trafficability. By the 1978-79 season, the western end of the NSR achieved year-round navigation with ships sailing between Murmansk and Dudinka on a regular basis. Other landmark voyages during this era of Russian Arctic marine transport history include the 1977 voyage of the *Arktika* to the geographic North Pole and the first complete high latitude passage by the surface vessel *Sibir* in 1978. By the mid-80s, the total volume of traffic passages through the NSR amounted to 6.6 million tons annually.

The NSR was formally opened to non-Russian vessels in the summer of 1991, only a few months before the Soviet Union was dissolved. Several developments have occurred during this modern period of Arctic marine transport history: the creation of the NSR Administration, the commissioning of the International Northern Sea Route Programme, the formation of the Noncommercial Partnership for the Cooperation of the Northern Sea Route Usages, leasing cargo space aboard Soviet SA-15 icebreaker cargo carriers, great strides in developing fleet and port infrastructure, and the establishment of year-round navigation in the western part of the Arctic.

The NSR is a substantially shorter passage (35-60 percent savings in distance) for shipping between northern European ports and those of the Far East and Alaska than routes through the Suez or Panama Canals. The ANSR, responsible for the overall planning, coordination and execution of organizational and regulatory activities for marine operations, is working to strengthen the competitiveness of the NSR. The Russian fleet of the world's most powerful icebreaking ships and special ice-strengthened ships for moving most types of cargo, highly developed infrastructure along the NSR and specialized ice navigation skills demonstrate that navigation along the NSR is technically feasible and that there is a cargo base for import, export and conceivably transit.

1991
The year the Northern Sea Route was open to non-Russian ships.

Arctic Tourism

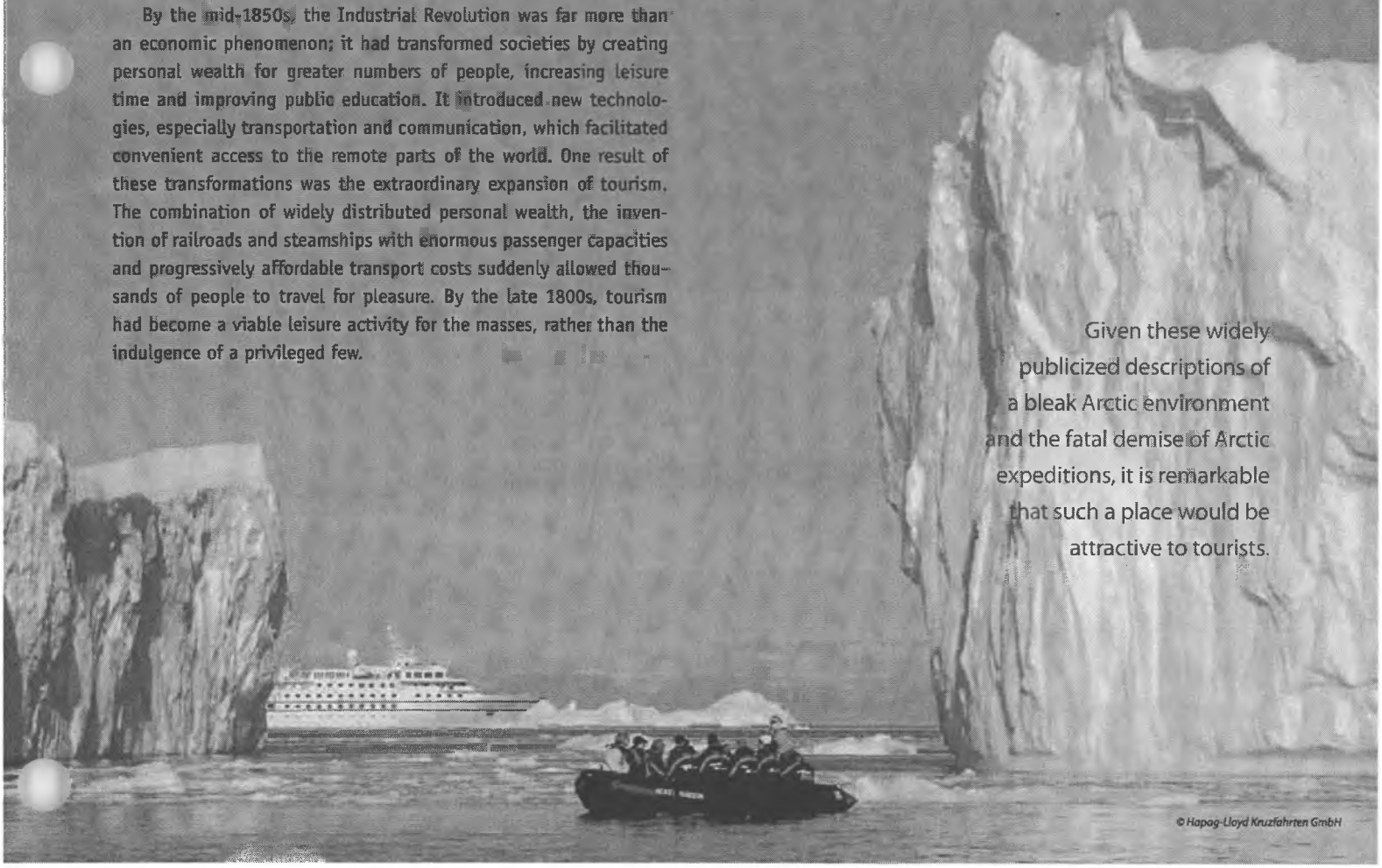
For most of European and American history, the many attempts to explore and occupy high latitudes were characterized by peril and tragedy. From 1576 onwards, numerous ventures into these cold, remote and icy places were conducted to obtain economic benefits and expand empires. All of the expeditions experienced hardships and many ships foundered and men perished in their attempts to penetrate these unknown seas and lands. By the 1800s, newspaper and book publications describing both the heroic and tragic aspects of polar exploits were immensely popular. Given these widely publicized descriptions of a bleak Arctic environment and the fatal demise of Arctic expeditions, it is remarkable that such a place would be attractive to tourists. But, in fact, tourists began visiting the Arctic in the early 1800s and their attraction to this unlikely destination has grown steadily for more than two centuries.

Arctic Tourism for the Masses

By the mid-1850s, the Industrial Revolution was far more than an economic phenomenon; it had transformed societies by creating personal wealth for greater numbers of people, increasing leisure time and improving public education. It introduced new technologies, especially transportation and communication, which facilitated convenient access to the remote parts of the world. One result of these transformations was the extraordinary expansion of tourism. The combination of widely distributed personal wealth, the invention of railroads and steamships with enormous passenger capacities and progressively affordable transport costs suddenly allowed thousands of people to travel for pleasure. By the late 1800s, tourism had become a viable leisure activity for the masses, rather than the indulgence of a privileged few.

By the late 1800s, steamship and railroad companies had achieved the capacity to transport large numbers of passengers. Given intense competition between those companies, travel costs were progressively lowered to attract customers and successfully compete. Simultaneously, companies aggressively expanded their transport networks to previously inaccessible regions, including the Arctic. All of those business decisions enabled more people to travel to more destinations.

In 1850, Arctic marine tourism by commercial steamship was initiated in Norway. By the 1880s, Arctic marine tourism was a booming business. Arctic destinations included Norway's fjords and North Cape, transits to Spitsbergen, Alaska's Glacier Bay and the gold rush sites as far north as Homer, riverboat cruises in the Canadian Yukon, and cruises to Greenland, Baffin Bay and Iceland. The tourist experience aboard the steamships was a mixture of exploration and luxury. Little known or recently discovered glaciers, bays, wildlife and indigenous communities attracted curious tourists led by Arctic explorers and naturalists. Shipboard life emphasized lavish meals, concerts



Given these widely publicized descriptions of a bleak Arctic environment and the fatal demise of Arctic expeditions, it is remarkable that such a place would be attractive to tourists.

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468

Researchers and experts from more than 100 institutions in 14 countries – the numbers involved in the International Northern Sea Route Programme.

provided by orchestras, beauty parlors and barbershops, photography studios and lectures presented within library settings. All of the 19th century Arctic destinations were commercially successful and cruise ship companies have continued to operate and expand their itineraries throughout those and other Arctic regions for more than a century. In addition, the combined themes of expedition and luxury cruising have also persisted to the present time.

By 1900, Arctic tourism was a flourishing commercial activity. Its diversity included independent travelers pursuing a variety of adventurous recreation activities in marine and land environments, as well as groups touring natural, wildlife, historical and cultural attractions. All of these Arctic tourism activities were extensively promoted in guidebooks and the popular press. Companies specializing in guidebooks, such as John Murray and Baedeker, came into existence at this time. And travel literature encouraging mass travel regularly appeared in widely distributed periodicals such as Harper's Weekly, The Century Magazine and the National Geographic Society Magazine. From the mid-1800s onward numerous editions of Arctic guidebooks would regale the splendors of the Land of the Midnight Sun.

The economic benefits of the Arctic tourism industry were immediately evident to both private companies and Arctic governments. Tourism provided jobs, personal income, revenues and financial capital for infrastructure. It also represented a new way to use the Arctic's natural resources. It was a departure from the resource extraction and depletion industries such as hydraulic mining, rampant timber harvesting, and the exploitive commercial fishing and whaling practices of the 19th and early 20th centuries.

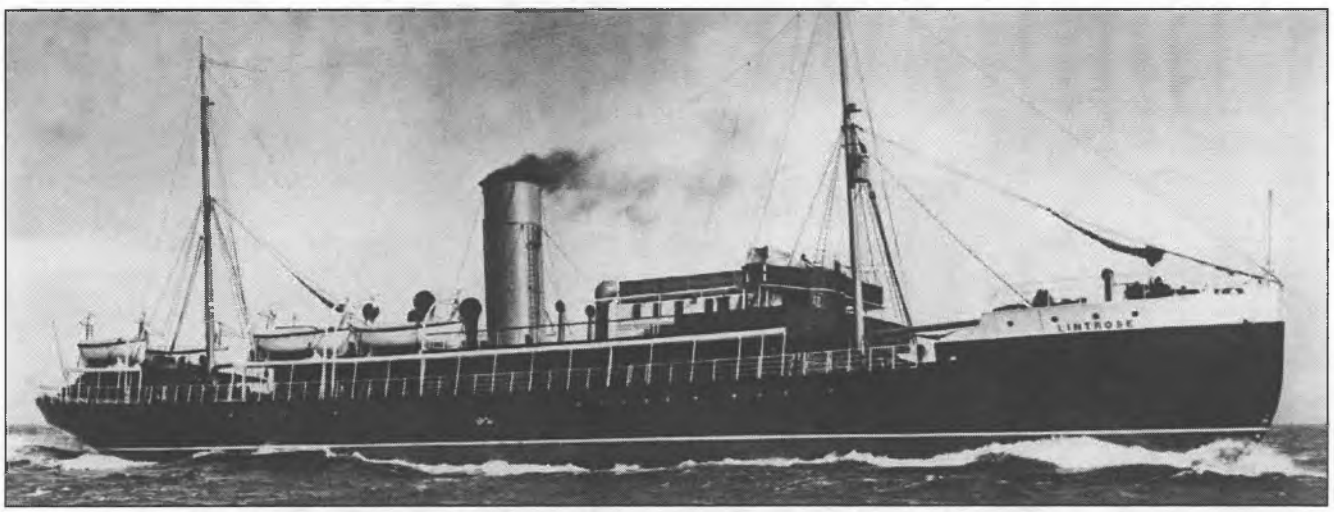
Major Arctic Marine Transport Programs, Studies and Workshops

Previous Arctic marine transport studies, workshops and reports contain a wealth of findings, recommendations and research agendas of significant importance to the AMSA and to any policy and regulatory framework for the future. Broad Arctic navigation studies, such as the 1993-1999 International Northern Sea Route Programme (INSROP), the 2001-2005 Arctic Operational Platform (ARCOP) and the 2002-2005 Japan Northern Sea Route-Geographic Information System (JANSROP-GIS) form a knowledge base on Arctic navigation in addition to localized findings such as the Alaskan trafficability studies. A summary of the 2004 Cambridge Workshop provides an intellectual synthesis of Arctic marine transport.

International Northern Sea Route Programme

The International Northern Sea Route Programme was the most comprehensive marine transport study ever undertaken prior to the AMSA, with the aim to create a research-based knowledge bank of commercial, international shipping on Russia's Northern Sea Route across the top of Eurasia in the Arctic Ocean.

The program was led and coordinated by three principal partners: the Ship and Ocean Foundation (SOF) of Tokyo, Japan; the Central Marine Research and Design Institute (CNIIMF) of St. Petersburg, Russia; and the Fridtjof Nansen Institute (FNI) in Oslo, Norway. The numbers involved are impressive: 468 researchers and experts from more than 100 institutions in 14 countries; 104 projects; an experimental voyage through the NSR; two large international conferences.



Historic photo

Growing population in the 21st century, together with increases in community re-supply and oil and gas development, has led to a greater demand for shipping in the region.

This work produced 167 peer reviewed working papers and a large number of articles and books governing almost every relevant aspect of shipping on the NSR. Funding was provided by the Nippon Foundation, Ship and Ocean Foundation, both from Japan, as well as various Norwegian sponsors and the Soviet Union.

It was acknowledged that the international shipping industry would need information and analysis before committing investments or vessels to the previously unknown route. On the initiative of the Soviet Ministry of Merchant Marine, contact was made with FNI to create an international research project, with St. Petersburg-based CNIIMF coordinating on the Soviet side. A pilot study was produced in 1990-1991. In 1992, SOF joined the partnership, and in May 1993 the three organizations signed an agreement establishing a secretariat at the Fridtjof Nansen Institute in Norway to coordinate the effort.

INSROP was designed as a multi-national, five-year effort, to be executed in two phases with a review conducted after three years. Four sub-programs were identified: 1) Natural conditions and ice navigation; 2) Environmental aspects; 3) Trade and commercial shipping factors; and 4) Political, legal and strategic aspects. In August 1995, a successful experimental transit voyage was conducted from Yokohama, Japan to Kirkenes, Norway onboard the Russian ice-strengthened carrier *Kandalaksha*, demonstrating the NSR's technical feasibility.

In 1999, final findings of INSROP were presented at an NSR user conference in Oslo, Norway, bringing to a close the massive research project. It took years of diplomatic networking, negotiations and lobbying to shape the program and to obtain funding. It was often difficult to bridge language and cultural gaps between the three principal partners - the Japanese, the Norwegians and the Russians - who often maintained different priorities and varying business practices.

INSROP demonstrated that navigation along the NSR was technically feasible, with a cargo base for export, import and conceivably transit. INSROP also noted challenges to overcome. INSROP did not include research on climate change and how ice conditions might eventually enable large scale shipping.

A wealth of new and unique knowledge on the Russian Arctic was produced and made available to the international community. INSROP also pioneered cooperation between Russian and foreign researchers in Arctic-related fields, and created a platform for further Arctic multidisciplinary studies.

Research Opportunities

- Extraction of sea ice data from historical journals and log books from Arctic exploring and whaling ships.
- Comprehensive study of the history, design evolution and use of icebreakers.
- Regional and local studies with mapping of the multiple uses (indigenous, commercial & government) in Arctic waterways.
- Develop a comprehensive database of damages to ships operating throughout the Arctic Ocean for use in risk assessments; develop, where possible in the historic record, detailed cause & effect reviews of each damage case.
- Comprehensive review of changes in Arctic marine technology during the past six decades, specifically for Arctic commercial ships, and how these changes may influence the future of Arctic marine transport systems.

U.S. Trafficability Studies of 1979-86

With the advent of offshore oil and gas leases in the 1970s, studies were required to assess the feasibility of year-round marine transportation in ice-covered waters of the Alaska Arctic, yet no amount of analytical modeling or studies without actual field data could provide the information and insight needed. Therefore, the U.S. Maritime Administration (MARAD) embarked on a multi-year program (1979-1986) to:

- Demonstrate the operational feasibility of commercial icebreaking ships along possible future Arctic routes;
- Define environmental conditions along routes in the Bering, Chukchi and Beaufort seas; and,
- Obtain data to improve design criteria for ice-capable ships and offshore structures.

To assess the feasibility of commercial icebreaking ships along possible future Arctic routes, two U.S. Coast Guard *Polar Class* icebreakers, the *Polar Star* and *Polar Sea*, the world's most powerful non-nuclear icebreakers and the only U.S. ships capable of mid-winter Arctic operations, were utilized as data collection platforms. During the eight-year research program, 15 icebreaker deployments occurred aboard the icebreakers and 14 of those were in the Alaska Arctic. General ship performance of trafficability data was continuously collected and summarized in 30-minute increments whenever the icebreakers changed locations.

Two dedicated transits (1981, 1983) from the south Bering Sea to the north Chukchi Sea were designed to simulate, as best as possible, a non-stop transit from the ice edge to northern Alaska. These voyages indicated that routing in the future could be around both ends of St. Lawrence Island and refuted the views of some experts that transit through the Bering Strait was not feasible in winter.

Thousands of ice thickness measurements were made, resulting in the formulation of a representative set of ice conditions for an Alaska route; supplemented with tables that offer suggestions on changes to reflect mild and severe ice conditions and possible voyage delays due to pressured ice conditions. In addition, zones of ice severity for the Bering, Chukchi and Beaufort seas were developed to provide designers and operators with a strategic perspective on year-round Arctic marine transportation systems.

Several major projects were performed onboard the icebreakers to aid in the development of advanced icebreaking hull forms and Arctic commercial vessels capable of year-round operations. The resulting analysis from eight years of data collection made a significant contribution to the knowledge of ice loads and the structural design of all icebreaking ships.

With 15 voyages of data, the U.S. Arctic Marine Transportation Program of 1979-86 was one of the most extensive field tests of icebreakers in history and has provided a valuable knowledge base for future considerations and a model for future cross-border research initiatives. Briefly, key findings from the operational, environmental and technical data can be summarized as follows:

- Field data can provide the at-sea ground truthing of ship modeling/studies, which may help to reduce the perceived risks of year-round marine transportation in the Arctic.
- The offshore Bering, Chukchi and Beaufort seas are extremely dynamic and ship icebreaking activities must be able to cope with the ever-changing ice environment. The most critical elements for successful ice navigation are crew skills and applied technology.

Arctic Marine Transport Workshop: Cambridge University

Amid growing interest and concern over the rapid climate changes occurring in the Arctic, experts in Arctic marine transport and international marine safety, as well as researchers of sea ice and climate change, met at the Scott Polar Research Institute at Cambridge University in October 2004 to create a research agenda and identify critical issues related to the future of Arctic shipping.

Co-sponsored by the Institute of the North, the United States Arctic Research Commission and the International Arctic Science Committee, the international gathering included 54 maritime experts and representatives from 11 countries (United States, Canada, Russian Federation, Sweden, Iceland, Denmark, Norway, the United Kingdom, Finland, Germany and Japan).

The three-day workshop provided the opportunity to study the extraordinary retreat of Arctic sea ice and what that means to the Arctic Ocean as a potential waterway for marine operations. While each area of discussion produced suggested topics for scientific research and questions on policy issues that were incorporated in the conference report, a few crosscutting conclusions emerged:

1. An inter-disciplinary research agenda needs to include economic analysis, assessments, Law of the Sea, indigenous Arctic communities, core issues of conflict, marine safety and environmental protection, and climate change impacts on future marine access.
2. The magnitude of sea ice variability creates difficult challenges for Arctic marine transport planning and adequate risk assessment.
3. Arctic marine charts and aids to navigation need to be updated and airborne ice information enhanced with satellite coverage.
4. Two key factors are needed to expand and develop the use of the Arctic Ocean as a shipping corridor: route reliability and security. Increased Arctic shipping will require an increase in the monitoring and enforcement of national and international laws governing ship security.
5. Multiple economic drivers could fuel expanded use of Arctic marine transportation. Incremental expansion would result in an incremental growth in regional traffic. However, a decision by world shippers to use the Arctic Ocean as an alternate route would require large scale global investments of escort vessels, aids to navigation and staging ports to transfer cargo between ice-strengthened and non ice-strengthened ships.

The workshop identified that the retreat of Arctic sea ice may lead to several plausible futures for the Northern Sea Route, Northwest Passage and central Arctic Ocean, requiring further research, planning and cooperation, as well as consideration of future development of transshipment and port infrastructure.

Findings

1] Despite attempts through history to make the Northwest Passage (NWP) a viable route between the east and west, the passage has not become the global trade route it was originally envisioned.

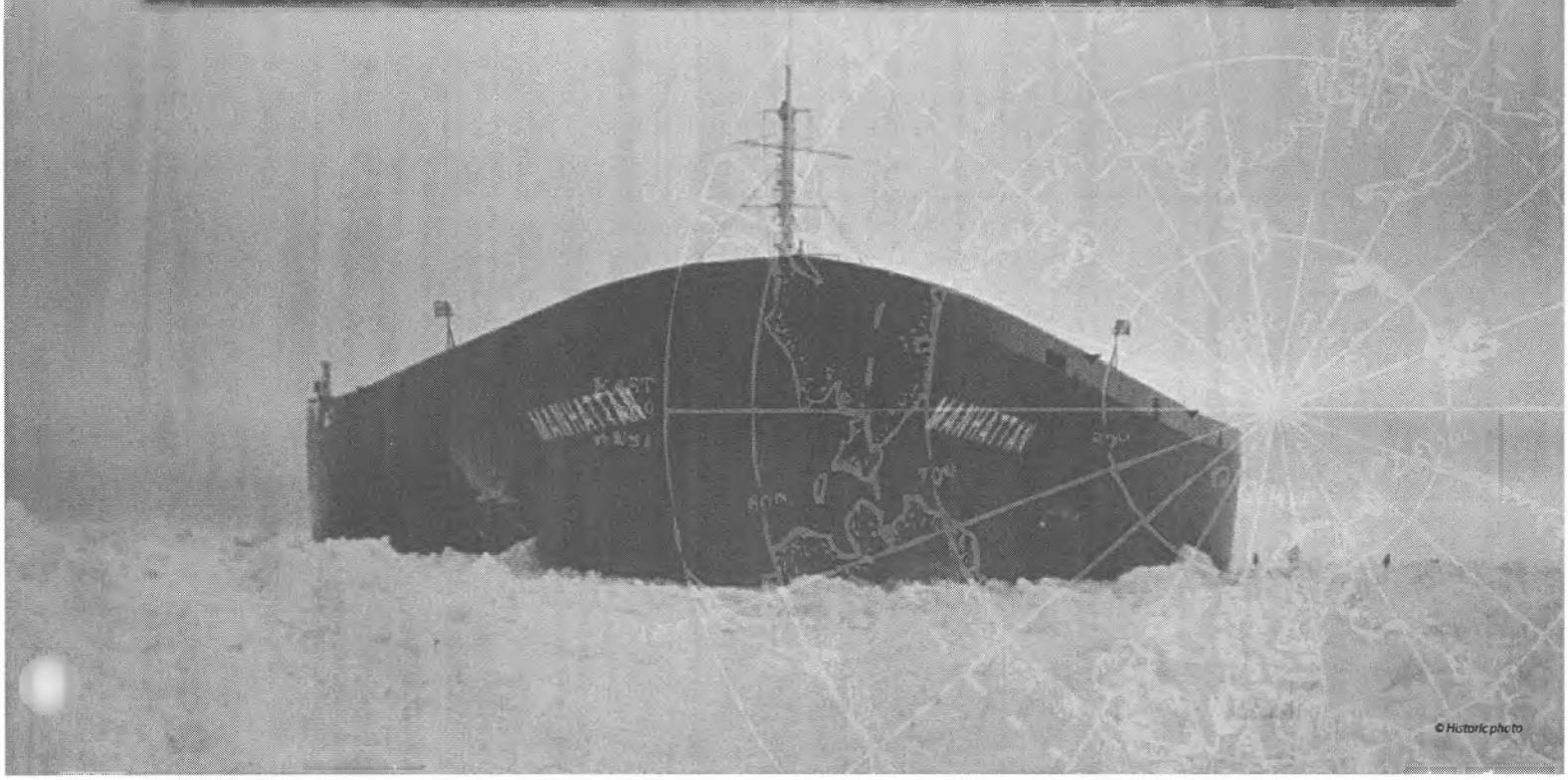
2] The Northern Sea Route (NSR) was highly developed during the Soviet Union era as an important national waterway facilitating Arctic marine transport. Notably, year-round navigation on the western NSR (i.e., from the port of Dudinka on the Yenisei River to Kara Gate) has been maintained since the 1978-79 winter season.

3] Field data can provide the at-sea ground truthing of ship modeling/studies, which may help to reduce the perceived risks of year-round marine transportation in the Arctic.

4] Icebreaking technology has been key to the development of Arctic marine transport in all regions of the Arctic Ocean.

5] Previous Arctic marine transport studies, workshops and reports contain a wealth of findings, recommendations and research agendas of significant relevance to AMSA and to any regulatory framework for the future.

6] Joint agency/ministerial research, public-private partnerships and international cooperation have been beneficial to tackling the many challenges of future Arctic marine transport systems.



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GOVERNANCE OF ARCTIC SHIPPING

The governance of shipping activities in the Arctic might be described as a complicated mosaic. The Law of the Sea, as reflected in the 1982 *United Nations Convention on the Law of the Sea* (UNCLOS), sets out the legal framework for the regulation of shipping according to maritime zones of jurisdiction. Other international agreements address specific elements of shipping such as marine pollution prevention standards, ship safety, seafarer rights and qualifications and liability and compensation for spills. In addition, Canada and the Russian Federation have adopted special national legislation for ships operating in ice-covered waters within their EEZs. Descriptions of international law, including as reflected in the UNCLOS, are included for the benefit of the reader and are not intended to constitute interpretations.

A wide range of actors affect the law, policy and practice applicable to shipping in the Arctic. In addition to governments, shipowners, cargo owners, insurers, port authorities, trade and labor union associations, among others, may be involved in determining when and where shipping in the Arctic should occur and under what conditions.

Governance of shipping is characterized by efforts to promote safety, security, protection of the environment from damage by accident, as well as harmonization and uniformity in international maritime law and standards. The International Maritime Organization (IMO), a specialized agency in the United Nations system, addresses a broad range of issues pertaining to international shipping, including maritime safety, security and environmental protection. Other intergovernmental organizations work closely with the IMO in the governance of international shipping. For example, the International Labour Organization (ILO) has played a seminal role in the establishment of minimum basic standards for seafarers' rights.

The IMO acts as secretariat for most international maritime conventions and facilitates their implementation through the adoption of numerous codes and guidelines aimed at operationalizing and facilitating the implementation of international rules and standards. International conventions and related protocols become binding only on those states that choose to become parties. Upon ratification of a convention, states must formally implement it into their national maritime regulatory regime. States can, however, legislate

the provisions of a convention or protocol without necessarily becoming a party.

An explanation of the governance of shipping would not be complete without noting the critical role played by standard form contracting and related "good practices" developed by industry. For example, in contracts for carriage by sea the carrier must prepare against foreseeable risks and provide a seaworthy ship for the voyage, which must be pursued without deviation or delay and with due care for the cargo or passengers. These standard forms have been recognized and applied by courts around the world.

Law of the Sea, as reflected in UNCLOS: The Overarching Legal Framework

The Law of the Sea, as reflected in UNCLOS, has struck a balance among the powers of coastal states, flag states and port states to exercise jurisdiction and control over shipping. The jurisdictional status of some Arctic waters, in particular internal waters and straits used (or potentially to be used) for international navigation, remains controversial and could give rise to future disputes concerning the exercise of national jurisdiction over international navigation through those waters.

Coastal State Jurisdiction and Control

For coastal states to claim maritime zones in the Arctic in accordance with UNCLOS, they must have coastal frontage in the region. Of the eight Arctic states, Canada, Denmark (Greenland), Norway, the Russian Federation and the United States have coastal frontage in the Arctic Ocean. Iceland has coastal frontage on the Norwegian Sea and Finland and Sweden in the Baltic Sea.

The extent of legislative and enforcement control over foreign ships by the coastal states of the Arctic Ocean varies according to the different maritime zones set out in UNCLOS, namely: internal waters, the territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf (Table 4.1).

The seaward limit of the maritime zones and jurisdictions is based primarily on distance from a combination of the low-water marks along the coast, straight baselines and closing lines for bays. With the exception of the United States, the Arctic Ocean states have proclaimed straight baselines along most or all of their Arctic coasts. Table 4.1 sets out the limits of jurisdictional claims by Arctic Ocean coastal states.

For internal waters, coastal states are entitled to exercise full sovereignty and maximum jurisdiction over ships and can, pursuant to that authority, set conditions for entry into its ports. For example,

Arctic States	Territorial Sea		200 nm Zones		
	3 nm	12 nm	EEZ	Extended Fisheries Protection	Fisheries Protection
Canada		√	√		
Denmark (Greenland)	√		√		
Iceland		√	√		
Norway		√	√		
- Jan Mayen		√		√	
- Svalbard		√			√
Russian Federation		√	√		
United States		√	√		

Table 4.1 Arctic coastal state maritime jurisdictional zone claims. *Source: AMSA*

coastal states might prohibit entry of certain "risky ships", such as substandard ships or those carrying radioactive wastes or other hazardous cargoes, or they might impose "zero discharge" limits on particular ship-source pollutants. The only likely constraint on the exercise of this power is the traditional and customary duty to grant refuge in sheltered waters to a ship in need of assistance.

Internal waters include marine areas on the landward side of closing lines for bays, ports and harbors and historically recognized internal waters. A coastal state may also choose to draw straight baselines around a deeply indented coastline or where there is a fringe of islands in the immediate vicinity of the coast. Waters enclosed would be internal. UNCLOS sets forth the rules on setting baselines.

Exactly which Arctic waters may be claimed validly as internal has been contentious. For example, Canada enclosed its Arctic archipelago with straight baselines, effective January 1, 1986, but the United States and other states protested against the internal waters status claim.

Within the limit of the 12 nautical miles that may be claimed for the territorial sea, Arctic coastal states have full sovereignty, but foreign ships retain the right to innocent passage; that is, passage which is continuous and expeditious, and is not prejudicial to the peace, good order or security of the coastal state. For example, undertaking research or surveys or fishing without the coastal state's

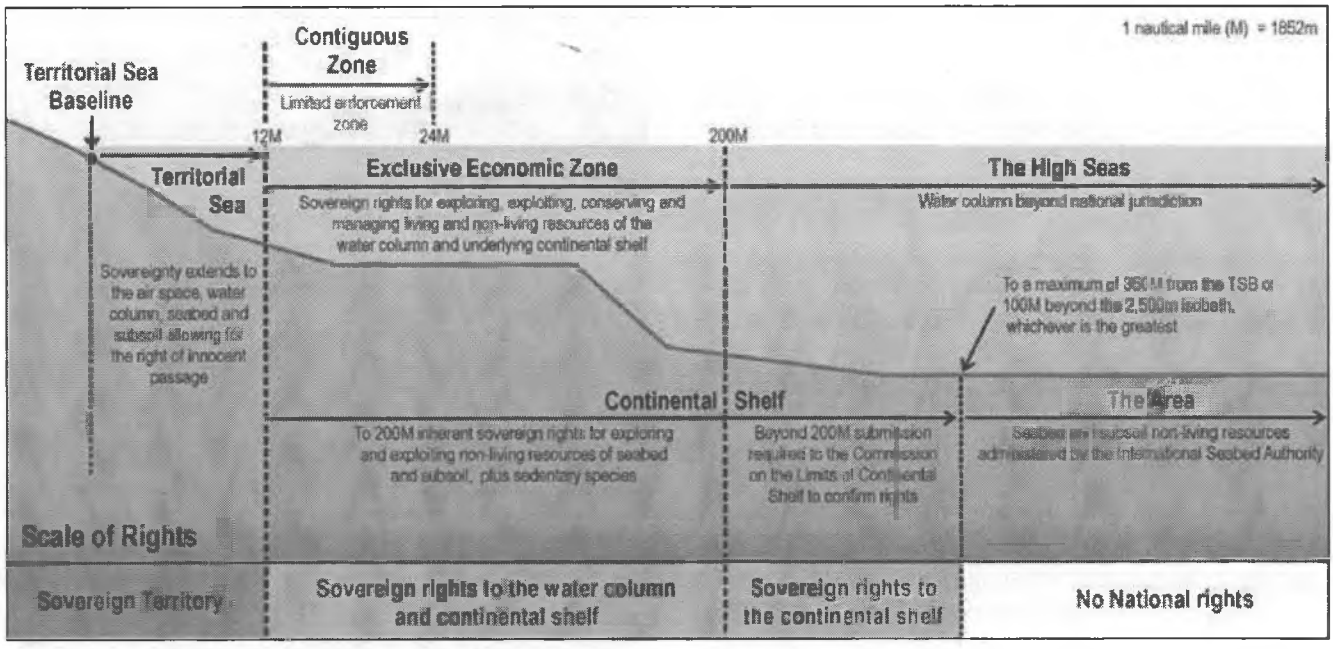

Illustration 4.1 Illustration of maritime zones (for illustrative purposes only). *Source: Geoscience Australia*

consent, or engaging in an act of serious and willful pollution in contravention of UNCLOS would be considered prejudicial to the interests of the coastal state.

UNCLOS allows coastal states the authority to adopt laws and regulations applicable to foreign ships transiting through the territorial sea. Domestic laws can be applied in relation to such things as safety of navigation, preservation of the marine environment and marine pollution control. There are two limits on this authority; namely, that coastal states cannot impose design, construction, crewing or equipment standards on foreign ships unless giving effect to generally accepted international rules or standards; and that such laws may not have the practical effect of denying or impairing the right of innocent passage. Coastal states may also, having regard to the safety of navigation, designate sea lanes and traffic separation schemes for foreign ships. However, the coastal state must take into account IMO recommendations and any channels customarily used for international navigation. They may not impose a charge on the passage itself; only specific fees for services rendered may be charged and without discrimination.

Coastal states may also claim a 12 nautical mile contiguous zone adjacent to the territorial sea (i.e., up to a seaward limit of 24 nautical miles). In this zone, coastal states may exercise necessary control over foreign ships to prevent infringement and to enforce violations of customs, fiscal, immigration or sanitary laws and regulations in their territory or territorial sea.

In a 200 nautical mile exclusive economic zone (EEZ), measured from the territorial sea baselines, coastal states have sovereign rights to explore, exploit, conserve and manage their natural resources, and jurisdiction over such things as protection of the marine environment. In part XII of UNCLOS, the issue of coastal states' ability to regulate shipping for the purposes of pollution prevention and control laws is addressed, which is that laws and regulations applicable to foreign ships must conform or give effect to international rules and standards established through the IMO.

A coastal state has limited enforcement powers in the EEZ against transiting foreign ships violating applicable international rules and standards for preventing and controlling pollution. A coastal state may only undertake physical inspection of a foreign ship where a violation has resulted in a substantial discharge causing or threatening significant pollution of the marine environment. Actual arrest and detention of a foreign ship is only allowed if a violation causes major damage or a threat of major damage to the coastline, interests or resources of the coastal state. In such a case, the coastal state may only impose monetary penalties.

UNCLOS defines the continental shelf of a coastal state as comprising the seabed and subsoil of the submarine areas beyond the

territorial sea to the outer edge of the continental margin, or to at least 200 nautical miles from coastal baselines where the outer edge of the continental margin does not extend to that distance. A coastal state with a continental shelf extending beyond 200 nautical miles has 10 years from the time the convention enters into force for that state to make a submission to the Commission on the Limits of the Continental Shelf. The limits of the continental shelf established by a coastal state on the basis of the recommendations of the commission shall be final and binding. While the coastal state's rights to the resources of the extended continental shelf are exclusive, the waters above the extended continental shelf are high seas. Therefore, the coastal state has no jurisdiction over foreign ships in those waters with very few exceptions (for example, where a foreign ship is undertaking exploration activities on the continental shelf without its consent.) The coastal state may locate artificial islands, installations or structures on an extended continental shelf and include safety zones that are consistent with international standards. However, it may not establish them where interference may be caused to the use of recognized sea lanes essential to international navigation.

Coastal states bordering a strait used for international navigation retain very limited powers over foreign ships because of their right to transit passage. States bordering straits cannot suspend passage and may only adopt ship-source pollution laws applicable to foreign ships if in accordance with international standards. Sea lanes and traffic separation schemes may be designated, but only with IMO approval. A ship exercising transit passage may do so in its "normal mode," a phrase taken to mean that a submarine may remain submerged, whereas in innocent passage it must navigate on the surface and show its flag.

UNCLOS does not specify the extent of international navigation required to transform navigable waters into a strait used for international navigation. National opinions have differed over the application of the straits used for an international navigation regime in the Arctic.

Article 234 of UNCLOS bolsters coastal state powers to regulate foreign shipping in order to prevent, reduce, and control marine pollution in the Arctic. It recognizes the coastal state's right to adopt and enforce special non-discriminatory pollution prevention, reduction and control laws in areas within the limits of the EEZ that are covered by ice for most of the year, when certain conditions are met. Additionally, the coastal state's laws and regulations must have due regard to navigation, protection and preservation of the marine environment and be based on the best available scientific evidence.

Article 234 raises various questions of interpretation. What is required to meet the litmus of "ice covering such areas for most of the year?" For example, will even partial ice cover suffice if there is an exceptional hazard to navigation? What is the significance of giving special coastal state powers only in the EEZ? One interpretation is that coastal states are given no greater powers than those applicable in the territorial sea. Another is that coastal states are granted broader powers, in particular the right to unilaterally adopt special ship construction, crewing and equipment requirements. Application of Article 234 to straits used for international navigation may also be questioned. Since UNCLOS does not exempt straits from the application of Article 234, questions of interpretation may again rise over the geographical scope of coverage and the breadth of coastal state regulatory powers.

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Flag State Jurisdiction and Control

Flag states play a vital role in the governance of shipping. UNCLOS permits a state to fix conditions for granting its nationality (i.e., flying its flag) to ships so long as there exists a "genuine link." Ships can only sail under the flag of one state at a time. The flag state's domestic laws, for example, criminal law, apply to those aboard its ships. A flag state must also ensure that its ships conform to international rules and standards concerning matters such as safety at sea, pollution control and communication regulations. On the high seas, the flag state is granted exclusive jurisdiction with only limited exceptions.

It should be noted that the provisions of UNCLOS regarding the protection and preservation of the marine environment do not apply to any warship or other vessel owned or operated by a state and used, for the time being, only on government non-commercial service. However, each state must ensure, by the adoption of appropriate measures not impairing operations or operational capabilities of such vessels owned or operated by it, that such vessels act in a manner consistent, so far as is reasonable and practicable, with UNCLOS.

Port State Control

Under general international law, the port state has the authority to impose conditions for the entry of foreign ships into its ports. Under UNCLOS, when foreign ships are voluntarily in the port of another state, the host state has broad inspection and enforcement powers for pollution violations occurring not only in the port and internal waters, but also in the territorial seas and the EEZs of other coastal states when those states request the port state's assistance in enforcement. A flag state may also request the port state's assistance in relation to enforcement of pollution offenses on the high seas. A port state must comply with requests from other states for investigation of discharge violations. If a port state determines that a foreign ship is unseaworthy and threatens marine environmental damage, it may prevent the ship from sailing until the deficiencies are corrected.

Maritime Boundaries in the Arctic

To date, there are eight bilateral agreements delimiting maritime zone and continental shelf boundaries between the five countries that border the Arctic Ocean, in addition to unresolved boundary issues. Lack of clearly delimited maritime boundaries for territorial seas and EEZs is of potential concern for future shipping in the Arctic. Ship operators may face uncertainty over which national shipping laws are applicable in a disputed zone, particularly with reference to laws and regulations adopted pursuant to Article 234 of UNCLOS and with regard to penalties and compensation for damage caused by ship-source spills. Unresolved maritime boundaries may also reduce opportunities to develop marine resources and expand shipping in the Arctic. This situation is, however, no different than in other maritime areas where maritime boundaries are not agreed.

High Seas

Trans-Arctic shipping across the high seas of the Arctic (i.e., beyond EEZs) raises other governance issues. Because a coastal state's authority to regulate foreign shipping does not extend to the high seas, transiting ships would only be subject to global shipping safety, environmental and security rules and standards adopted through the IMO and as may be applied by the flag states. Thus the adequacy of international shipping standards for Arctic conditions and the need to provide special protective measures for the Arctic high seas must be considered.

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International Public Maritime Law Framework

Ships and their crews operating in the Arctic environment face unique risks. A significant body of international public maritime law has established safety, environmental and security rules and standards for international shipping and seafarers. Generally, the contents of IMO safety conventions are not specific to Arctic shipping. Nonetheless, many of the requirements, for example, double hulls for tankers and increased safety and communications equipment systems for passenger ships and cargo ships, will affect ships trading into or transiting Arctic waters. Not all applicable standards are mandatory. Whereas the provisions of the *International Convention on Safety of Life at Sea, 1974* (SOLAS), for example, are mandatory, the *2002 IMO Guidelines for Ships Operating in Arctic Ice-covered Waters* (Arctic Guidelines) only provide internationally accepted recommendatory guidelines. These guidelines, however, are under review by the IMO.

Maritime Safety Rules and Standards

For the most part, international safety standards for merchant shipping are formulated in the rules, codes and procedures adopted within the framework of SOLAS (Table 4.2). The convention specifies minimum safety standards for the construction, machinery, equipment and operation of ships. Flag states are responsible for ensuring compliance of their ships with SOLAS requirements, and certificates are prescribed as proof that this has been done. Using port state control, contracting states can inspect ships of other states on a non-discriminatory basis. Chapter V of SOLAS sets forth provisions of an operational nature including the maintenance of meteorological services for ships, the ice patrol service, routing of ships and the maintenance of search and rescue services. Chapter VII of SOLAS regulates the carriage and care of dangerous goods through the *International Maritime Dangerous Goods* (IMDG) *Code* and the carriage of liquefied natural gas (LNG) through the *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk Code* (International Gas Carrier Code). The IMDG Code may need to be reviewed for the purpose of identifying any dangerous goods that may be affected by extremely low temperature during transportation in the Arctic.

The American Bureau of Shipping and the Russian Maritime Register of Shipping recently announced they are jointly developing classification rules for Arctic LNG carriers. Ice-strengthening for LNG carriers focuses on hull, containment system, propulsion and propeller requirements.

Arctic States	Safety					
		SOLAS				
	COLREGS 1972*	Convention 1974*	Protocol 1978*	Protocol 1988*	SAR 1979*	Load Lines 1966*
Canada	√	√	–	–	√	√
Denmark	√	√	√	√	√	√
Finland	√	√	√	√	√	√
Iceland	√	√	√	√	√	√
Norway	√	√	√	√	√	√
Russian Federation	√	√	√	√	√	√
Sweden	√	√	√	√	√	√
United States	√	√	√	√	√	√

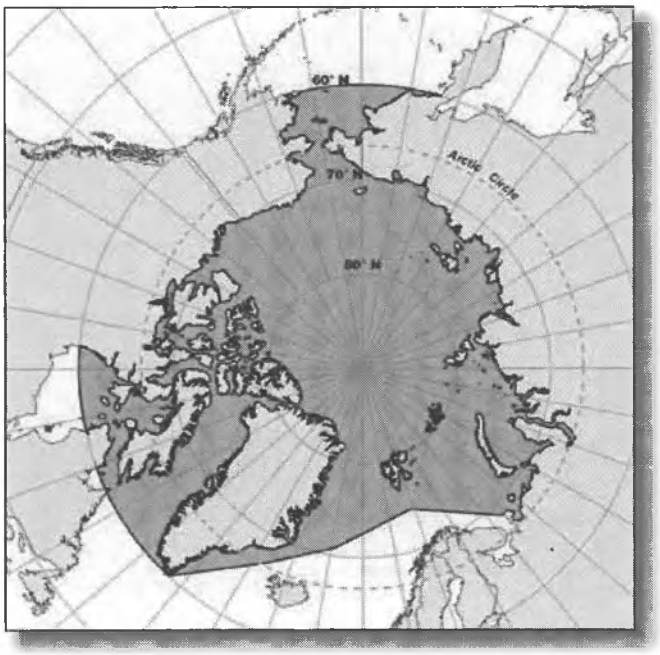
*Abbreviations: (√) = Ratification; (–) = Not Party; * = In Force (data as of October 10, 2008)*

Table 4.2 Ratification of International Maritime Safety Agreements and Instruments. *Source: AMSA*

SOLAS also includes specifications for passenger ships. However, at this time there are no international construction requirements specific for cruise ships in polar operations. Cruise ships, which are not classed as ice-strengthened, may operate in the Arctic at certain times of the year and in areas of open water. The international cruise ship industry has initiated a Cruise Ship Safety Forum to develop design and construction criteria for new vessels and to consider other safety issues.

Additional non-mandatory industry standards for passenger ships have been adopted by the IMO. In January 2008, the IMO adopted *Guidelines on Voyage Planning for Passenger Ships Operating in Remote Areas,* also called the Arctic Guidelines. The Guidelines call for ships to develop detailed voyage and passage plans that include contingency plans for emergencies. Emergency contingency plans should be developed with reference to the IMO MSC/Circular 1184, *Enhanced Contingency Planning Guidance for Passenger Ships Operating in Areas Remote from SAR [Search and Rescue] Facilities.* This guidance document outlines extra steps that should be taken when passenger ships operate remote from SAR facilities, including keeping the appropriate authorities informed of the ship's position and intentions while the ship is operating in the remote area. Consideration should also be given to voyage "pairing" (i.e., coordinating travel with another vessel

Map 4.1 Geographical scope of the 2002 IMO *Guidelines for Ships Operating in Arctic Ice-covered Waters* (Arctic Guidelines) (shaded area). *Source: IMO Arctic Guidelines*



to ensure emergency assistance), the carriage of enhanced life-saving appliances and the provision of additional life-saving resources.

The 1994 *International Safety Management Code* (ISM Code), adopted under Chapter IX of SOLAS, provides an international standard for safe management and operation of ships and for pollution prevention. The code calls on shipping companies to establish a safety and environmental protection policy ("safety management system") that is both ship-based and shore-based. The safety management system should ensure compliance with mandatory rules and regulations, as well as industry standards, and is subject to certification by national maritime authorities and verification by both flag and port states. The ISM Code is applicable to ships operating in Arctic waters although its provisions do not deal with the special circumstances and operational hazards of Arctic navigation. As shipping activity increases in the region, express provision for safety management for ice navigation might need to be considered.

The voluntary Arctic Guidelines apply to ships covered by SOLAS, including passenger ships and cargo ships of 500 gross tonnage or more engaged in international voyages in ice-covered waters (Map 4.1). The Arctic Guidelines are additional provisions deemed necessary for consideration beyond existing SOLAS requirements. They provide the most comprehensive standards for ships in ice-covered waters, including construction, equipment and operational matters.

Polar Class	General Description
PC 1	Year-round operation in all Arctic ice-covered waters
PC 2	Year-round operation in moderate multi-year ice conditions
PC 3	Year-round operation in second-year ice which may include multi-year ice inclusions
PC 4	Year-round operation in thick first-year ice which may include old ice inclusions
PC 5	Year-round operation in medium first-year ice which may include old ice inclusions
PC 6	Summer/autumn operation in medium first-year ice which may include old ice inclusions
PC 7	Summer/autumn operation in thin first-year ice which may include old ice inclusions

Table 4.3 The Arctic Guidelines and the Unified Requirements, adopted by the International Association of Classification Societies, designate a system of *Polar Classes* for ships with different levels of capability and construction, structural and equipment requirements under various ice conditions. The Unified Requirements apply to ships of member associations constructed on or after March 1, 2008. *Source: IMO Arctic Guidelines*

The Arctic Guidelines are structured in four parts. Part A provides construction, subdivision and stability in damaged condition recommendations for new *Polar Class* ships. The guidelines suggest a harmonized classification of *Polar Class* ships into seven categories according to intended ship operations and the level of ice in the area (Table 4.3). Ships should be able to withstand flooding resulting from hull penetration due to ice damage. No pollutants should be carried directly against the hull in areas of significant risk of ice impact. Operational pollution of the environment should be minimized by equipment selection and operational practice. Navigational, communications, safety-related survival and pollution control equipment should be appropriate for Arctic conditions.

Part B applies to *Polar Class* and non-*Polar Class* ships and includes recommendations on fire safety, fire detection and extinguishing systems, life-saving appliances and arrangements and navigation equipment in conformance with SOLAS, Chapter V. All *Polar Class* ships should be provided with an Automatic Identification System. *Polar Class* ships are encouraged to carry fully enclosed lifeboats. Other ships are urged to carry lifeboats having tarpaulins of sufficient size to provide complete coverage from environmental conditions.

Part C concerns ship operations, crewing and emergencies. Ships should carry operating manuals, as well as training manuals with relevant information concerning operations in ice-covered waters, including emergency procedures. Qualifications and training for crew and ice navigators are suggested.

Arctic States	Seafarers									
	ILO								IMO	
	C147 1976*	P147 1996 Protocol*	C163 1987*	C164 1987*	C166 1987*	C180 1996*	C188 2007	Maritime Labour 2006	STWC Convention 1978*	STWC-F Convention 1995
Canada	√	--	--	--	--	--	--	--	√	--
Denmark	√	√	√	--	--	√	--	--	√	√
Finland	√	√	√	√	--	√	--	--	√	--
Iceland	√	--	--	--	--	--	--	--	√	√
Norway	√	√	√	√	--	√	--	--	√	√
Russian Federation	√	--	√	--	--	--	--	--	√	√
Sweden	√	√	√	√	--	√	--	--	√	--
United States	√	--	--	--	--	--	--	--	√	--

Table 4.4 Ratification of International Marine Labor Agreements and Instruments. *Source: AMSA*

*Abbreviations: (√) = Ratification; (--) = Not Party; * = In Force; C188 = Work in Fishing Convention; C180 = Seafarers' Hours of Work and the Manning of Ships Convention; C166 = Repatriation of Seafarers Convention; C164 = Health Protection and Medical Care (Seafarers) Convention; C163 = Seafarers' Welfare Convention; P147 = Protocol of 1996 to the Merchant Shipping (Minimum Standards) Convention; C147 = Merchant Shipping (Minimum Standards) Convention (data as of October 6, 2008)*

Part D provides for environmental protection and damage control equipment, recognizing the navigational and environmental hazards and limited response capabilities for assistance in Arctic ice-covered waters. All ships navigating in Arctic ice-covered waters should be adequately equipped and their crews properly trained to provide effective damage control and minor hull repair, as well as containment and cleanup of minor spills.

The Arctic Guidelines have been criticized for various deficiencies. Criticisms include the lack of details or uniform international standards on training, failure to require actual ice navigational experience for ice navigators and limited provisions on prevention and mitigation of sea-spray icing of ships. Guidance about towage in ice-covered waters is also limited. The IMO recently agreed to revise the Arctic Guidelines and to extend their application to the Antarctic.

The *Convention on the International Regulations for Preventing Collisions at Sea, 1972* (COLREGS) sets out technical and seamanship rules for ships on the high seas and in all other waters navigable by seagoing vessels connected thereto, including bays, straits, territorial seas and EEZs. COLREGS applies to navigation in the Arctic, but it does not contain specific rules for ships navigating in ice-covered waters. COLREGS covers a situation where a ship is constrained in its ability to maneuver due to size, draft or other reason such as ice. However, the application of some rules may need to be considered with reference to ice navigation. With an extended Arctic shipping season and increased ship traffic, COLREGS can be expected to assume greater importance.

The remoteness and harsh conditions present special search and rescue challenges in the Arctic. The *International Convention on Maritime Search and Rescue, 1979* (SAR Convention) provides for rescue coordination centers, ship position reporting systems and expedited entry of rescue units into the territorial waters of other states. Arctic state parties to the SAR convention shall coordinate SAR-incidents in their respective areas of responsibility and cooperate

The increased use of Arctic waters for tourism, shipping, research and resource development also increases the risk of accidents and, therefore, the need to further strengthen search and rescue capabilities and capacity around the Arctic Ocean to ensure an appropriate response from states to any accident. Cooperation, including on the sharing of information, is a prerequisite for addressing these challenges. We will work to promote safety of life at sea in the Arctic Ocean, including through bilateral and multilateral arrangements between or among relevant states.

~ Ilulissat Declaration, May 2008

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with each other as required. The IMO has established 13 major search and rescue areas around the world, within which coastal states have designated search and rescue regions.

The Global Maritime Distress and Safety System (GMDSS) facilitates maritime safety communications for merchant and passenger ships. The Arctic is "Sea Area A4" and extends to 90°N for GMDSS purposes. Canada, Norway and the Russian Federation plan to coordinate navigational and related maritime safety information in one or more designated navigational areas (NAVAREAs) by 2011.

Representatives from the five Arctic coastal states meeting in Ilulissat, Greenland, recently adopted a declaration reaffirming their commitment to work together through the IMO to strengthen existing measures and to develop new measures to improve the safety of maritime navigation and prevent or reduce the risk of ship-based pollution in Arctic waters. The Ilulissat Declaration recognizes the need to further strengthen search and rescue capabilities and capacity around the Arctic Ocean.

As international shipping increases in the Arctic, it should be expected that ships will be more frequently in need of assistance. There are, however, practical difficulties in finding and supporting suitable places of refuge for ships in the Arctic, even during the summer navigation months. The 2003 IMO *Guidelines on Places of Refuge for Ships in Need of Assistance* provide a risk assessment and decision-making framework for coastal state decision-makers, masters of ships and salvors when a ship needs refuge in sheltered coastal waters such as a port or a bay. The guidelines are not mandatory. Many states have adopted places of refuge policies and/or designated such places, with the European Union requiring member states to designate places of refuge.

When a ship becomes a casualty and eventually sinks, it may continue to pose a hazard for navigation. Shipwrecks within and beyond the territorial sea will eventually be covered by the 2007 *Nairobi International Convention on the Removal of Wrecks*, which is not yet in force. Shipowners are responsible for locating, marking and removing ships, and must carry suitable insurance for this purpose.

Standards for Seafarers in the Arctic and Maritime Labor Law Issues

The Arctic presents a particularly hazardous work setting for those who must live and work under its extreme conditions. Both the IMO and the ILO set international standards for seafarers' competence and their working and living conditions (Table 4.4). In addition, the World Health Organization (WHO) sets standards for seafarers' health issues such as medical fitness for duties and requirements for on-board medical supplies. Most international standards are directed to flag states and apply to ships undertaking international voyages, although some requirements are directed to countries in their capacity as maritime labor supply states.

The IMO addresses seafarer competency and training and other safety matters for both ship and crew through the *International Convention on Standards of Training, Certification and Watchkeeping*

Arctic States	Environment												
	London		MARPOL 73/78						OPRC				
	London Convention 1972*	Protocol 1996*	Annex I/II*	Annex III*	Annex IV*	Annex V*	Protocol 1997 (Annex VI)*	Salvage 1989*	Convention 1990*	OPRC/NHS 2000	Anti-fouling 2001**	Ballast Water 2004	Wreck Removal 2007
Canada	√	√	√	√	--	--	--	√	√	--	--	--	--
Denmark	√	√	√	√	√	√	√	√	√	--	√	--	--
Finland	√	--	√	√	√	√	√	√	√	--	--	--	--
Iceland	√	√	√	√	--	√	--	√	√	--	--	--	--
Norway	√	√	√	√	√	√	√	√	√	--	√	√	--
Russian Federation	√	--	√	√	√	√	--	√		--			--
Sweden	√	√	√	√	√	√	√	√	√	√	√	--	--
United States	√	--	√	√	--	√	√	√	√	--	--	--	--

Table 4.5 Ratification of International Environmental Protection Agreements and Instruments. *Source: AMSA*
*Abbreviations: (√) = Ratification; (--) = Not Party; * = In Force; ** In Force September 17, 2008 (data as of October 10, 2008)*

for Seafarers, 1978 (STCW) and SOLAS. The STCW is again being revised, including standards for medical fitness for duty and hours of work and rest.

Since 1920, the ILO has adopted more than 70 international conventions and recommendations addressing maritime labor conditions and standards for decent working and living conditions for seafarers, for example, hours of rest and work, accommodations, occupational safety and health, wages, food and medical care. More than 35 of these maritime labor conventions and related recommendations were consolidated in the 2006 *Maritime Labour Convention*, which is expected to enter into force by 2011.

IMO, ILO and WHO have not adopted specific mandatory instruments addressing Arctic or Antarctic shipping as distinct from the general requirements. Existing minimum standards apply to ships flying the flag of states party to these conventions, and flag states are responsible for enforcing them on their ships. However, they would also be enforced on non-party ships under the regime of port state control inspection. Outside STCW or the ILO standards, there do not appear to be any special requirements for minimum hours of rest or maximum hours of work and safe manning despite navigation under what could be regarded as especially hazardous conditions.

The Arctic Guidelines also make recommendations on labor issues not dealt with under SOLAS or STCW. The integrated approach adopted by the guidelines recognizes that safe operation in ice-covered conditions "requires specific attention to human factors including training and operational procedures." The guidelines recommend that crew have ice navigation and simulator training prior to entering Arctic waters, as well as exposure to ice-breaking operations and cold weather cargo handling; and that all ships operating in Arctic ice-covered waters should have at least one qualified ice navigator available to continuously monitor ice conditions when the ship is underway and making way in the presence of ice. The guidelines recommend that the ice navigator provide documentary evidence of having satisfactorily completed an approved training program in ice navigation. Currently, most ice navigation programs are ad hoc and there are no uniform international training standards. Although the Arctic Guidelines are not comprehensive with respect to seafarer training for the Arctic, they are the first international instrument to emphasize the need for specialized training in ice navigation.

Marine Environmental Rules and Standards

The *International Convention for the Prevention of Pollution from Ships, 1973 as Modified by the Protocol of 1978 Relating Thereto* (MARPOL 73/78) establishes international standards for pollutant discharges from ships. The standards are applicable in some Arctic waters (Table 4.5). Six annexes set out technical rules and procedures dealing with the prevention and control of pollution from ships by oil (I), noxious liquid substances (II), harmful substances in packaged form (III), sewage (IV), garbage (V) and air emissions (VI).

MARPOL does not totally prohibit the discharge of wastes in the marine environment. Establishing oily ballast and bilge water discharge limits, Annex I is an important annex for the protection of

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the Arctic marine environment. Oily ballast water from tankers may be discharged at a rate of 30 liters per nautical mile while en route and over 50 nautical miles offshore. Annex I also establishes a 15 ppm discharge limitation on oily bilge water from oil tankers, as well as from other ships. Amendments to MARPOL in 1992 and 2003 introduced a mandatory requirement of double hulls for new oil tankers and an accelerated phase-out period for existing single-hull tankers, as well as prohibition of operation of single-hull oil tankers carrying heavy grade oil as cargo accordingly. A proposal is before IMO to prohibit the use and carriage of heavy grade oil in the Antarctic Special Area, which may be considered in the future whether it should also apply to the Arctic.

Annex IV sets out sewage regulations that apply to ships of 400 gross tonnage or more, or ships that are certified to carry more than 15 persons. Sewage may be discharged at a distance of more than three nautical miles from the nearest land when a ship has an approved treatment system and the sewage discharged is comminuted and disinfected. Sewage that is not treated may be discharged at a distance of more than 12 nautical miles from the nearest land if the ship is proceeding at not less than four knots and the discharge is not instantaneous but at a moderate rate.

Annex V, while prohibiting the disposal of plastics into sea, still allows ships to discharge some garbage generated by normal operations of a ship and depending on the distance from land. For example, ships are allowed to dispose of packing materials more than 25 nautical miles from the nearest land.

Annex VI allows special sulfur oxide (SOx) emission control areas to be declared, where sulfur content of ship fuels would be lowered for designated regions (1.5 percent m/m) from the global standard of 4.5 percent m/m. Amendments to MARPOL 2008 introduced increasingly stringent regulations, including gradually decreasing the global cap for SOx (from 4.5 percent m/m to 0.5 percent m/m) and decreasing SOx and particulate matter in Emission Control Areas from 1.5 percent m/m to 0.1 percent m/m. Stringent controls were also placed on nitrogen oxide (NOx) emissions and the ability to create Emission Control Areas for such emissions is now also available. These amendments enter into force on July 1, 2010. However, neither polar region has been proposed for special treatment.

Where the discharge standards under MARPOL Annexes I, II and V are not sufficient for protecting sensitive areas of the marine environment, IMO may designate special areas based on oceanographic and ecological as well as ship traffic conditions. For example, the Antarctic area (south of 60° latitude) is designated as a special area under all three annexes and a very high standard for discharges under Annex I has been established, namely a prohibition on any discharge of oil or oily mixtures from any ship. The Arctic may satisfy at least the oceanographic and ecological conditions for special area designation, if not also ship traffic conditions, as set out in the 2002 IMO *Guidelines for the Designation of Special Areas under MARPOL 73/78*. Before a special area becomes effective, regional coastal states must undertake to provide port reception facilities, an important consideration in the Arctic with its limited port infrastructure.

Marine areas can also receive special protection from the IMO because of their particular sensitivity to international shipping through designation as particularly sensitive sea areas (PSSAs). The IMO has developed *Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas,* most recently revised in 2005. To be eligible for designation as a PSSA, there must be three elements: (1) the area must have certain attributes as set forth in the Revised PSSA Guidelines, (2) there must be an identified vulnerability from

international ship traffic and (3) there must be an IMO measure to address the identified vulnerability. These IMO measures are called associated protective measures and include such things as areas to be avoided, traffic re-routing and separation schemes, mandatory ship reporting, discharges, restrictions and designation as a special area. If the conditions and criteria set out above are satisfied in a given area of the Arctic, that area may be eligible for PSSA designation.

There is also the option of obtaining protective measures under SOLAS without necessarily involving the designation of a PSSA. Routing and reporting measures under SOLAS Chapter V (Regulations 10 and 11) normally associated with safe passage (such as recommended routes, precautionary area and area to be avoided) may be obtained through the IMO to protect the marine environment. Measures of this sort have already been obtained and applied in northern waters, such as Alaska's Prince William Sound, the Baltic Sea and waters off the coast of Norway, Iceland and Greenland.

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 and its 1996 Protocol govern ocean dumping from ships (excluding wastes from normal ship operations) and the dumping (intentional sinking) of ships in the Arctic (Table 4.5). The convention permits dumping except for those wastes listed on a "black list" pursuant to a national ocean dumping permit. The 1996 Protocol adopts a precautionary approach, and only wastes listed on a global "safe list," for example, dredged material and organic wastes of natural origin, may be disposed of subject to a waste assessment audit and a national permit.

Seven Arctic states are parties to the 1990 *International Convention on Oil Pollution Preparedness, Response and Co-operation* (OPRC), which sets out a framework for cooperative measures in relation to pollution incidents involving oil (Table 4.5). The 2000 *OPRC-Hazardous and Noxious Substances (HNS) Protocol* provides a similar framework for cooperation in preparedness and response measures for dealing with HNS incidents, but not all Arctic states are parties. State parties are required to establish measures for dealing with oil and HNS pollution incidents, either nationally or in cooperation with other countries, and the conclusion of further bilateral or multilateral agreements is encouraged. The OPRC envisages an ongoing need to assess the adequacy of pre-positioned equipment for responding to pollution incidents in light of changing risks, such as an increase in shipping levels.

Under OPRC, trained crew and appropriate damage control materials must be on board ships and offshore installations to implement their ship oil pollution emergency plans to effect damage repair and mitigate pollution, including responding to ice damage. OPRC calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill combating exercises and the development of detailed plans for dealing with pollution incidents. State parties have a duty to provide assistance to other states in pollution emergency situations.

Regional and bilateral arrangements are in place that provide a framework for cooperation among some Arctic states under OPRC in the Arctic. For example, the Arctic Council's Emergency Prevention, Preparedness and Response (EPPR) working group has noted the need to increase communication and to share information with the IMO in such areas as dispersant application, waste removal and treatment, in-situ burn up and spill response in ice and snow conditions. Several Arctic states have joint contingency planning arrangements. They include, among others, the *Canada/United States Joint Marine Pollution Contingency Plan* for the Beaufort Sea area, the *Russia/USA Joint Marine Pollution Contingency Plan*, the joint *Russian/Norwegian Plan for the Combating of Oil Pollution in the Barents Sea* and the *Canada/Denmark Agreement for Marine Environmental Cooperation,* which includes annexes for responding to shipping and offshore hydrocarbon spills.

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The *International Convention on the Control of Harmful Anti-Fouling Systems on Ships* addresses the use of anti-fouling systems, including paints containing toxic substances such as tributyltin (TBT). The convention, which entered into force on September 17, 2008, requires ships to either not use organotin compounds on their hulls by January 1, 2008 or to have a protective coating to prevent leaching of organotin compounds. Although several Arctic Council states regulate TBT use and the European Union has introduced a complete ban on TBT-based paints, only Denmark, Norway and Sweden are parties to the convention.

An additional vessel-source environmental concern is ballast water, whereby ships take up sea water in order to maintain ship stability and structural integrity. When ballast water is discharged, pathogens and alien living organisms may be released that can disrupt local marine species and ecosystems.

The 2004 IMO *International Convention for the Control and Management of Ships' Ballast Water and Sediments* is intended to prevent, minimize and ultimately eliminate the risks of introduction of harmful aquatic organisms and pathogens via ships' ballast water, but it is not yet in force. The convention details technical standards for the control and management of ships' ballast water and sediments with the goal of shifting ballast water management from exchange to treatment for all ships by 2016. Among the Arctic states, only Norway has consented to be bound by the convention.

The Ballast Water Convention encourages enhancement of regional cooperation, including the conclusion of regional agreements. The 2007 non-binding IMO *Guidelines for Ballast Water Exchange in the Antarctic Treaty Area* provide an example of a regional approach. Various measures are recommended, including the exchange of ballast water before arrival in Antarctic waters. The specific impact of ballast discharges in the Arctic marine environment remains largely unknown. These issues require further research.

The Role of Ports in International Maritime Law

Port state control could play an important role in promoting maritime safety and marine environmental protection in the Arctic. A global network of memoranda of understanding (MOUs) on port state control among national maritime authorities provides a systemic ship inspection approach to ensure compliance with international standards on ship safety, labor, training and pollution prevention such as SOLAS, COLREGS, MARPOL 73/78 and STCW. The inspection data is centralized in databases to which member authorities have access, and is used to track the compliance of a particular ship and the record of violations by flag. The Paris MOU among European maritime authorities is potentially relevant for ships navigating within the Arctic Circle. The maritime authorities of the Arctic Council states, except for the United States, are parties to the Paris MOU. The United States administers its own port state control system, but has cooperating observer status with the Paris MOU.

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Regional maritime authorities in the Arctic may wish to consider whether existing MOUs are sufficient to enforce higher regulatory safety and environmental standards applicable to the Arctic or to coordinate port state control enforcement efforts through a new dedicated MOU. Arctic states would need to consider what uniform standards would be enforced through port state control. Currently, only Canada and the Russian Federation have designated national safety and environmental standards for navigation in their Arctic waters separately from international standards adopted under the auspices of the IMO, including the Arctic Guidelines. The Russian Federation employs a ship inspection system for passage through the Northern Sea Route. Canada requires that ships comply with the *Arctic Waters Pollution Prevention Act* and regulates construction and other standards before navigating in Arctic waters, and inspects for this purpose.

Ports and maritime authorities also play a role in the international maritime security regime. In 2002, the IMO introduced the mandatory *International Ship and Port Facilities Security Code* (ISPS Code), which is linked to chapter XI-2 of the SOLAS Convention, for all commercial vessels over 500 gross tonnage engaged in international trade, as well as mobile offshore drilling units. Public and private ports and terminals must be secure, and ships may be required to provide notice and information to the maritime authorities of the host state. For example, Canada and the United States have advance notice of arrival requirements for ships that vary with the duration of the voyage. Certificates are issued to ships, companies and ports and

security plans are subject to periodic audit. Arctic ports and terminals require a risk assessment followed by adoption of security plans to comply with the ISPS Code. Ships engaged in cargo operations, support services or cruises in the Arctic have to comply with the ISPS Code and cooperate with port and terminal security. In areas under their jurisdiction and in accordance with UNCLOS, Arctic coastal states should have ship control procedures in place, as well as a secure system of assessing threats and sharing intelligence among law enforcement agencies.

International Private Maritime Law Framework

The international customs and practices of the shipping, cruise and merchant communities are likely to govern the Arctic movement of goods and passengers in addition to international maritime law. Since ships move between different countries, their owners' contracts can be subjected to a variety of different national jurisdictions and laws. To reduce confusion, the international community has concluded international private law conventions that establish uniform contractual regimes for the carriage of passengers and the carriage of goods under bills of lading (Table 4.6).

Shipowners interact with commercial parties, such as cargo owners and cruise passengers, or the suppliers of essential shipping services, like insurers and salvors, through private contracts. The essence of a contract of sea carriage is an agreement for safe transport and delivery by ship in exchange for payment of freight, hire or passage and the allocation of risks and responsibilities of the transit between the parties. These contracts also take into account the relevant international maritime law, with the carrier ensuring that its ship meets international standards for human safety and environmental protection (e.g., SOLAS, the 1972 *International Convention for Safe Containers* (CSC), MARPOL 73/78 and STCW). International shipping organizations and traders' associations have also developed standardized clauses for particular trades, cargoes and routes and organized them into blank forms of contracts.

Arctic States	Carriage of Goods and Passengers										
	Athens								CSC		
	Convention 1974*	Protocol 1976*	Protocol 1990	Protocol 2002	Hague Rules 1924*	Hague-Visby Rules 1968*	SDR Protocol 1979*	Hamburg Rules 1978*	Convention 1972*	CSC Amendments 93	Multimodal Transport 1980
Canada	--	--	--	--	R	--	--	--	√	--	--
Denmark	--	--	--	--	D	√	a	--	√	--	--
Finland	--	--	--	--	D	√	√	--	√	--	--
Iceland	--	--	--	--	--	--	--	--	√	--	--
Norway	--	--	--	--	D	√	√	--	√	--	--
Russian Federation	√	√	--	--	--	--	a	--	√	--	--
Sweden	--	--	--	--	D	√	√	--	√	--	--
United States	--	--	--	--	√	--	--	--	√	--	--

Table 4.6 Ratification of International Carriage of Goods and Passengers Agreements and Instruments. *Source: AMSA*
*Abbreviations: (√) = Ratification; (—) = Not Party; (D) = Denounced; (R) = Revoked; (a) = Accession; * = In Force (data as of October 10, 2008)*

The international customs and practices of the shipping, cruise and merchant communities are likely to govern the Arctic movement of goods and passengers in addition to international maritime law.

Contracts of carriage for the movement of petroleum, liquefied natural gas (LNG) and minerals moved in bulk in tankers and ore carriers that tramp (sail) around the world from port to port are known as charter parties. Industry bodies like the Baltic and the International Maritime Council (BIMCO) and International Association of Independent Tanker Owners (INTERTANKO) have devised generally accepted standard terms of trade for inclusion in individual charter parties. For example, BIMCO's voluntary "ice clauses" allow a carrier to deviate from the contracted carriage to prevent a ship from becoming icebound.

Packaged, crated and containerized items, including hazardous goods, are carried under contracts represented by bills of lading and sea waybills that are regulated under competing international rules with similar modes of operation and regulatory function. These rules differ in the standards of conduct expected of the carrier, the scope of application of the rules and the limits of liability for their breach. The 1924 *International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading* as amended by the Protocols of 1968 and 1979 (Hague-Visby Rules), or some variant of them, are the most widely applied international regulations. The other rules are the 1978 *United Nations Convention on the Carriage of Goods by Sea* (Hamburg Rules) and the *1980 United Nations Convention on International Multimodal Transport of Goods* (Multimodal Rules). The United Nations Commission on International Trade Law has prepared a wholly new uniform set of rules, the *Draft Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea,* presented to the General Assembly in October 2008. States that are not party to a particular convention may choose to legislate the rules into carriage contracts, for example, Canada implements the Hague-Visby Rules through the Marine Liability Act. Each set of rules applies to marine transportation in the Arctic just the same as in any other ocean area.

Intergovernmental and non-governmental organizations also influence the standard of care set out in a carriage contract. Since 2006, a number of classification societies have introduced winterization guidelines for navigation in cold climates that establish standards of ship preparedness for Arctic shipping, thereby indirectly establishing the expected minimum standard of reasonable care for cargo.

The commercial carriage of passengers by sea, whether on ferries or cruise ships, is internationally regulated by the 1974 *Athens Convention Relating to the Carriage of Passengers and their Luggage by Sea* and its protocols of 1976 and 1990 not yet in force. A further protocol concluded in 2002 is also not yet in force: the consolidated treaty will be known as the *Athens Convention*, 2002. The carrier is responsible for the safety of everyone on board, whether crew, cruise company employees or fare paying passengers. The Athens Convention establishes liability rules and limitations for personal injuries to passengers and loss or damage to their luggage. The safety criteria to be followed in order to negate a finding of negligence are established by the international shipping practices of operators, for example, *Association of Arctic Expedition Cruise Operators Guidelines,* as well as by SOLAS and other binding IMO shipping safety rules.

Marine Insurance

Arctic shipping will not be sustainable without the availability of marine insurance at reasonable commercial rates. Unlike most other areas of shipping, the practice of marine insurance is not regulated in an international convention. A business and private law matter, marine insurance is legislated at the national level, for example, Canada and the Russian Federation; and occasionally at a sub-national level, for example, the United States. Insurance practices are driven by international insurance markets. Of particular significance for Arctic shipping is protection and indemnity insurance, offered through P & I Clubs. Until recently, Russian Federation shipping in the Arctic tended to be insured under state schemes, and now P & I coverage is a requirement for trading on the Northern Sea Route.

Although most of the risks associated with shipping are well known and understood by insurers and assureds alike, the risks associated with polar navigation are still not fully known or understood. With the exception of the Northern Sea Route, the Arctic is perceived as an unknown quantity or a marine frontier. As a result, the

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Arctic States	Liability and Compensation										
	CLC			FUND				LLMC			
	Convention 1969*	Protocol 1976*	Protocol 1992*	Convention 1971	Protocol 1976*	Protocol 1992*	Protocol 2003*	Convention 1976*	Protocol 1996*	HNS 1996	Bunkers 2001**
Canada	D	--	√	D	√	√	--	--	√	--	--
Denmark	D	√	√	D	√	√	√	D	√	--	√
Finland	D	√	√	D	√	√	√	D	√	--	√
Iceland	D	√	√	D	√	√	--	--	--	--	--
Norway	D	√	√	D	√	√	√	D	√	--	√
Russian Federation	D	√	√	D	√	√	--	--	√	√	√
Sweden	D	√	√	D	√	√	√	D	√	--	--
United States	--	--	--	--	--	--	--	--	--	--	--

Table 4.7 Ratification of International Maritime Liability and Compensation Agreements and Instruments. *Source: AMSA*
*Abbreviations: (√) = Ratification; (–) = Not Party; (D) = Denounced; * = In Force; ** In Force November 21, 2008 (data as of October 10, 2008)*

provision of insurance for Arctic shipping tends to be on a case-by-case basis and expensive, with seasonal additional premiums. The availability and cost of marine insurance is a major constraint on Arctic marine shipping.

Salvage

The availability of salvage services can be expected to be vital for the future of commercial shipping in the Arctic. The 1989 *International Convention on Salvage* establishes the general legal principles for salvors and salvage operations. All Arctic Council states are parties to the convention. Salvage refers to the actual service provided to a ship in need of assistance, the body of law that exists to govern this maritime institution, and the reward due to the salvors for their services. Essentially, salvors are entitled to a reward (a percentage of the value of the salved property) for successful salving of the vessel or cargo, such as, "no cure, no pay". Most commonly, private firms of professional salvors respond to shipping casualties, although the Russian Federation has a fleet of polar vessels that provide salvage services. In general, the rights and obligations of the parties to a salvage operation are legislated and subject to industry standard form agreements, the best known being the *Lloyd's Open Form of Salvage Agreement*. If there is no contract, the parties will turn to domestic courts to obtain a salvage award. The convention provides for an enhanced salvage award for salvors preventing or minimizing damage to the marine environment.

Generally, there is limited infrastructure for ship repair and/or salvage and pollution countermeasures capability in the Arctic basin or companies with significant Arctic salvage experience. This lack of salvage capability is a concern to marine insurers.

Liability and Compensation

Should there be incidents resulting in oil or other hazardous substance spills that cause damage to the Arctic marine environment, property or economic loss, national and international systems of financial compensation for cleanup and losses sustained will become important. The current international system for compensation for pollution damage caused by ship-source pollution is fragmented and limited. Separate conventions address oil pollution liability and compensation from tankers; damages from the spill of bunker fuel carried in ships other than tankers, such as cargo ships; and hazardous and noxious substance spills from ships (Table 4.7). Compensation is only available to state parties to the respective conventions and to private bodies or individuals who have suffered damage as a result of the pollution. None of the conventions address damage to the high seas beyond national jurisdiction. In general, under the conventions, the shipowner is strictly liable for the loss or damage up to a certain amount. A supplementary fund may provide additional compensation when the victims do not obtain full compensation from the shipowner or the insurer.

The compensation regime for damage caused by persistent cargo and fuel (bunker) oil pollution from oil tankers is the 1992 *Civil Liability Convention* (1992 CLC) and the 1992 *Fund Convention*, as well as the 2003 *Supplementary Fund Protocol*. These conventions do not apply to spills of bunker oil from ships other than tankers. In the Arctic context, it is unclear if the conventions apply to floating production, storage and offloading units and permanently and semi-permanently anchored ships engaged in ship-to-ship oil transfer operations.

While seven Arctic states have adopted the 1992 Civil Liability and Fund conventions, the United States has established a separate regime under the *Oil Pollution Act of 1990*. The international regime limits compensation for environmental damage to actual restoration costs; U.S. regulations provide compensation for both diminution in value of natural resources and the cost of assessing such damages.

The *International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996* (HNS Convention) also establishes a two-tier international compensation regime for bulk solids (excluding coal and iron ore and radioactive materials), liquids including non-persistent oils, liquid gases such as LNG and liquefied petroleum gases (LPG) and packaged substances. Individual receivers of HNS by sea in state parties to the convention would contribute to the International Hazardous and Noxious Substances Fund. The HNS Convention is not yet in force. Among the Arctic states, only the Russian Federation is a party.

The 2001 *International Convention on Civil Liability for Bunker Oil Pollution Damage*, which entered into force on November 21, 2008, applies to pollution damage caused by the spill of bunker oil from a ship other than a tanker and makes the shipowner strictly liable. The Bunkers Convention preserves the right of the shipowner and insurer to limit liability under any applicable national or international regime. The convention is accompanied by a Resolution (Annex 1) that urges all states to ratify or accede to the 1996 Protocol to the 1976 *Convention on Limitation of Liability for Maritime Claims* (LLMC 1976) thus increasing the funds available for bunker pollution claims. Among the Arctic states, the Russian Federation, Denmark, Finland and Norway are parties.

Selected National Legal Frameworks: Canada and the Russian Federation

Canada and the Russian Federation regulate shipping in the Arctic under UNCLOS Article 234, as well as under other authorities.

Canada has established special ship construction, equipment and crewing requirements and near zero oil pollution discharge standards through the *Arctic Waters Pollution Prevention Act* (AWPPA) and its regulations. The legislation applies to a 100 nautical mile pollution prevention area, but recent amendments will extend this to the 200 nautical mile EEZ.

Pollution standards for discharges are stricter in Canadian Arctic waters than MARPOL, with only untreated sewage or emergency discharges permitted. The *Canada Shipping Act, 2001* authorizes regulations to be passed establishing vessel traffic services (VTS) zones in an Arctic shipping safety control zone whereby vessel reporting and clearance would be mandatory. To date, only a voluntary non-regulatory VTS zone known as NORDREG has been adopted for the Canadian Arctic. Currently, Canada effectively has a routing requirement in that the Shipping Safety Control Zones (adopted under the

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Research Opportunities

- Comparative investigation of national construction and equipment standards for ships and their consistency with IACS Unified Requirements for *Polar Class* ships.
- Comparative examination of the extent to which states have followed the IMO Arctic Guidelines.

AWPPA) stipulate when and where ships of certain ice strength can operate. Recently, the Canadian federal government announced plans to extend the application of the AWPPA to 200 nautical miles and to move NORDREG to a mandatory reporting system for ships entering Canadian Arctic waters.

The Russian Federation has opened the Northern Sea Route for foreign shipping under certain conditions and has increased the number of ports in the Arctic region.

Regulations adopted in 1990 and 1996 allow navigation in the Northern Sea Route on a non-discriminatory basis for ships of all states based on *Regulation for Navigation on the Seaways of the NSR*, 1991; *Guide for Navigation through the NSR*, 1995; and *Regulation for Design, Equipment and Supply of Vessels Navigation the NSR*, 1995. In these documents, priority is given to prevailing international legal standards and appropriate rights of the coastal states to ensure maritime safety and to take measures for preventing the pollution of the marine environment. Pollution standards are stricter than MARPOL. For example, no garbage deposits or oily ballast water discharges from tankers are permitted. The regulations impose various conditions for using the Northern Sea Route. An application to Russian maritime authorities has to be made and they would give careful consideration to navigational safety and environmental concerns. A ship inspection (at the shipowner's expense) is required and at least two pilots need to be taken on board. Crew size must be sufficient to allow for a three-shift watch and the master should at least have a 15-day experience of steering ships under ice conditions along the Northern Sea Route. The NSR fee system is continuously improving. The existing fee system is in place to necessitate financial support for icebreaker assistance and NSR infrastructure throughout the year. In the case of future growth in cargo volumes, the charge for each individual vessel passing by the NSR is expected to decrease as the overall volume increases. The estimated volumes of maritime traffic are about 40 million tons of oil and gas per year by 2020, which may improve the economic effectiveness of cargo transportation through the NSR.

In Summary

Governance in shipping is characterized by efforts to promote harmonization and uniformity in international maritime law. The reason for the global approach to shipping governance is that by definition and function, shipping is essentially an international tool in the service of global trade. The term governance highlights the complex range of actors that affect shipping law, policy and practice in the Arctic. Indeed, the largest flag states and suppliers of marine labor do not border the Arctic Ocean.

Natural resource, cruise and maritime trade related shipping in the Arctic is on the increase. As marine insurance at reasonable rates becomes available and an appropriate infrastructure is put in place to service Arctic navigation routes, a concomitant increase in international shipping can be expected. This will raise, among others, safety and marine environment protection concerns: There are complex global and national legal regimes that establish standards for navigation and protection of the marine environment that are applicable in the Arctic, however, for those to be effective, a common understanding of those regimes, along with enhanced regional cooperation in ocean management and greater participation by Arctic states in the global international maritime conventions will be needed. If the Arctic marine environment is to be protected, existing regimes will need to be strengthened by Arctic states and the international community.

Not all Arctic states are parties to important conventions, and indeed not all relevant conventions are in force. There is a dearth of mandatory international standards specifically designed for navigation in the Arctic, as well as voluntary guidelines. Arctic states will need to work closely with global and regional international organizations, the people of the North and the international maritime community in regime-building to facilitate governance of Arctic shipping.

Findings

1] Differing national viewpoints over what waters may legitimately be claimed as internal and what waters constitute straits used for international navigation have yet to be fully resolved and could give rise to future disputes concerning the exercise of jurisdiction over shipping activities.

2] Coastal state authority to regulate foreign shipping in the Arctic Ocean in order to prevent, reduce and control marine pollution was bolstered by Article 234 of UNCLOS. However, the precise geographic scope of coverage (waters covered by ice most of the year within the limits of the Exclusive Economic Zone) and the breadth of regulatory powers, in particular the extent to which a coastal state may unilaterally impose special construction, crewing and equipment standards, given the requirements that such standards must give due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence could give rise to differing interpretations.

3] The IMO international voluntary *Guidelines for Ships Operating in Arctic Ice-covered Waters* for the safety of ships and seafarers in the Arctic are currently under review. This review provides an opportunity to assess and strengthen guidance in the area of ship construction, equipment and operations and to consider the need for a legally-binding code in the future.

4] Safe navigation in ice-covered waters depends much on the experience, knowledge and skill of the ice navigator. Currently, most ice navigator training programs are ad hoc and there are no uniform international training standards. For example, this could be addressed by developing training standards for navigation in polar conditions and in Arctic safety and survival for seafarers that could be incorporated into IMO's *Standards of Training, Certification and Watchkeeping* (STCW 78/95).

5] The International Association of Classification Societies (IACS) has developed Unified Requirements for member societies addressing essential aspects of construction for ships of *Polar Class*. The IACS Unified Requirements for member societies are incorporated by reference into the IMO *Guidelines for Ships Operating in Arctic Ice-covered Waters*. If the application of the harmonized *Polar Class* were to be made mandatory, then it could be an effective way to strengthen safety and environmental protection in Arctic waters.

6] Specific international construction requirements for cruise ships operating in polar waters have not been adopted. The cruise ship industry has formed a Cruise Ship Safety Forum to further develop specific design and construction criteria for new vessels, but it remains to be seen how navigation in polar waters will be addressed.

7] The *International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978* (MARPOL) sets out minimum international standards for operational discharges and emissions from ships which are also applicable to Arctic waters. Pursuant to Article 234 of UNCLOS, coastal states may unilaterally impose additional, non-discriminatory requirements within the limits of their Exclusive Economic Zone (EEZ) when certain conditions are met. At this time, some national standards for regulating ship-source pollution in the Arctic are not consistent among Arctic states.

8] Stricter environmental standards have neither been proposed nor established by Member States through the IMO for the Arctic. For example, under MARPOL the Arctic Ocean could be designated as a "special area" where more stringent than normal discharge standards would apply under MARPOL Annexes I and V. Such an area could also be considered for designation as an Emission Control Area under Annex VI.

9] Expanded international shipping in the Arctic Ocean increases the possibility of introduction of alien species and pathogens through the discharge of ballast water and through hull fouling. The Ballast Water Convention imposes management (i.e., exchange and treatment) requirements on party ships to protect marine areas from the hazards posed by ballast water from ships and encourages establishment of regional approaches such as the *Guidelines for Ballast Water Exchange in the Antarctic*.

10] In the Arctic Ocean there is very little commercial or government salvage and ship repair response capacity. Salvage and ship repair are important to support commercial shipping and the lack of this capacity is of concern to the marine insurance industry.

11] The availability and cost of marine insurance is a major restraint on shipping in many parts of the Arctic. The underwriting of present shipping activities takes place only on a case-by-case basis.

12] The international liability and compensation regime is fragmented and limited, with separate conventions addressing pollution from oil tankers, bunker fuel from non-tankers, and hazardous and noxious substances from all ships. No convention or protocol addresses damage to the high seas beyond national jurisdiction.

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CURRENT MARINE USE AND THE AMSA SHIPPING DATABASE

In order to better understand Arctic shipping today, a database of Arctic marine activity for a given year was seen as essential. Since no comprehensive database existed, AMSA undertook the collection of shipping data from all Arctic states. The result is the first comprehensive Arctic vessel activity database for a given calendar year. It contains a range of information on where and when different vessels are operating in the Arctic, what types of vessels, what activity they undertake and what cargo they may be carrying, among other information. The AMSA database is a flexible tool that can be built upon as additional information is obtained and can be used to further assess environmental impacts from vessel activity, locate areas of potential conflicting multiple use and provide a baseline for an analysis of future growth in vessel activity in the region.

Methodology

Vessel activity data for the AMSA study was collected from all Arctic states with coastal waters through the use of a specially designed questionnaire distributed to the Arctic Council's Senior Arctic Officials and PAME working group representatives in February 2006. A number of state administrations responded directly and, in some cases, other organizations were engaged to develop responses on a state's behalf. For the purposes of the study, 2004 was chosen to be the baseline year; where data was found to be insufficient for 2004, data from later years was provided and used for those areas only.

The data requested included such information as the number of vessels operating in the states' waters, the type of vessels, cargo

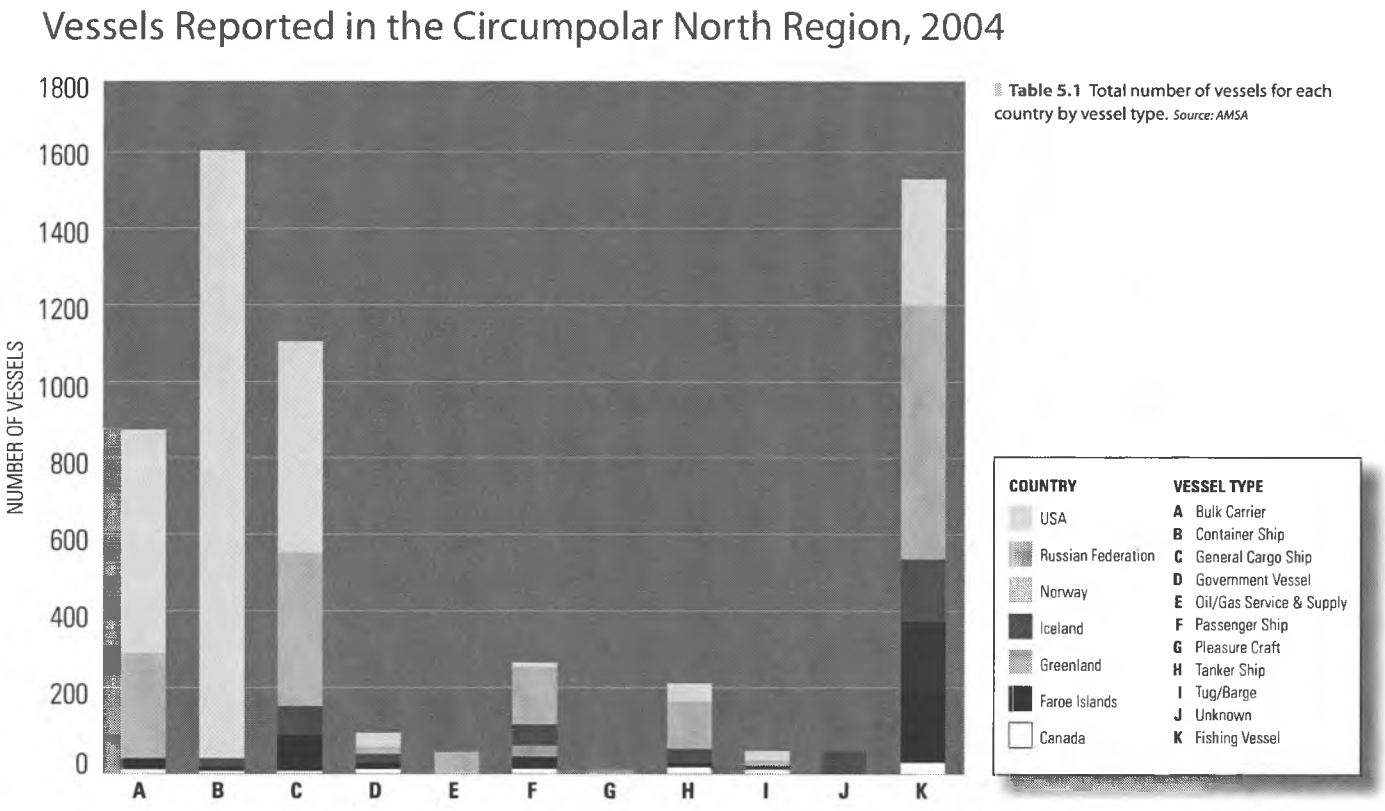


Table 5.1 Total number of vessels for each country by vessel type. *Source: AMSA*

carried, operational routes, fuel used, engine size of the vessels, date of operations, etc. Response to the questionnaire varied. Some responses were submitted with very detailed information, while some were submitted with very basic information or, at times, incomplete. In order to make the database more usable for most types of analysis, some assumptions have been made and post-processing of the data has been undertaken. For example, where route data was unavailable or contained obvious errors, such as passages across land, the information has been adjusted to follow known shipping routes. In terms of data reporting, there is some inconsistency in how states defined vessel types, as some states reported oil carriers as tankers, while others reported similar vessels as bulk carriers or tug and barge. There are also varying levels of certainty regarding the routes traveled, ranging from very complete records of course changes to records that provided only departure and arrival points.

Where limited vessel-specific information was provided, other data sources were integrated, including ferry and cargo vessel sailing schedules, to add additional parameters to the data set. To facilitate analysis of the raw data, vessels were grouped into standardized vessel categories by the country that reported it and by the season in which it operated (Table 5.2). A summary of total number of vessels per category per country is shown in Table 5.1. Seasons were defined as: Winter - December to February; Spring - March to May; Summer - June to August; Autumn - September to November. For the purposes of the AMSA, the Arctic has been defined according to the internal policies among Arctic Council member states. This has meant that some states reported vessel activity that is below 60 degrees north, the traditional definition of the Arctic.

To further enhance understanding and presentation of the data, the raw data was mapped into a Geographic Information System (GIS), which provided the tools required to manage and analyze the spatial as well as the attribute components. Incorporating the data into a GIS provided for the development of maps that create a visual presentation, allowing for further analysis of all Arctic vessel activities, such as modeling vessel CO_2 emissions and comparing current vessel traffic and mapped ecologically sensitive areas.

Table 5.2 AMSA vessel categories. *Source: AMSA*

Ship Category	General Description
Government Vessels and Icebreakers	An icebreaker is a special purpose ship or boat designed to move and navigate through ice-covered waters. For a ship to be considered an icebreaker it requires three components: a strengthened hull, an ice-clearing shape and the power to push through ice, none of which are possessed by most normal ships.
Container Ships	Container ships are cargo ships that carry all of their load in truck-size containers, in a technique called containerization.
General Cargo	Ships designed for the carriage of various types and forms of cargo and the combined carriages of general cargo and passengers with 12 or less fare paying passengers.
Bulk Carriers	Ships specifically designed for bulk carriage of ore with additional faculties for alternative, but not simultaneous, carriage of oil or loose or dry cargo. Bulk carriers are segregated into the following major categories: handysize (10,000 to 35,000 DWT), handymax (35,000 to 55,000 DWT), panamax (60,000 to 80,000 DWT), capesize (80,000 DWT and over).
Tanker Ships	Propelled ships designed and constructed for the bulk carriage of liquids or compressed gas, as in the case of natural gas.
Passenger Ships	Ships that carry passengers, whether for transport purposes only or where the voyage itself and the ship's amenities are part of the experience.
Tug / Barge	Tug: vessel designed for towing or pushing. Additional activities may include salvage, fire fighting and work duties of a general nature. Barge: non-propelled vessel for carriage of bulk or mixed cargoes on weather or protected decks. May carry liquid cargo in holds or tanks. Some barges are modified for specific purposes (for example, crane barge).
Fishing Vessels	Fishing boats can be categorized by several criteria: the type of fish they catch, the fishing method used, geographical origin and technical features such as rigging. Modern commercial fishing uses many methods: fishing by nets, such as purse seine, beach seine, lift nets, gillnets or entangling nets; trawling, including bottom trawl; hooks and lines, long-line fishing and hand-line fishing; fishing traps. Fishing boats are generally small, often little more than 30 meters (98 ft) but up to 100 meters (330 ft) for a large tuna or whaling ship and can feature holds large enough to keep a good-sized catch.
Oil and Gas Exploration Vessels	There are many specialized vessels that are designed specifically for the exploration and extraction of natural gas and oil.

Using the GIS, the fishing data was defined by fishing vessel days per year, taking the number of fishing days times the number of fishing vessels reported. This number was then assigned to the appropriate Large Marine Ecosystem (LME) based on where the fishing events took place. A bathymetry layer is also provided in GIS format and can be used to discern draft limits to navigation. Map 5.1 shows the map-based depiction of all of the vessel activity in the AMSA database, including fishing vessel activity by LME.

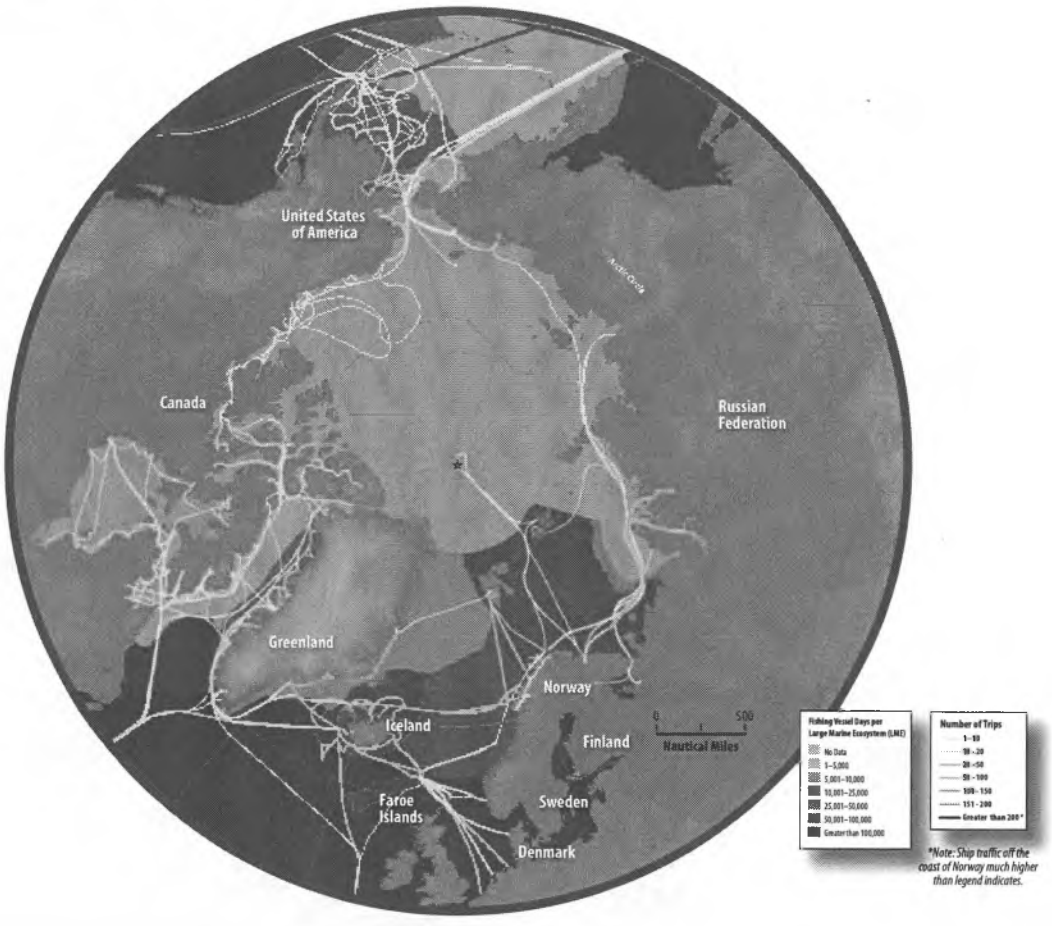
Results

In 2004, approximately 6,000 individual vessels were reported operating in the Arctic, including vessels traveling on the North Pacific's Great Circle Route between Asia and North America through the Aleutian Island chain, defined by the U.S. as within the Arctic. Great Circle Route vessels account for half of all the vessels reported. Excluding the vessels plying the Great Circle Route, the most vessels in one category were fishing boats, at slightly less than 50 percent of the total; with the next largest vessel category being bulk carriers at about 20 percent of all vessels. The AMSA database contains information on individual voyages into or through Arctic waters. This means that the number of individual vessels is not necessarily proportionate to the total number of voyages, as many vessels made multiple trips within the region. Results are also potentially an underestimation of total vessels and marine use for 2004, given probable underreporting bias and obvious data gaps in many areas and vessel types.

While 2004 provides a snapshot of current Arctic vessel traffic, clear trends emerged from the data to show what common types of vessels are operating in the Arctic, where and when most activity is typically taking place. The AMSA database identified four types of vessel activities as most significant in the Arctic in 2004: community re-supply, bulk cargo, tourism and fishing vessel activity operations.

6,000

The approximate number of vessels in the Arctic marine area during 2004, including the North Pacific Great Circle Route.



Map 5.1 Overview of all vessel activity for 2004, including fishing vessels. *Source: AMSA*

Regional Distribution of Vessel Activities

The overview map of vessel traffic shows that nearly all voyages took place on the periphery of the Arctic Ocean. Regions of high concentrations of traffic include: along the Norwegian coast and into the Barents Sea off northwest Russia; around Iceland; near the Faroe Islands and southwest Greenland; and in the Bering Sea. Different factors determine this distribution of marine activity. In the Bering Sea, in addition to the ships along the North Pacific Great Circle Route (through the Aleutian Islands), most of the ship traffic is bulk cargo ships serving the Red Dog mine in northwest Alaska, fishing and coastal community (summer) resupply. Traffic around Iceland, the Faroe Islands and southwestern Greenland is a

The AMSA database identified four types of vessel activities as most significant in the Arctic in 2004: community re-supply, bulk cargo, tourism and fishing vessel activity operations.

Icebreaker Navigation in the Central Arctic Ocean, 1977-2008

One of the historic polar achievements at the end of the 20th century and early in the 21st century has been the successful operation of icebreakers at the North Pole and across the central Arctic Ocean.

Between 1977 and 2008 access in summer has been attained by capable icebreaking ships to all regions of the Arctic basin. Seventy seven voyages have been made to the Geographic North Pole by the icebreakers of Russia (65), Sweden (five), USA (three), Germany (two), Canada (one) and Norway (one).

Nineteen of the 77 voyages have been in support of scientific exploration and the remaining 58 have been for marine tourism, all but one of the tourist voyages conducted aboard ice breakers.

Of the 76 icebreaker voyages that have been to the pole in summer, the earliest date of arrival has been July 2, 2007 and the latest September 12, 2005, a short 10-week navigation season for highly capable icebreaking ships.

The Soviet nuclear icebreaker *Arktika*, during a celebrated voyage, was the first surface ship to attain the North Pole on August 17, 1977. *Arktika* departed from Murmansk on August 9 and sailed eastbound initially north of Novaya Zemlya and through Vilkitski Strait to the ice edge in the Laptev Sea. The ship sailed northward to the pole along longitude 125 degrees east and reached the pole on August 17. *Arktika* arrived back in Murmansk on August 23 having sailed 3,852 nautical miles in 14 days at a speed of 11.5 knots.

The only voyage to the pole not to be conducted in summer was that of the Soviet nuclear icebreaker *Sibir*, which supported scientific operations during May 8 to June 19, 1987, reaching the North Pole on May 25. *Sibir* navigated in near-maximum thickness of Arctic sea ice while removing the personnel from Soviet North Pole Drift Station 27 and establishing a new scientific drift station (number 29) in the northern Laptev Sea. This successful voyage in the central Arctic Ocean could be considered the most demanding ice [illegible] ate.

No commercial ship has ever conducted a voyage across the central Arctic Ocean. However, seven trans-Arctic voyages, all in summer, have been accomplished by icebreakers in the central Arctic Oc[illegible]

A voyage across the central Arctic Ocean with tourists was conducted by the Soviet nuclear icebreaker *Sovetskiy Soyuz* in August 1991. The Arctic Ocean Section 1994 Expedition, conducted by Canada's icebreaker *Louis S. St-Laurent* and the *Polar Sea* of the United States, was the first scientific transect of the Arctic Ocean accomplished by surface ship. During July and August 1994 both ships sailed from the Bering Strait to the North Pole and to an exit between Greenland and Svalbard through Fram Strait. The expedition made

extensive use of real-time satellite imagery (received aboard *Polar Sea*) for strategic navigation and scientific planning.

Two trans-Arctic voyages with tourists through the North Pole were accomplished by the Russian nuclear icebreaker *Yamal* in summer 1996. In summer 2005, Sweden's icebreaker, the *Oden*, and the American icebreaker *Healy* also made trans-Arctic passages in a second and highly successful scientific expedition by surface ships across the central Arctic Ocean.

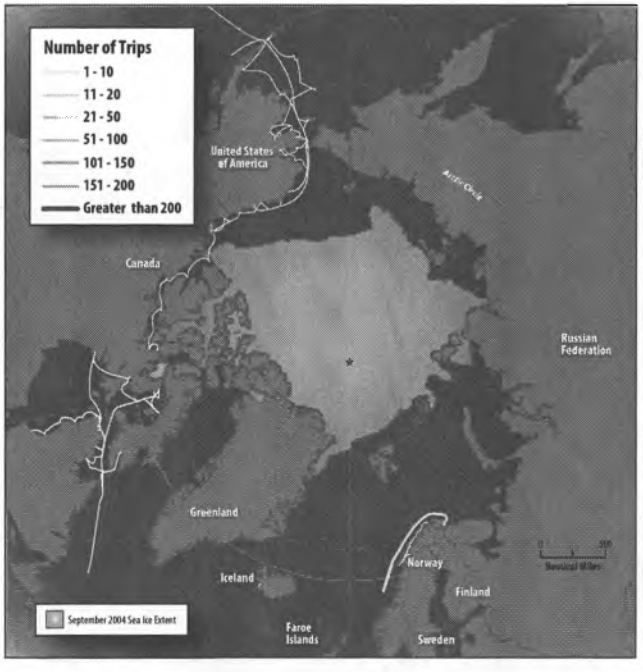
Although not a trans-Arctic voyage, the operation of a three-ship scientific expedition for Arctic seabed drilling during late summer 2004, mentioned earlier, is noteworthy included in the AMSA 2 004 database. The expedition was comprised of Russia's nuclear icebreaker *Sovetskiy Soyuz* and Sweden's *Oden*, both used extensively for ice management and the Norwegian-flag icebreaker *Vidar Viking* outfitted for drilling. One of the key accomplishments was the return of a 400-meter sediment core from the seabed that is being used for scientific studies of past Arctic climates.

A review of these historic polar voyages indicates that marine access in summer throughout the Arctic Ocean has been achieved by the 21st century by highly capable icebreakers. The nuclear icebreakers of the Soviet Union and later the Russian Federation have clearly pioneered independent ship operations in the central Arctic Ocean, especially on voyages to the North Pole in summer. Conventionally powered icebreakers have also operated successfully on trans-Arctic voyages in summer, as well as on scientific expeditions to high latitudes in all regions of the Arctic Ocean. Any planning for future navigation in the central Arctic Ocean would do well to understand the ship performance, environmental conditions and ice navigation capabilities of these successful operations in the ice-covered central Arctic Ocean.

mix of fishing, domestic cargo supply and cruise ships. The Barents Sea experiences the highest concentrations of marine activity in the Arctic region. Ships plying these waters include: bulk cargo carriers, oil tankers, LNG carriers, coastal ferries, fishing vessels, cruise ships and other smaller vessels. Many ships pass along the Norwegian coast and in Norwegian waters during bad weather en route to Murmansk and northwest Russia. There is tanker traffic in the region and ships servicing the Norilsk Nickel mining complex sail year-round from the port of Dudinka on the Yenisei River to Murmansk.

Marine Use: Arctic Community Re-supply

For 2004, community re-supply made up a significant portion of the ship traffic throughout the Arctic. In some areas of the region, this is also referred to as coastal Arctic shipping. In areas such as the Canadian Arctic, eastern Russia and Greenland, this activity was the basis for most ship traffic. Re-supply activities provide a lifeline to many communities that have no or very limited road access and no or limited capacity to handle heavy aircraft. Most communities serviced - mainly in Canada, the Russian Federation, Greenland, the United States, Svalbard and Bear Island - are ice-locked for parts of the year and rely heavily on marine transportation during the summer months for their dry foods, fuel, building materials and other commodities.



Map 5.2 Tug/barge traffic. *Source: AMSA*

Community re-supply and coastal Arctic shipping involve a range of ship types, including tankers, general cargo and container ships and, in some areas, tug/barge combinations. Tug/barge operations are particularly common in the western Canadian and Alaska Arctic and are used in these regions for mostly community re-supply, as well as for supplying mining and other construction projects. Tug/barge operations typically consist of a tug towing up to three barges. Depending on conditions, a tug/barge train can be a kilometer in length or more. Map 5.2 shows where the tug/barge activity took place, according to the data reported.

Summer resupply is handled by barge traffic along the Alaska Arctic, and in the Canadian Arctic a lack of deepwater ports requires lightering from larger supply ships at select Arctic communities. Lightering (shuttling goods from the anchored main ship to shore) is used to bring cargo ashore and tanker ships transfer petroleum products ashore by way of pumps and floating fuel lines, at many Arctic locations without deepwater access. There are select ports in Greenland, Svalbard and along the Northern Sea Route for normal cargo handling in small ports. Along the coasts of Norway and Iceland, and in Murmansk (northwest Russian Federation), all of which are ice-free year-round, there are deepwater port facilities to handle volumes of cargo from global shipping.

Community re-supply is expected to expand in the coming years due both to population increases in Arctic communities and increasing development in the region, stimulating demand for goods and construction materials. The 2004 AMSA data shows where this type of vessel traffic is occurring and can, therefore, serve as a good baseline tool when projecting future activity under various scenarios for population and economic growth.

Bulk transport of commodities such as oil, gas and various types of ore is a significant portion of total Arctic vessel traffic in 2004.

Marine Use: Bulk Transport of Ore, Oil and Gas

Bulk transport of commodities such as oil, gas and various types of ore is a significant portion of total Arctic vessel traffic in 2004 in volume of cargo transported. There are some very large mines in the Arctic producing commodities such as nickel, zinc and other ores, as well as oil and gas producing fields off the coast of Norway and in the Russian and U.S. Arctic. The Red Dog mine in Alaska is one of the world's largest zinc mines. The Norilsk Nickel mine near the port of Dudinka in the Russian Federation is also the world's largest producer of nickel and palladium. Nearly all bulk traffic in the Arctic is outbound, shipping extracted natural resources out of the region to the world's markets. In 2004, there were no Arctic transits of bulk goods east, west or through the central Arctic Ocean.

Most bulk transport takes place during the ice-free season or in ice-free parts of the Arctic including the Norwegian Arctic and parts of the Russian Arctic such as Murmansk. The exceptions are high-value perishable cargoes such as the concentrates from the Dudinka region and the nickel from Deception Bay in northern Quebec, Canada, which must be shipped year-round because they degrade if left too long without processing. In 2004, these two operations were the only all-season operations recorded in seasonally ice-covered parts of the Arctic, which demonstrates that given economic incentive, year-round operations may be possible in other areas where ice is a limiting factor. In other Arctic mining areas that are ice-locked throughout the winter, bulk cargoes are stored during winter and spring and are shipped out in the brief ice-free summer/autumn season. Because some of the mines, such as Red Dog, produce very large amounts of ore, the ice-free season means heavy traffic and carefully planned bulk shipments to ensure mines get all of the ore out before the fall ice forms. Large bulk carriers, Panamax and Handymax size up to 65,000 tons, visit Red Dog mine in Alaska during the short summer season. Many of the bulk carriers operating throughout the Arctic in the summer are not ice-strengthened or *Polar Class*.

Development of the rich natural resources in the Arctic is a rapidly growing industry. Since 2004, several significant new bulk shipments have begun operations, such as the year-round oil shipments out of Varandey in the Russian Arctic. In early 2008, an offshore lease sale conducted by the U.S. Minerals Management Service for the U.S. Arctic totaled nearly $US2.7 billion; offshore

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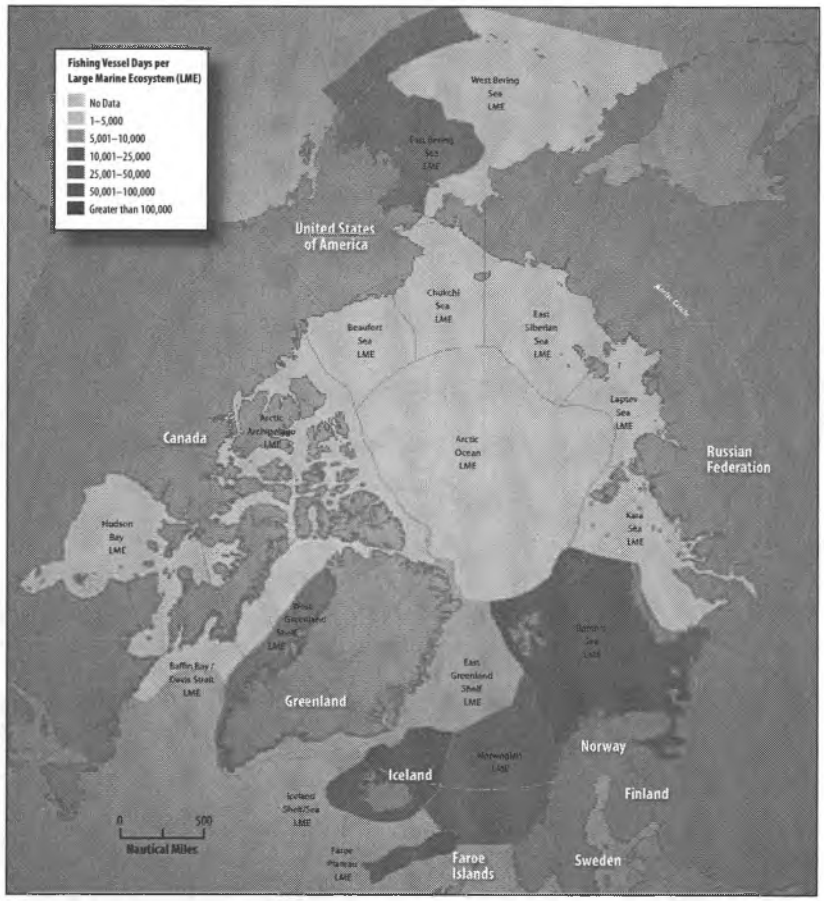
$US2.7B

The approximate amount of money received by the U.S. Minerals Management Service for an Arctic offshore lease sale in 2008.

gas appears to be the resource under consideration for development in this Arctic region. In June 2008, the Government of Canada received record breaking bids for oil and gas exploration leases in the Beaufort Sea, including a $C1.2 billion bid for the rights to explore an offshore area of 611,000 hectares. In September 2008, a test shipment of some of the purest iron ore found on the planet was delivered to Europe from the Baffinland mine in Mary River on Baffin Island. Depending on the regulatory review, the mine could begin year-round operations in the next 3-5 years. As planned resource development projects such as these become operational, bulk carrier traffic in the Arctic will continue to increase. This type of ship activity is likely where the most growth will be witnessed in the near future.



Map 5.3 Fishing vessel activity. *Source: AMSA*

Marine Use: Fishing

Fishing vessel operations constitute a significant portion of all vessel activity in the Arctic in 2004, given that some of the world's most productive fisheries are in the Arctic region. The amount of fishing activity reported in the AMSA database almost certainly underestimates the amount of activity actually taking place, as there are regions of the Arctic for which no data was submitted, but there is known to be commercial fishing occurring. Also, much fishing activity is likely to take place on smaller vessels, which are, for the most part, not captured in the AMSA database. The reported fishing vessel activity takes place in a few key areas, including the Bering and Barents seas; on the west coast of Greenland; and around Iceland and the Faroe Islands. Very limited fishing activity occurs in the Arctic Ocean and the Canadian Arctic Archipelago, mostly small-scale food fisheries. Since fishing in the Arctic takes place up to the ice edge, not in close ice pack conditions, operations are in completely or seasonally ice-free or low ice concentration areas and opportunistic in nature. Fishing vessel activity in the database has been categorized according to the Large Marine Ecosystem in which the activity took place. LMEs are geographical entities defined as ecosystems based on a series of ecological criteria. Each comprises a fairly large sea area, typically 200,000 km² or larger, with distinct bathymetry, hydrography, productivity and trophically dependent populations.

Fishing vessel operations constitute a significant portion of all vessel activity in the Arctic in 2004, given that some of the world's most productive fisheries are in the Arctic region.

23
The number of commercial cruise ships transiting the Northwest Passage between 1984 and 2004.

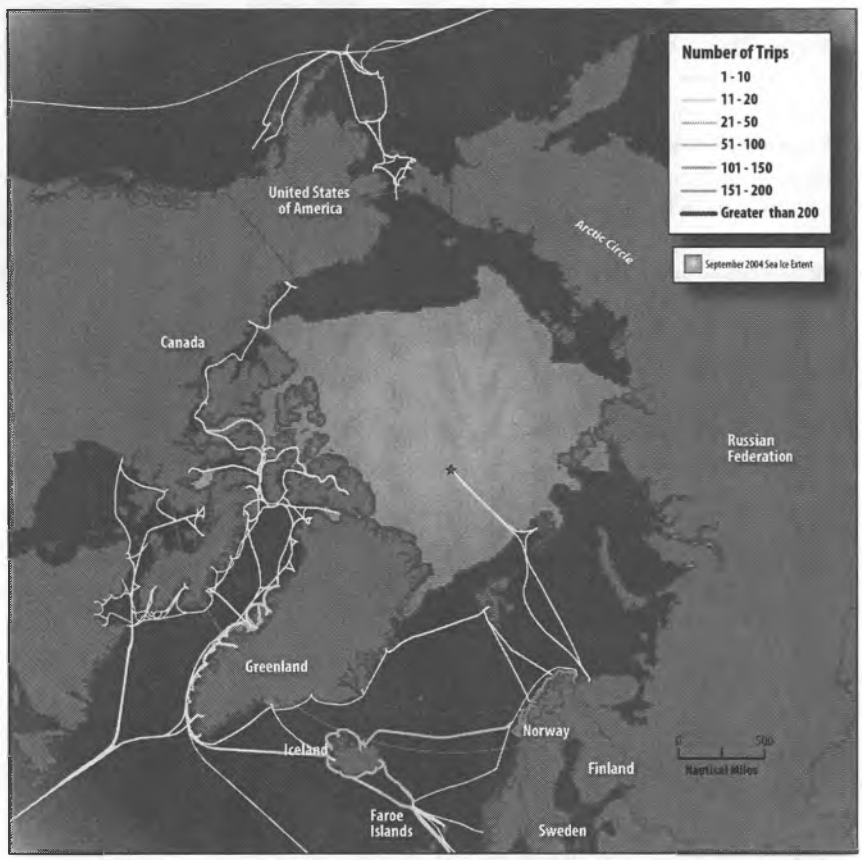
Map 5.3 shows general levels of activity in each of the LMEs within the AMSA area of study and highlights those for which data was not available. Fishing vessel data is presented in terms of days in an area rather than as routes, because fishing vessels typically meander in search of catch rather than follow a specific itinerary. Although further analysis of the impacts of fishing or its potential growth fall outside the scope of this report, it is important to appreciate that fishing activity represents a significant proportion of all current vessel activity in the Arctic region in considering cumulative effects.

Marine Use: Passenger Vessels and Tourism

Passenger vessel activity represents a significant proportion of the vessel activity reported in the Arctic for 2004. The type of activity captured in the AMSA database includes ferry services, small and large cruise vessels and any other vessels where people are transported, whether for tourism purposes or otherwise. The type of activity taking place varies depending on its location. In Norway, Greenland and Iceland, some of the passenger vessel traffic consists of ferries, carrying people into and out of coastal communities. In other areas, such as Alaska and the Canadian Arctic, ferry services are non-existent and all passenger traffic would be vessels for marine tourism only. Some services, such as the Hurtigruten around Norway and ferry service to Iceland and Greenland from mainland Europe are hybrids, serving both as ferries and cruise ships. Map 5.4 presents the overall passenger vessel traffic in the Arctic for 2004.

Nearly all passenger vessel activity in the Arctic takes place in ice-free waters, in the summer season and the vast majority of it is for marine tourism purposes. In 2004, the only passenger vessels that traveled in ice-covered waters were the Russian nuclear icebreakers that took tourists to the North Pole, voyages they have been making for tourism purposes since 1990. The heaviest passenger vessel traffic in the AMSA 2004 ship activity database is seen along the Norwegian coast, off the coast of Greenland, Iceland and Svalbard. Though there was some passenger vessel traffic in the Canadian Arctic and Alaska, those numbers were small in comparison to the higher traffic areas.

Marine-based tourism is the largest segment of the Arctic tourism industry in terms of numbers of persons, geographic range and types of recreation activities. The size and type of vessels that service this industry range from relatively small expedition style vessels that hold less than 200 people, to large luxury cruise liners that can hold 1,000 or more. In the Arctic, marine tourism is highly diversified and is driven by five main types of tourists seeking out a range of activities. These include mass market tourists primarily attracted to sightseeing within the pleasurable surroundings of comfortable transport and accommodations; the sport fishing and hunting market driven by tourists who pursue unique fish and game species within wilderness settings; the nature market driven by tourists who seek to observe wildlife species in their natural habitats, and/or experience



Map 5.4 Passenger vessel traffic. *Source: AMSA*

157 to 222

The increase in cruise ships making port calls in Greenland between 2006 and 2007.

© Ross MacDonald

Year	Arrivals	Number of cruise ships	Average number of arrivals/ship	Average passenger capacity/ship
2003	164	14	13	490
2004	195	24	8	468
2005	115	25	5	714
2006	157	28	6	546
2007	222	35	6	671
2008	375*	39*	10*	641*

*= Estimates for 2008 (full data not available at time of printing)

Table 5.3 Cruise ship arrivals in Greenland ports and harbors, 2003 – 2008.
Source: Greenland Tourism (Grønlands Turist- og Erhvervsråd)

the beauty and solitude of natural areas; the adventure tourism market driven by tourists who seek personal achievement and exhilaration from meeting challenges and potential perils of outdoor sport activities; and the culture and heritage tourism market driven by tourists who either want to experience personal interaction with the lives and traditions of indigenous people, or personally experience historic places and artifacts.

While Arctic ship-based tours are booked well in advance, many of the itineraries are somewhat opportunistic. The precise route and the ports and communities visited depend on the ice conditions and the difficulty and risk of access. Cruise ships often intentionally travel close to the ice edge and shorelines for wildlife viewing opportunities, increasing the risk of interaction with ice and other hazards. Many Arctic cruise ships visit destinations that were once totally inaccessible to the public, such as the North Pole, Northwest Passage and the Northern Sea Route. Between 1984 and 2004, 23 commercial cruise ships accomplished transits of the Northwest Passage; seven commercial tours were planned for 2008 alone.

According to the Cruise Lines International Organization, the number of passengers served worldwide has grown from about 500,000 in 1970 to more than 12 million in 2006. Additional growth is now occurring in the number and passenger capacity of new cruise ships entering the market. The Royal Caribbean's *Freedom of the Seas* entered the fleet in June 2007 with the largest passenger capacity yet – 3,634 – twice the size of ships built a decade ago. From 2000 to the end of 2008, 88 new cruise ships were introduced. The vast majority of these vessels were not constructed or designed to operate in Arctic conditions, yet as Arctic cruise tourism continues to grow, it is very likely that many of them may make trips to the region. The cruise ship industry considers Arctic voyages to be a vital and especially lucrative part of their international tourism product. This is apparent when considering the price that tourists pay to travel to this region. As of 2008, the prices for Arctic cruises range between $US2,900 and $US55,000 per person. The cruise ship industry has indicated that it not only intends to maintain an Arctic presence, but to expand in terms of ship passenger capacity, destinations and extended seasons of operations. This will be encouraged by circumpolar nations that consider tourism important for growing and strengthening their economies.

Cruise ship traffic in the Arctic region has increased significantly in the four years that have passed since the AMSA database was developed. An independent survey indicated more than 1.2 million passengers traveled in 2004 to Arctic destinations aboard cruise ships; however, by 2007 that number had more than doubled.

A specific example of where cruise ship traffic is increasing at a rapid rate is off the coast of Greenland. As Table 5.3 shows, cruise ship visits and the number of passengers visiting Greenland has increased significantly between 2003 and 2008. For example, between 2006 and 2007, port calls into Greenland increased from 157 to 222 cruise ships. The number of port calls in 2006 combined for a total of 22,051 passengers, a number that represents nearly half of Greenland's total 2006 population of 56,901.

In 2008, approximately 375 cruise ship port calls were scheduled for Greenland ports and harbors, more than double the number of port calls seen in 2006. The areas visited by the cruise vessels in Greenland are also changing. Likely driven by increased demand in adventure tourism, Tourism Greenland has reported that in the past few years there has been a marked increased interest in trips to the

Arctic Marine Tourism: A New Challenge

As passenger and cruise vessel traffic continues to increase in the Arctic, infrastructure and passenger safety needs will become of increasing concern. The large number of tourists already cruising Arctic waters now exceeds the emergency response capabilities of local communities (See page 172). The Arctic's cold air and water temperatures require the quick and efficient rescue of capsized vessels and tourists aboard lifeboats and rafts. Even limited exposure to cold weather and seas quickly reduces human endurance and chances of survival. These hazardous environmental conditions prevail in a region that has very scarce emergency response resources and where long distances result in lengthy response times. Emergency protocols become increasingly difficult as both small and large cruise ships seek remote wilderness settings and wildlife habitats. The primary polar attractions sought by tourists are rarely close to emergency response services. This combination of hostile environmental conditions and scarce emergency infrastructure is a serious threat to human life.

When performing search and rescue in the polar regions, there is an urgent need to respond quickly, as the prevention of injury and loss of life depends on timely response, prompt evacuation and the application of medical and other emergency response services. Effective responses can only be accomplished by the design and implementation of appropriate search and rescue management policies and programs, supported by appropriate physical infrastructure and well-trained personnel.

Ship evacuation produces a host of emergency response problems in the polar world. Passengers and crew must be sheltered from inclement weather, properly clothed, nourished and hydrated. The provision of these basic necessities in the polar environment, either sea or land, is formidable. The ability to successfully communicate a distress signal of any sort in the polar world can further exacerbate these threatening circumstances. Communications in the Arctic may be a challenge. However, ships equipped with adequate communication equipment (for example, digital selective calling-high frequency, or DSC-HF, and Electronic Position Indicating Radio Beacon, or EPRIB) are able to transmit distress messages.

© Harald Pinkler

It is not likely that communities located in the remote, high Arctic have sufficient medical resources to respond to illnesses involving hundreds, or perhaps thousands, of cruise ship passengers and crew. And given their histories, the indigenous people living in rural Arctic communities are understandably fearful of exposure to infectious diseases.

A dangerous consequence of the growing popularity and number of cruise ships operating in and transiting through polar waters is the significant increase of marine incidents. Serious marine incidents include sinkings, groundings, pollution and other environmental violations, disabling by collision, fire and loss of propulsion. Rapid increase in the number of cruise ship voyages has led to a similar increase in the number of incidents.

Given the large number of cruise ships and other recreational boaters currently operating throughout the polar seas and the probable growth of those markets, marine operators, Arctic governments and local communities are faced with significant management challenges.

far North of Greenland, an area that has traditionally not been visited by many tourists. In 2008, 28 vessels were scheduled to travel as far north as Uummannaq, some continuing on to Qaanaaq, both destinations far north of the Arctic Circle and far from good infrastructure or emergency response capabilities. Many of the cruise vessels traveling to these destinations are likely not ice-strengthened. Though this area is classified as ice-free in the summer, this does not mean that ice is not present and, even in small amounts, ice can pose a serious hazard. The Greenland government is very conscious of the rapid growth in cruise ship traffic in their waters and Island Command Greenland, the naval service covering Greenland waters that organizes both rescue and emergency operations, has recently put an increased focus on cruise activities in Greenland waters.

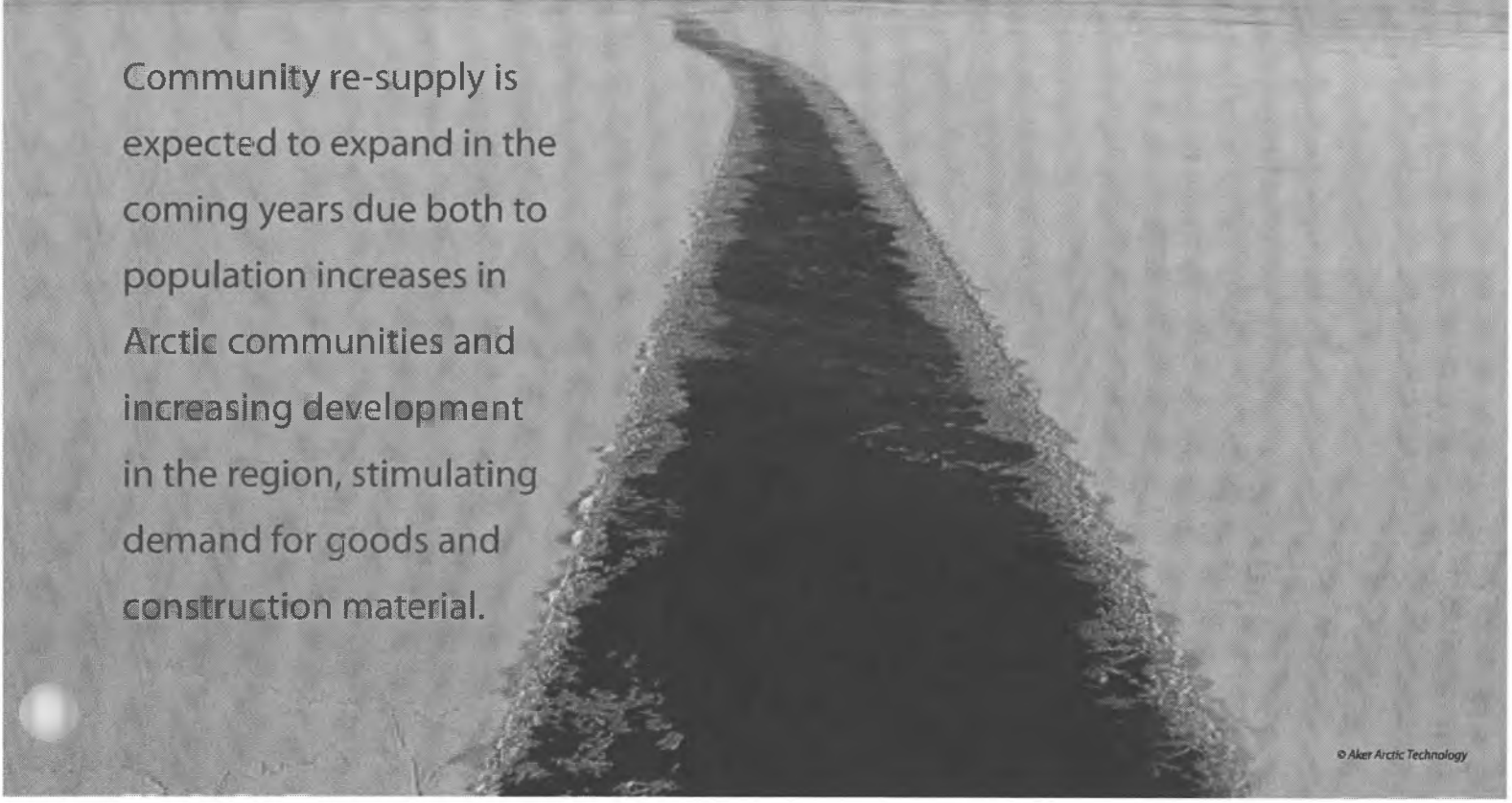
Passenger vessels, in particular cruise ships, is a sector that has experienced rapid growth in certain regions in the few years that have passed since the development of the AMSA database and is one which is expected to expand further in coming years. As this sector grows and more and larger ships begin to ply Arctic waters, it will become increasingly important to understand this type of activity so that Arctic states are prepared to meet the future needs of these vessels and their passengers.

Marine Use: Icebreaker, Government and Research Vessel Operations

Icebreakers, government and research vessels represent a relatively small proportion of the total vessel traffic in the Arctic. However, they are invaluable for surveying, oceanographic research, vessel escort in ice, salvage, pollution response and search and rescue. For the AMSA database, these vessel types were grouped since they conduct similar missions and also often carry out multiple tasks on a voyage. In the AMSA 2004 database, 83 of this type of ship were reported; however, several Arctic states did not include government vessels in their submission so the total for this category is likely larger. In keeping with the scope of the Arctic Council, naval or military vessels were not included in the AMSA database.

The icebreaker fleets of Canada and the Russian Federation conduct a range of tasks in their respective regions; summer sealift icebreaking duties are an important mission for these ships. Though several icebreakers might be capable of operating in the winter, nearly all icebreaker operations reported in the AMSA are conducted in the spring, summer and autumn. During summer 2004, the AMSA database indicates that there were eight voyages that reached the

Community re-supply is expected to expand in the coming years due both to population increases in Arctic communities and increasing development in the region, stimulating demand for goods and construction material.



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Year-round Arctic Marine Transport to Dudinka in Support of Natural Resource Development and Production

Since the winter of 1978-79, one of the most advanced Arctic marine transport systems in the Arctic has been the year-round operation comprised of traffic between the mines of the Mining and Metallurgical Company Norilsk Nickel to the port in Dudinka, on the Yenisei River at the then 231 nautical mile sailing to Murmansk, on the Kola Peninsula.

MMC Norilsk Nickel is the world's largest producer of nickel and palladium, and is among the top four platinum producers in the world, as well as among the top 10 copper producers. MMC Norilsk Nickel is also a large global enterprise with production facilities in the Russian Federation, Australia, Botswana, Finland, the United States and the Republic of South Africa.

Mining in the Norilsk area began in the 1920s. The region quickly became a critical supplier of non-ferrous metals within the Soviet Union. During the 1950s, the Northern Sea Route Administration was tasked with building a year-round Arctic marine transport system on the western end of the NSR and into the Yenisei.

The development of large, nuclear icebreakers came first with the *Lenin* in 1959 (world's first nuclear surface ship) followed by a small fleet of larger icebreakers of the *Arktika* class. These icebreakers were designed to create tracks in the ice for lower-powered cargo ships to sail in convoy astern of a lead icebreaker.

With unlimited endurance, the nuclear icebreakers could provide year-round services in the deeper waters along the major routes of the NSR. Ice-strengthened cargo ships and shallow-draft icebreakers came next. By the 1978-79 winter season there was enough icebreaking capacity to maintain year-round navigation by convoying ships from the Yenisei west across the Kara Sea and into the Barents Sea to Murmansk. A continuous flow of non-ferrous metal concentrates could be maintained to smelters on the Kola Peninsula and to other industries in the Soviet Union.

During 1982-87, a new icebreaking cargo ship, the SA-15 or *Norilsk* class, was delivered by Finland's former Valmet and Wartsila shipyards to the Soviet Union. Nineteen of these Arctic freighters (174 m length and 19,950 dwt) were built and several today remain in service on the route between Dudinka and Murmansk.

In many respects, the *Norilsk* class multi-purpose carriers revolutionized Arctic shipping in the same manner as the commercial carrier *MV Arctic* developed for the Canadian Arctic during the same years. With high propulsion power (21,000 shp), the *Norilsk* class ships could operate under their own power as an icebreaker. These ships carried cargoes the length of the NSR in summer during the late 1980s; during the winter they were used effectively to support the Norilsk-Dudinka operation.

Their proven capability for independent navigation through ice fields without icebreaker support was a significant technological achievement, as well as a notable advance in efficient (and cost-effective) Arctic marine operations. The successful operation of these ships was a harbinger of the future for Arctic marine transport.

In April 1988, a new, shallow-draft polar icebreaker named *Taymyr* was delivered to the Soviet Union by Wartsila's Helsinki shipyard. A single nuclear reactor was installed at the Baltic shipyard in (then) Leningrad, and the ship was ready for service along the NSR and in the shallow Siberian rivers by 1989. A second ship of the class, *Yaygach*, was added to the Murmansk Shipping Company's icebreaker fleet in 1990.

The design of this class represents the apex in the development process for the Soviet nuclear icebreaker fleet. Combined in its design are Finnish advances in shallow-draft ship design with nuclear propulsion developed in the Soviet Union. A draft of only 8 meters was obtained with *Taymyr*, which compares favorably with the average 11-meters draft of the largest Soviet icebreakers of the period. A power plant producing 44,000 shp provided a capability of continuously breaking 1.8 meters of level ice at a 2-knot speed. These capabilities fit perfectly with the requirements for icebreaking (level river ice) on the shallow Yenisei River to the port of Dudinka; these extraordinary nuclear ships could maintain an ice track out to the Kara Sea through the winter in nearly all conditions.

Year-round shipping to Dudinka functioned throughout the 1990s and the early years of the new century despite the financial challenges facing the Russian Federation. MMC Norilsk Nickel was restructured several times and since 2001 the company has flourished, focusing on economic efficiencies, foreign marketing and potential investments. The marine transport component also received significant attention as the SA-15 *Norilsk* class ships supporting the Dudinka run began to age.

The company's marine operations department worked closely with the Finnish shipbuilder Aker Yards to develop a new freighter class that would be owned and operated by MMC Norilsk Nickel. The vision was for a fleet of five icebreaking containerships designed for year-round operations. The first of the ships, *Norilsk Nickel* (168 meter length, 14,500 dwt, 650 TEU capacity), was completed in Helsinki early in 2006. The new ship is designed as a "double-acting hull" and is fitted with an azimuthing pod for propulsion.

The Azipod concept, as it is called, allows the ship to move stern-first efficiently in the ice: the ship is designed to break 1.5 meter thick ice unassisted. In light ice or open water, *Norilsk Nickel* turns 180 degrees and moves bow first. Ice trials for the new ship were conducted in March 2006 in the Kara sea and Yenisei River, and the vessel achieved a 3-knot speed continuously moving through 1.5 meter thick ice.

Norilsk Nickel has performed well in operating unassisted (without icebreaker es[illegible] its initial two years of service. With four more of the class being built in Germany, MMC Norilsk Nickel will have an operational fleet of five icebreaking carriers, all highly capable of operating independently through the winter season to serve the port of Dudinka. Safe and efficient, the *Norilsk Nickel* class ships represent a new concept of Arctic marine operations. They will enhance a regional, Arctic marine transport system in western Siberia and better link a key Russian commercial enterprise to world markets.

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North Pole, including a three-ship scientific expedition designed to drill into the Arctic seabed. The expedition was composed of the Russian Federation's nuclear icebreaker *Sovetskiy Soyuz*, Sweden's icebreaker *Oden* and the Norwegian-flag icebreaking drill ship *Viking Vidar*. During 2004-2008, there were 33 icebreaker transits to the North Pole for science and tourism. An increasing number of icebreakers and research vessels are conducting geological and geophysical research throughout the central Arctic Ocean related to establishing the limits of the extended continental shelf under UNCLOS.

Seasonality of Operations and Sea Ice Extent

The Arctic is defined by extreme seasonal variability, impacting the behavior of the animals that live in and migrate to and from the region, as well as human activity. Generally, most of the central Arctic is ice-covered, dark and very cold throughout the winter months. There are some areas, such as the Aleutian Island chain, the northern coast of Norway, southern Iceland and the Murmansk region in northern Russia where, due to ocean currents and other factors, ice does not form in the Arctic in the winter. However, these areas still experience darkness, extreme cold and variable conditions. The Arctic summer is the opposite extreme, with 24 hours of light and temperatures that can be uncomfortably warm. The pattern of vessel traffic in the AMSA database shows that vessel activity in the Arctic is highly affected by seasonal variability.

The AMSA GIS database includes Arctic sea ice maps for each month in 2004, with information collected and compiled by national ice administrations working cooperatively to create an Arctic sea ice picture. When layered with 2004 seasonal vessel traffic this data demonstrates how vessel traffic patterns interacted with the minimum sea ice extent at the time.

Maps 5.5 and 5.6 show the differences in sea ice extent between winter (January) and summer (July) traffic levels. Map 5.5 shows virtually no vessel activity in the central Arctic in the winter, although some takes place on the fringes in year-round ice-free zones. As mentioned earlier, the database indicates that only year-round commercial operations in the Arctic in seasonally ice-covered areas were into Dudinka in the Russian Federation and Deception Bay in Canada. These two operations were the only commercial icebreaking activities taking place in 2004; government icebreakers and research vessels conducted all other icebreaking that year. The data indicates that this was done only in the spring, summer and fall seasons.

Map 5.6 demonstrates the surge in vessel activity in the summer season, when all of the community re-supply takes place and most bulk commodities are shipped out and supplies brought in for commercial operations. Summer is also the season when all of the passenger and cruise vessels travel to the region. Wildlife in the Arctic also follows this pattern: although most species migrate

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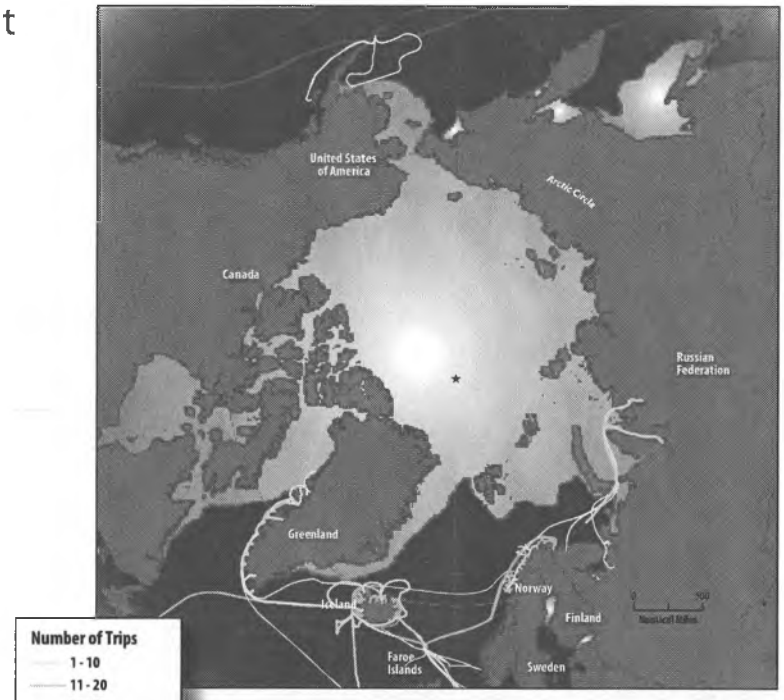
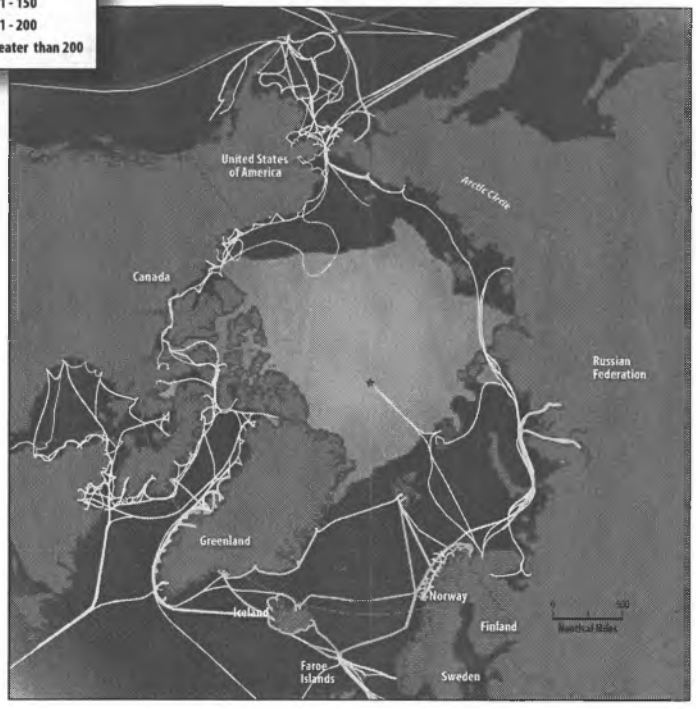
Sea Ice Extent Differences



Map 5.5 January traffic.
Source: AMSA



Map 5.6 July traffic.
Source: AMSA

earlier in the spring before ice break-up, animals gather in large aggregations in the summer to feed and reproduce. This is important to consider when examining potential environmental and ecosystem impacts that may result from current or increased vessel activity in the region.

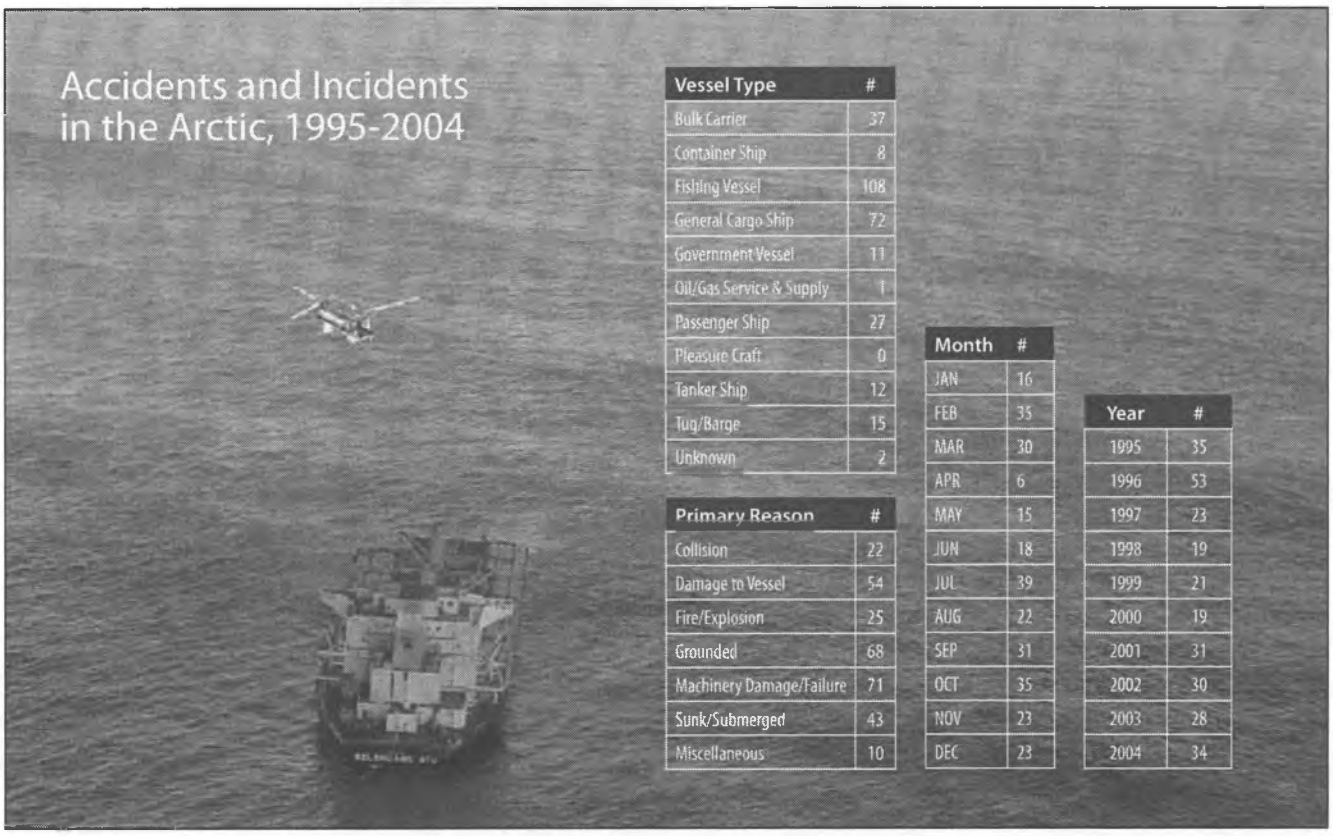
Summer and fall are the safest and most economical seasons for marine activity; therefore, activities such as resource development, tourism or community re-supply will most likely increase in the summer months. There may be a few exceptions, where high value commodities may drive year-round operations, but that will be driven by economics, not climate. If ice conditions continue to change and sea-ice extent reduces as predicted in the near term, the summer and fall shipping seasons will most likely lengthen. Even as perennial sea ice is reduced, winter in the central Arctic will remain inhospitable to marine navigation; therefore, future Arctic vessel activity will continue to be highly seasonal in the region.

Incidents and Accidents in the Arctic

The Arctic has always been and will continue to be a challenging environment for search and rescue and emergency response (See page 168). This is due to the very large geographic area involved and the relative low density of activity and response capabilities. In order to grasp potential threats to human safety and the marine environment as a result of potential incidents, it is important to understand what incidents may have occurred and where the areas are that have had the most incidents.

As part of the AMSA database, a summary of the incidents and accidents occurring in the Arctic region between 1995-2004 was developed. No one source of data was found to be sufficient to cover the circumpolar region; therefore a compilation of a number of sources was necessary to create the summary. The main sources

Table 5.4 Incident summary tables, 1995-2004. *Source: Lloyd's Marine Intelligence Unit Sea Searcher Database, Canadian Transportation Safety Board (Marine), Canadian Hydraulics Centre - Arctic Ice Regime System Database.*



Vessel Type	#
Bulk Carrier	37
Container Ship	8
Fishing Vessel	108
General Cargo Ship	72
Government Vessel	11
Oil/Gas Service & Supply	1
Passenger Ship	27
Pleasure Craft	0
Tanker Ship	12
Tug/Barge	15
Unknown	2

Primary Reason	#
Collision	22
Damage to Vessel	54
Fire/Explosion	25
Grounded	68
Machinery Damage/Failure	71
Sunk/Submerged	43
Miscellaneous	10

Month	#
JAN	16
FEB	35
MAR	30
APR	6
MAY	15
JUN	18
JUL	39
AUG	22
SEP	31
OCT	35
NOV	23
DEC	23

Year	#
1995	35
1996	53
1997	23
1998	19
1999	21
2000	19
2001	31
2002	30
2003	28
2004	34

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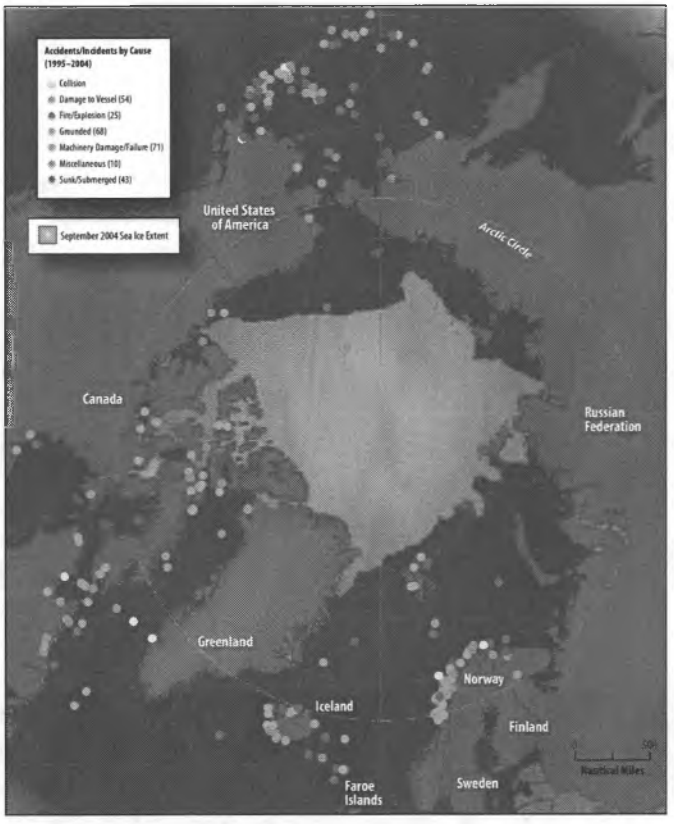


Map 5.7 Arctic shipping accidents and incidents causes, 1995-2004. *Source: Lloyd's Marine Intelligence Unit Sea Searcher Database, Canadian Transportation Safety Board (Marine), Canadian Hydraulics Centre- Arctic Ice Regime System Database.*

of information used were the Lloyds MIU Sea Searcher database, the Canadian Hydraulics Centre Arctic Ice Regime System database and the Canadian Transportation Safety Board (Marine.) Though this combined dataset is limited, it provides a basis for a very broad analysis of what type of incidents are occurring in the Arctic region and what areas may be more prone to incidents and therefore at a greater risk of further ones in the future.

The incidents and accidents were categorized by the type of incident that occurred, where and when it occurred, whether there were fatalities as a result, whether there was a significant oil spill involved and whether the vessel involved was considered a total loss for insurance purposes. Incident types were grouped into the following categories:

- **Grounding**: where a vessel came in contact with the bottom and, therefore, required assistance or significant effort to be re-floated. In some cases, vessels could not be re-floated and were either abandoned or broken up for salvage.
- **Collision**: where two vessels make contact resulting in minor to a serious damage to the vessel.
- **Damage to Vessel**: where damage to the vessel occurred, due to a variety of reasons ranging from contact with the pier, collision with ice, extreme weather or other factors.
- **Fire/Explosion**: where a fire or explosion occurred onboard a vessel, resulting in minor to very serious damage to the vessel and other consequences, such as fatalities.
- **Sunk/Submerged**: where a vessel was submerged in water for a period of time or sunk completely due to a range of causes.
- **Machinery Damage/Failure**: where a vessel sustained damage to machinery or complete machinery failure.

It is important to note that the incidents captured as part of AMSA excluded onboard incidents that may have involved injury to passengers and crew, but where there was no damage to the vessel. For a summary of the number and type of accidents and incidents involving vessels see Table 5.4.

Using the exact geographic locations for the different incidents and accidents, the data was entered into the GIS database, along with the different characteristics identified. The result was Map 5.7, which shows all of the reported incidents and accidents reported for the circumpolar region for the period of 1995-2004.

When looking at the geographic distribution of the incidents for the defined period shown in Map 5.7 there are certain gaps and trends that emerge. There is a complete absence of incidents reported in the Russian Arctic and there are some areas where there appears to be a concentration of incidents during the years collected. These areas are along the northern coast of Norway, around the Aleutian Island chain and in the Bering Sea, along the Labrador coast and in Hudson Strait in Canada and around Iceland and the Faroe Islands. These concentrations of incidents are consistent with the traffic patterns shown in the AMSA activity database – areas that show the concentrations of incidents are also those where the largest volume of vessel activity is occurring. This trend is even more apparent when the vessel routes for 2004 are shown on the same map as the incidents.

One of the most dramatic incidents in 2004 was the loss of life and sinking of the *Selendang Ayu* off the coast of Alaska. The incident is a graphic example of the key gaps in infrastructure, emergency response and salvage services that are readily available in other parts of the world's oceans.

The *Selendang Ayu* Disaster in the Alaska Arctic

On November 28, 2004, after loading 1,000 tonnes of fuel and 60,200 tonnes of soybeans, the *Selendang Ayu* departed Seattle, Washington, with a crew of 26 along the North Pacific Great Circle Route bound for Xiamen, China. Ten days later the 225-meter Malaysian-registered bulk carrier broke apart off the rugged coast of the Aleutian Islands of Alaska resulting in the deaths of six crew members, causing the crash of a U.S. Coast Guard helicopter and spilling an estimated 66 million metric tons of soybeans, 1.7 million liters of intermediate fuel oil, 55,564 liters of marine diesel and other contaminants into the environment further causing the deaths of seabirds and marine mammals (See page 151).

A U.S. National Transportation Safety Board marine accident brief is the basis for this report. Despite passing inspection by port authorities and U.S. Coast Guard officials prior to leaving Seattle, the seven-year old Panamax class vessel encountered engine problems approximately 100 nautical miles from Dutch Harbor, the closest place of refuge, and about 46 nautical miles from the nearest point of land. After leaving port in Seattle, the ship had encountered heavy seas and between gale and strong gale force winds.

On his second transit of the Bering Sea, the vessel's master, a citizen of India and a 32-year seagoing veteran, notified the harbormaster in Dutch Harbor via the vessel's satellite phone he was having difficulties and needed assistance. The Coast Guard immediately dispatched the cutter *Alex Haley* but because of the rough seas could only reach a top speed of 10 knots. Nearly six hours later, the cutter reached the *Selendang Ayu* and attempted to slow its drift toward the coastline by attaching a tow line to the vessel until the tugboat *Sidney Foss* arrived, which was then approximately 11 nautical miles away.

In the meantime, the wind and sea conditions continued to deteriorate. Arriving on scene, the tugboat master reported seeing the *Selendang Ayu* lying beam to the sea in 7.6-meter seas, hammered by 45- to 55-knot winds. Some crew members were desperately struggling to remain on the bow as the freighter rolled 25 to 35 degrees with waves crashing over the deck amid passing snow and ice squalls. The remainder of the crew, some who had been up for some 41 hours, worked frantically to restart the engines.

On the scene, the *Sidney Foss* was able to slow the drift but unable to turn the stricken ship's bow into the wind as the vessel drifted closer to the shore. A second tug, the *James Dunlap*, arrived from Dutch Harbor with sunrise 5 ½ hours away, noted the NTSB report. "Because of the sea state and the darkness, the masters of the *Sidney Foss* and the *James Dunlap* decided to wait until daylight before attempting to swing the bow of the *Selendang Ayu* around by putting a line on the stern."

Then, some three hours before sunrise, the towline parted and the stricken vessel continued its now unabated drift toward Unalaska Island. At sunrise, with the *Selendang Ayu* picking up speed toward the coastline, the ship's master dropped anchor in hopes to slow or even stop the drift. It almost worked.

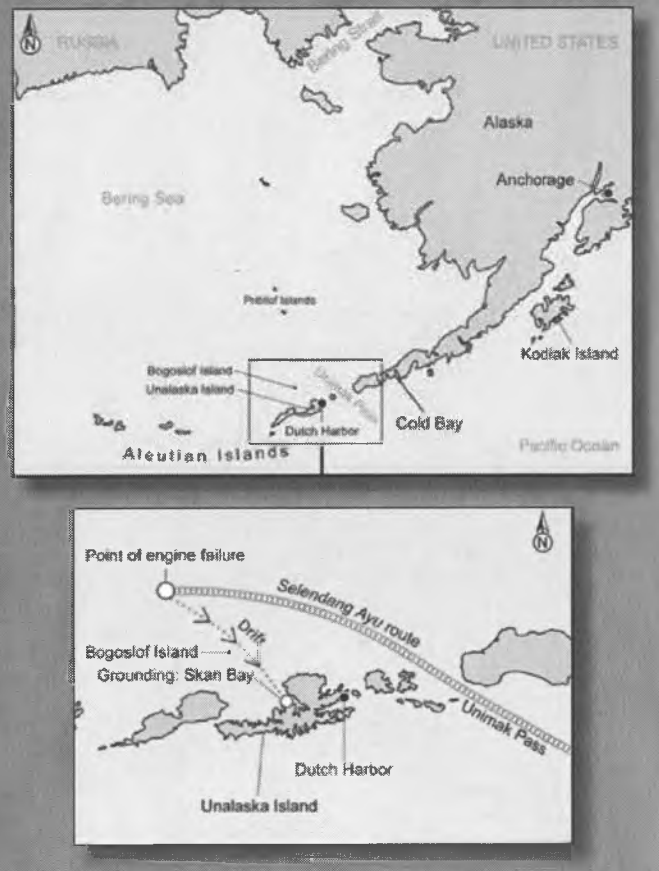
The port anchor immediately caught, slowing and almost stopping the vessel's drift. The feeling of relief was short-lived as some 15 minutes later the ship began slipping its anchor under the unrelenting pounding of the growing storm and started to drift at 2 knots toward shore. The weather continued to worsen with steep seas of 6 to 7.6 meters and periodic wind gusts of up to 65 knots, which occasionally pushed the waves to 9 to 10 meters. The Coast Guard suggested dropping the starboard anchor, "but the *Selendang Ayu* master said the starboard anchor might foul on the port anchor's chain," the report stated.

Several attempts to reestablish a towline failed and with now fading light and its proximity to shore, the Coast Guard recommended evacuating the crew. The master finally allowed a group of 18, those he considered the least essential for dealing with the emergency, to depart. Wearing lifejackets, but not the reddish-orange buoyant survival or immersion suit that protects against heat loss and ingress of water, they would be extracted in two groups. (At the time of the accident, the *International Convention for Safety of Life at Sea*, SOLAS, required a cargo vessel to carry at least three immersion suits for each lifeboat, unless the vessel had a totally enclosed lifeboat on each side. The *Selendang Ayu* carried two fully enclosed lifeboats, one port and one starboard and was equipped with three immersion suits. In an amendment effective July 1, 2006 the SOLAS regulation was changed to require one immersion suit for each person onboard a cargo ship. An exemption from this requirement for ships that voyage "constantly" in warm climates is not allowed for bulk carriers.)

Using a USCG HH-60 Jayhawk helicopter that had arrived from Cold Bay, Alaska, the first group of nine *Selendang Ayu* crew members were hoisted from the rolling deck. Then only a mile from shore, the ship's port anchor was dropped. It caught. Shortly thereafter, a second Jayhawk helicopter hoisted the second group of nine sailors from the ship. Eight crew members remained on board and continued to work frantically on the engines. As darkness began to close in, the Coast Guard radioed the master and said they wanted to remove the remainder of the crew before sunset. Then came the first of several shudders as the vessel ran aground on a small underwater shelf about 130 meters offshore. Knowing the ship's fate, the master radioed the *Alex Haley* and requested immediate extraction.

The eight remaining crew members gathered on the port bow, where the two previous evacuations had taken place. The vessel was rolling badly in the shallow water and increasing groundswell. Another HH-60 Jayhawk helicopter was dispatched from Dutch Harbor to the scene and a short time later the *Alex Haley* launched the smaller HH-65 Dolphin helicopter. Both aircraft reached the freighter around 6 pm with the larger Jayhawk helicopter performing the rescue. Fifteen minutes later all of the ship's crew, save the master and the USCG rescue swimmer, had been hoisted onboard when a huge rogue wave struck the bow of the freighter, sprayed up and engulfed the Jayhawk. The helicopter's engines stalled, spun around causing its tail and mail rotor blades to slam into the side of the crippled ship and crashed into the sea next to the *Selendang Ayu*'s forward port side. The Dolphin helicopter, which had been hovering close by, immediately went into rescue mode and quickly recovered the three-member flight crew and the one *Selendang Ayu* crew member who survived the

crash. With no other sign of survivors, the helicopter headed to Dutch Harbor. While the master and the Coast Guard swimmer were awaiting rescue, the ship broke in two on the rocks. After three hours of being bombarded by crashing waves, howling winds in total darkness, the ship's master and the USCG rescue swimmer were hoisted on board the Dolphin, which had returned from its trip to Dutch Harbor. It was 10:35 pm on December 8, nearly 60 hours since the *Selendang Ayu* engines failed.



Map 5.8 Accident location in Bering Sea. Inset shows route of *Selendang Ayu* through Unimak Pass, approximate point at which engine failed, path of vessel's drift without power, and site on Unalaska Island where it grounded.
Source: National Transportation Safety Board

Summary Discussion: Current Arctic Marine Use

As noted earlier, Arctic shipping has existed since the late 1400s, mostly on the periphery of the region. As in the past, most commercial activity today is generally linked to supplying communities or exporting raw goods out of the Arctic. The number of ships operating today in the Arctic is significant in the context of both the unique aspects of the Arctic environment and the insufficient infrastructure and emergency response in many parts of the region, relative to southern waters. However, from the outlook of the global maritime industry, the level of vessel activity found to occur in the 2004 baseline year is still relatively low. To put it into perspective, the total number of vessels reported as operating in the Arctic region (not including fishing vessels and the Great Circle Route traffic) represents less than 2 percent of the world's registered fleet of oceangoing vessels over 100 gross tonnage. Although the total vessels operating in the Arctic may represent a small proportion of the world's fleet, they can still have significant impacts on the environment in which they operate. At current shipping activity levels, it will not take many more ships operating in the Arctic in future years to double or triple the 2004 numbers.

Most shipping traffic in the Arctic is in waters that are either permanently or seasonally ice-free, an important distinction. Permanently ice-free waters include those in the Aleutian island chain, the northern coast of Norway, southern Iceland and the Murmansk region in northwest Russia. In other areas of the Arctic, which are seasonally ice-covered, nearly all the vessel activity occurring in 2004 took place in waters where the ice had melted or was melting and where icebreakers are not required for access. However, an area can be determined to be ice-free and still have ice-related dangers, such as bergy bits and pan ice, which are hard to detect and can damage a vessel.

In recent years, given the changing ice conditions in the Arctic, much attention has been paid to possible trans-Arctic shipping via the central Arctic Ocean, Northwest Passage or the Northern Sea Route. In the AMSA 2004 database, it was found that vessels operated on sections of both the NSR and NWP; however, there were no full transits by commercial vessels on any of three routes. The vessels reported as operating in the Northwest Passage were either community re-supply or Canadian Coast Guard. On the Northern

Sea Route, the only vessels reported were bulk carriers and tankers for community re-supply. None sailed the full route, and the only Russian traffic through the Bering Strait were bulk carriers servicing communities on the far northeast of Russia coming from the Bering Sea. In 2004, no ships transited the entire Arctic Ocean from the Pacific to the Atlantic or vice versa.

The only vessels that went into the central Arctic Ocean in 2004 were the eight trips made to the North Pole, three of which were research vessels carrying out a core drilling expedition and five Russian nuclear icebreakers for tourism purposes. Apart from those trips, all the vessel activity in 2004 took place around its periphery and largely in coastal waters.

In the four years that have passed since the AMSA 2004 baseline year for shipping activity, there has already been an increase in vessel activity in certain sectors. As discussed earlier, cruise vessels have been traveling to the Arctic in rapidly increasing numbers. There has also been new activity in other types of vessel traffic, particularly in the Barents, Kara and Norwegian seas. An Arctic tanker shuttle system has been established to support a route from a new Russian terminal in Varandey in the Pechora Sea to Murmansk and direct to global markets. The first 70,000 dwt tanker for this service, *Vasily Dinkov*, delivered its initial cargo to eastern Canada in June 2008; two additional icebreaking tankers for this operation have been built in South Korean shipyards. Two similar icebreaking tankers, under construction in St. Petersburg, will be used to ship oil from the Prirazlomnoye oil field in the northern Pechora Sea to a floating terminal in Murmansk. Again, year-round operations are envisioned in seasonally ice-covered waters, in this case to provide a continuous supply of oil to Murmansk for subsequent export by supertanker.

Off the coast of the Norwegian Arctic, the Snohvit ("Snow White") gas complex is now operational and its first shipment of gas arrived in Spain via an LNG carrier in October 2007; another shipment of Snohvit LNG was delivered to the U.S. East Coast in February 2008. LNG carrier operations out of northern Norway to world markets are poised to increase during the next decade and Norwegian Arctic offshore production is forecast through 2035.

In early 2008, an offshore lease sale conducted by the U.S. Minerals Management Service for the U.S. Arctic totaled nearly $US2.7 billion; offshore gas appears to be the resource under consideration for development in this Arctic region. Increasing Arctic marine operations off Alaska in the Chukchi and Beaufort seas to support oil and gas exploration are envisioned for the next decade.

While the AMSA database only looks at the year 2004, it is apparent, based on anecdotal information, that Arctic marine vessel activity is in a state of transition. The current types of vessel activities seen today are in support of community re-supply, bulk natural resource shipments, fishing and tourism. It appears there will be a growth in all Arctic shipping sectors, as well as the possible emergence of new opportunities.

Research Opportunities

- Develop a consistent and accurate circumpolar database of Arctic ship activity, as well as ship accidents and incidents to date.
- Trend analysis of shipping activity, using the 2004 AMSA database as the baseline.

Findings

1] There were approximately 6,000 vessels in the Arctic in 2004: nearly half the vessels were operating on the Pacific Great Circle Route, which crosses the Aleutian Islands and the southern Bering Sea. Of the remaining vessels, about 50 percent, or 1,600, were fishing vessels. The availability of data and reporting on Arctic marine activity varied greatly between Arctic states; several states could not provide comprehensive data for 2004. As a result, the AMSA database likely underestimates the levels of activity throughout the reporting year.

2] Marine activity took place throughout the Arctic in 2004 and in recent years icebreaking ships voyaged in the central Arctic Ocean in the summer. However, operations were primarily in areas that were ice-free, either seasonally or year-round.

3] The AMSA database indicates that no commercial vessels conducted trans-Arctic voyages on the Northwest Passage, Northern Sea Route or in the central Arctic Ocean in 2004.

4] Early in the 21st century there are only a few Arctic regions with year-round shipping in seasonal sea ice. These year-round operations are driven largely by natural resource development such as in the Canadian Arctic and northwest Russia.

5] Most shipping in the Arctic today is destinational, moving goods into the Arctic for community re-supply or moving natural resources out of the Arctic to world markets. Nearly all marine tourist voyages are destinational, as well.

6] Regions of high concentration of Arctic shipping activity occur along the coasts of northwest Russia, and in ice-free water offshore Norway, Greenland, Iceland and the Bering Sea.

7] Most of the Arctic fishing took place in the Bering and Barents seas, on the west coast of Greenland and around Iceland and the Faroe Islands.

8] The Arctic states do not generally collect and share Arctic marine activity data in any systematic manner.

9] Information about vessel incidents and accidents in the Arctic is not shared among Arctic states, other than through IMO processes. Knowing such information is an important step toward understanding and assessing future risks.

10] Cruise ship traffic into and around Greenland has increased exponentially in recent years. The majority of cruise ships observed recently in Arctic waters are not purpose-built for Arctic operations. Many are built for voyaging in open water in lower latitudes and warmer climates.

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SCENARIOS, FUTURES AND REGIONAL FUTURES TO 2020

Plausible Futures for Arctic Marine Navigation

Marine use of the Arctic Ocean is expanding in unforeseen ways early in the 21st century. The continued depletion of natural resources in the world has led to an increase in interest in developing Arctic natural resources, and this interest has fostered a transformation of marine activity in the Arctic. In addition, regional climate change and the resulting Arctic sea ice retreat are providing for increased marine access in all seasons throughout the Arctic basin and its coastal seas. The AMSA takes a circumpolar view, but has also considered many regional and local issues where the impacts of expanded marine use may be greatest. The AMSA has also sought the views of the Arctic states, indigenous residents of the Arctic and many non-Arctic stakeholders and participants within the global maritime industry, so as to involve multiple perspectives.

The Arctic Climate Impact Assessment (ACIA) documented the recent changes in the Arctic sea ice cover: sea ice thinning, extent reduction and a reduction in the area of multi-year ice in the central Arctic Ocean. In addition, model simulations for the 21st century (using Global Climate Models) indicate increasing ice-free areas in all coastal Arctic seas, suggesting plausible increases in marine access and longer seasons of navigation. The AMSA has used the Arctic sea ice information from the ACIA and the 4th Assessment of the Intergovernmental Panel on Climate Change as guides to what marine access could be in future decades. The key task for the AMSA has been to understand more clearly the uncertainties that might shed light on the determinants of future Arctic marine operations. One way to do this is through the creation of a set of scenarios that are plausible, relevant and diverse.

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AMSA Scenario Workshops

During 2007, scenario workshops were held in San Francisco (April) and Helsinki (July) to create a framework of plausible futures for Arctic marine navigation to 2050. The workshops were facilitated by Global Business Network, a pioneer in the application and evolution of scenario thinking, and drew some 60 maritime experts and stakeholders. The purpose of these strategic conversations was to identify the major uncertainties that would be critical to shaping the future of Arctic marine activity to 2020 and 2050. The use of different stories of future marine activity can indicate how critical uncertainties might play in ways that can challenge the Arctic states to make timely and effective decisions. The scenario narratives provide a rich source of material for strategic discussions about the future of marine safety and marine environmental protection among a diverse group of Arctic and non-Arctic stakeholders and decision makers.

Uncertainties from the Workshops

Participants in the AMSA scenario workshops identified nearly 120 factors and forces that could shape the future of Arctic marine activity by 2050. Among those factors deemed most important were: global trade dynamics and world trade patterns; climate change severity; global oil prices; the marine insurance industry; legal stability (governance) of marine use in the Arctic Ocean; the safety of other global trade routes (for example, the Suez and Panama canals); agreements on Arctic ship construction rules and global operational standards (International Maritime Organization); a major Arctic shipping disaster; limited windows of operation for Arctic shipping (the economics of seasonal versus year-round Arctic operations); the emergence of China, Japan and Korea as Arctic maritime nations; transit fees; conflicts between indigenous and commercial uses of Arctic waterways; new resource discoveries; an escalation of Arctic maritime disputes; a global shift to nuclear energy; and socio-economic impacts of global weather changes. This list of critical factors illustrates the great complexity and range of global connections surrounding future use of the Arctic Ocean (Table 6.1).

Key Uncertainties from the AMSA Scenarios Effort

Influences on the Future of Arctic Navigation

- Stable legal climate
- Radical change in global trade dynamics
- Climate change is more disruptive sooner
- Safety of other routes
- Socio-economic impact of global weather changes
- Oil prices ($US55-60 to $US100-150)
- Major Arctic shipping disaster
- Limited windows of operation (economics)
- Global agreements on construction rules and standards
- Rapid climate change
- China, Japan and Korea become Arctic maritime nations
- Transit fees
- Conflict between indigenous and commercial use
- Arctic maritime enforcement
- Escalation of Arctic maritime disputes
- Shift to nuclear energy
- New resource discoveries
- World trade patterns
- Catastrophic loss of Suez or Panama canals
- Maritime insurance industry engagement

Table 6.1 Key uncertainties from the AMSA scenarios effort. *Source: AMSA*

Illustration 6.1 Scenarios matrix. *Source: AMSA*

AMSA Scenarios Framework

The AMSA scenarios work created six potential matrices for framing a set of scenarios. Pairs of critical factors or uncertainties were chosen and crossed to produce candidate frameworks:

- Indigenous Welfare *crossed with* Resource Exploitation
- New Resource Development *crossed with* Maritime Disasters
- Climate Change *crossed with* Level of Trade
- Indigenous People *crossed with* Rise of Asia
- Legal Regime *crossed with* Value of Natural Resources
- New Resource Development *crossed with* Legal Regime

The strengths, weaknesses and applicability to the Arctic of each of these matrices were discussed. Through brainstorming and plenary discussions, two primary drivers and key uncertainties were selected as the axes of uncertainty for the final AMSA matrix:

Resource and Trade: the level of demand for Arctic natural resources and trade. This factor exposes the scenarios to a broad range of potential market developments, such as the rise of Asia or regional political instabilities. More demand implies higher demand from more players and markets around the world for Arctic resources, including increased access for trade in the Arctic Ocean. Less demand implies fewer players interested in fewer resources.

Governance: the degree of relative stability of rules for marine use both within the Arctic and internationally. Less stability implies shortfalls in transparency and a rules-based structure, and an atmosphere where actors and stakeholders tend to work on a unilateral basis. More stability implies a stable, efficiently operating system of legal and regulatory structures, and an atmosphere of international collaboration.

	Arctic Race	Polar Lows	Polar Preserve	Arctic Saga
Framing Uncertainties	▲ More Demand for Resources and Trade ◀ Less Stable Governance	▼ Less Demand for Resources and Trade ◀ Less Stable Governance	▼ Less Demand for Resources and Trade ▶ More Stable Governance	▲ More Demand for Resources and Trade ▶ More Stable Governance
High Concept	High demand and unstable governance set the stage for an economic rush for Arctic wealth and resources. This is a world in which many international players anxiously move to outwit competitors and secure tomorrow's resources today. Intense interest in Arctic natural resources.	Low demand and unstable governance bring a murky and underdeveloped future for the Arctic. This is a world in which domestic disturbances divert attention from global issues, and simmering frictions cause prolonged divisiveness. Global financial tensions are prevalent.	Low demand and stable governance slow Arctic development while introducing an extensive eco-preserve with stringent "no-shipping zones." This is a world where concern about the environment, coupled with geopolitical and economic interests elsewhere, drives a movement toward a systematic preservation of the Arctic Ocean.	High demand and stable governance lead to a healthy rate of development that includes concern for the preservation of Arctic ecosystems and cultures. This is a world largely driven by business pragmatism that balances global collaboration and compromise with successful development of the resources of the Arctic.
Primary Drivers of Change	• Global competition among many nations for future rights to resources intensified by rise of Asia; new oil & gas discoveries • Acute demand for water worldwide; continuing Middle East tensions • Climate warms faster than models predicted; tourism expands	• Global economic downturn and increasing national protectionism • Increased domestic troubles worldwide, including regional outbreaks of new-generation Avian flu • Recession of Arctic ice slower than models projected	• Arctic oil and gas reserves disappointing • Alternative energy emerges as viable source for global growth • Public concern about climate change and conservation, especially impacts to the Arctic	• Expanded global economic prosperity • Systematic development of oil, gas and hard mineral resources • Shared economic and political interests of Arctic states • Climate warms as expected
Implications for Arctic Marine Navigation	• Much activity dominated by destinational traffic supporting resource development • Unilateral governance regimes lead to inconsistent infrastructure with incompatible standards • Seasonal trans-Arctic passage possible, but not economical	• Minimal Arctic marine traffic, consisting of government re-supply and research, with periodic disruptions • Market for ice-class ships cools, reducing R&D and shipbuilding • Low attention to regulations, with unenforced and mismatched standards, and no new infrastructure	• Harmonized rules for Arctic ship design and mariner training • Seasonal trans-Arctic shipping possible but proves prohibitively expensive due to environmental restrictions, frequent patrols and aggressive enforcement • Growth of Arctic marine tourism allowed through limited number of "use permits"	• Wide range and variety of marine activity • Navigational infrastructure and aids expanded, making marine transport safer and more efficient • Comprehensive international Arctic ship rules • New technologies make seasonal trans-Arctic shipping a possibility

Table 6.2 Scenarios comparison. *Source: AMSA*

Scenarios

Scenarios are tools for ordering one's perceptions about alternative future environments in which today's decisions might be played out. In practice, scenarios resemble a set of stories, written or spoken, built around carefully constructed plots. Stories are an old way of organizing knowledge; when used as strategic tools, they confront denial by encouraging - in fact, requiring - the willing suspension of disbelief. Stories can express multiple perspectives on complex events; scenarios give meaning to these events.

Scenarios are powerful planning tools precisely because the future is unpredictable. Unlike traditional forecasting or market research, scenarios present alternative images instead of extrapolating current trends from the present. Scenarios also embrace qualitative perspectives and the potential for sharp discontinuities that econometric models exclude. Consequently, creating scenarios requires decision-makers to question their broadest assumptions about the way the world works so they can foresee decisions that might be missed or denied.

Within an organization, scenarios provide a common vocabulary and an effective basis for communicating complex - and sometimes paradoxical - conditions and options. Good scenarios are plausible and surprising; they have the power to break old stereotypes, and their creators assume ownership and put them to work. Using scenarios is rehearsing the future. By recognizing the warning signs and the drama that is unfolding, one can avoid surprises, adapt and act effectively. Decisions that have been pre-tested against a range of what fate may offer are more likely to stand the test of time, produce robust and resilient strategies and create distinct competitive advantage. Ultimately, the result of scenario planning is not a more accurate picture of tomorrow but better thinking and an ongoing strategic conversation about the future.

The chosen axes met three key criteria: degree of plausibility, relevance to the Arctic and maritime affairs and being at the right level or threshold of external factors. The roles of global climate change and continued Arctic sea ice retreat are fully considered in the AMSA scenarios. Retreating Arctic sea ice acts as a facilitator and is assumed to provide opportunities for improved marine access and potentially longer seasons of navigation. For the AMSA, globalization of the Arctic and development of natural resources are the primary drivers for increased marine use in the region. Greater access facilitates that use, but economic drivers are considered paramount.

Table 6.2 illustrates the crossed uncertainties (Resources & Trade and Governance) and outlines four resulting scenarios central to the message of the AMSA. The Arctic Race scenario, with high commodity prices and demand for Arctic natural resources, implies an "economic rush" for development, based in part on global markets, not a geopolitical "race" for sovereign rights or new territory. This is a region where the international maritime community has moved into the Arctic Ocean for resource extraction and marine tourism at a time when there is lack of an integrated set of maritime rules and regulations, and insufficient infrastructure to support such a high level of marine activity.

Polar Lows is a future of low demand for resources and unstable governance: a murky and undeveloped future for the Arctic. There is minimal marine traffic in the Arctic Ocean in this scenario and low attention is given to regulations and standards that remain weak and undeveloped.

Polar Preserve is a future of low demand, but with a stable and developed governance of marine use. This also is a world where environmental concerns, with geopolitical and economic interests focused elsewhere, drive a movement toward a systematic preservation of the Arctic. In this scenario, Arctic oil and gas reserves are disappointing, and there is strong public concern about climate change (environmental awareness is high) and conservation impacts on Arctic affairs.

Arctic Saga is a future of high demand for resources and trade coupled with a stable governance of marine use. This world leads to a healthy rate of Arctic development that includes concern for the preservation of Arctic ecosystems and cultures, and shared economic

and political interests of the Arctic states. There is improved marine infrastructure making marine transportation safer and more efficient, supporting systematic and safe development of oil, gas and hard minerals.

Arctic State Challenges from the Scenarios

A significant challenge facing the Arctic states is to recognize the international nature of shipping in the Arctic Ocean and to effectively engage with a very broad range of non-Arctic actors, stakeholders and decision-makers. Recognition of this global reach of the maritime industry also includes a responsibility to work toward balancing historic navigation rights under UNCLOS with regimes and mechanisms designed to enhance marine safety and to protect the Arctic marine environment. A major task will be for the Arctic states to convince the IMO membership to take into account the uniqueness of marine operations in the Arctic and work within the IMO and other global organizations for international standards. The Arctic states must also recognize there may be a host of new maritime players at the table with a stake in the future use of the Arctic Ocean.

If the retreat of Arctic sea ice continues, marine access should improve throughout the Arctic basin. Complementing this change will be new Arctic ship designs that will also allow greater access and independent operations (without icebreaker escort) during potentially longer seasons of navigation. Such extended marine operations will require greatly expanded search and rescue cooperation and expanded regional environmental response networks. Information and data sharing may also be a key to the future of the maritime Arctic.

Expanded surveillance and monitoring of marine operations, particularly in the central Arctic Ocean, will require agreements among the Arctic states (and other interested parties such as flag states) for the rapid transfer of ship transit information. Monitoring of the environment could be enhanced by the establishment of a Sustainable Arctic Observing Network (SAON), an activity that was promoted during the International Polar Year. Expanded traffic in the central Arctic Ocean will provide new and unique challenges to the Arctic states and the global maritime community, since there will be a lack of communications, salvage and other critical infrastructure.

The AMSA scenarios effort has identified three key issues, among many, for the Arctic states: the ongoing globalization of the Arctic through natural resource development and resulting destinational marine traffic; arrival of the global maritime industry in the Arctic Ocean with Arctic voyages of large tankers, cruise ships and bulk carriers on regional and destinational voyages; and the lack of international policies, until now, in the form of maritime governance to meet this arrival.

The Arctic states will continue to be challenged by a widespread lack of adequate maritime infrastructure to cope with current and future levels of Arctic marine operations. In order to better enhance marine safety and environmental protection, the Arctic states working within the IMO could develop an integrated, or complementary, system of rules and regulations governing Arctic marine activity. The Arctic states must continue to engage non-Arctic states and global institutions that will influence the future of Arctic marine operations. More cooperation in Arctic maritime affairs among the eight Arctic states will be an imperative to address complex marine use issues in an uncertain future.

Future Natural Resource Development

A U.S. Geological Survey report, issued in July 2008, indicates the Arctic may contain as much as one-fifth of the world's undiscovered oil and natural gas. More specifically, the assessment found the Arctic to potentially contain 90 billion barrels of undiscovered oil and 1,670 trillion cubic feet (47 trillion cubic meters) of undiscovered natural gas, representing 13 percent of the undiscovered oil and 30 percent undiscovered natural gas. Of the total for undiscovered oil reserves, more than half are estimated to occur in geologic provinces in the Alaska Arctic (offshore and onshore), the Amerasian Basin (offshore north of the Beaufort Sea) and in West and East Greenland (offshore). More than 70 percent of the undiscovered natural gas is estimated to be located in three areas: the West Siberian Basin (Yamal Peninsula and offshore in the Kara Sea), the East Barents Basin (location of the Russian Federation's giant offshore Shtokman field) and the Alaska Arctic (offshore and onshore). Each of these regions would require vastly expanded Arctic marine operations to

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support future exploration and development. Several regions, such as offshore Greenland, would require fully developed Arctic marine transport systems to carry hydrocarbons to global markets.

Despite the recent global recession, two Arctic nations, Norway and the Russian Federation, have already made significant investments during recent decades in developing Arctic hydrocarbons in offshore Arctic Norway and northwest Russia's offshore systems in the Pechora Sea. Arctic marine transport systems support each of these developments, and oil and LNG tanker traffic from the Barents Sea to world markets is expected to continue for several decades.

For the Russian Federation, future investments in developing the Shtokman gas field west of Novaya Zemlya in the east Barents Sea are evolving. This field, understood to be one of the world's largest gas fields, lies 600 kilometers offshore and in depths of water to 2,000 meters. Exploration and development of this large, offshore region will require extraordinary levels of Arctic marine operations, most conducted in waters that are not ice-covered, but under extreme cold temperatures. Natural gas from Shtokman would be transported by sub-sea pipeline or a marine tanker system, either of which would increase marine operations in this region of the Arctic. For the United States (Alaska) and Canada, where offshore Arctic lease sales were held for the Chukchi (U.S.) and Beaufort (Canada) seas in 2008, the future remains uncertain. The leases represent long-term, strategic investments. Marine exploration of the Arctic offshore should continue during the next decade.

One of the key factors in future Arctic offshore developments is that a majority of the seabed oil and gas resources are located within the Exclusive Economic Zones (EEZs) of the Arctic states (i.e., Arctic offshore regions of Alaska, Canada, Norway, Greenland and the Russian Federation). While there remain several, regional boundary disputes where potential resources may overlap, the general jurisdictional issues are clear and do not appear to be significant obstacles to future Arctic hydrocarbon development.

Hard minerals development in the Arctic will continue to be influenced by global commodities markets and prices. However, the largest zinc mine in the world (Red Dog in the Alaska Arctic) and the largest nickel mine (Norilsk in Siberia) will continue to be solely dependent on marine transport systems - seasonal in the case of Red Dog and year-round operations for Norilsk Nickel. It is plausible that the summer, ice-free season for support to the Red Dog mine could be extended as Arctic sea ice continues to retreat in the Chukchi Sea.

The Mary River iron ore deposits on Baffin Island, Nunavut in the Canadian Arctic represent a highly valuable mineral resource (high grade iron ore of 67 percent iron). Plans have been underway for some time to develop a mining operation and ship to European markets 18 million tons of ore each year, estimated to last for a minimum of 25 years. This is a large Arctic project that would involve a fleet of ice-capable cargo carriers operating on a year-round basis between Baffin Island and Europe. Ice navigation would be required for operations in the winter and early spring.

Greenland geology records more than four billion years of earth history, preserving significant mineral deposits. For example, the Kvanefjeld Project near the southwest tip of Greenland represents a multi-element deposit containing rare elements, uranium and sodium fluoride. Potentially world class and multi-commodity ore deposits exist in other regions of coastal Greenland. The exploration and development of these mines will require Arctic marine transport systems to carry these scarce commodities to global markets.

Future Arctic Marine Tourism

Tourists now represent the single largest human presence in the Arctic and the overwhelming majority of these visitors travel aboard ships. The Arctic's once forbidding marine environment now attracts growing numbers of tourists aboard more and larger ships to a greater diversity of Arctic destinations. The future of Arctic marine tourism represents serious challenges to public authorities and businesses seeking to address the issues of safe passage and resource management.

Managing Future Marine Tourism

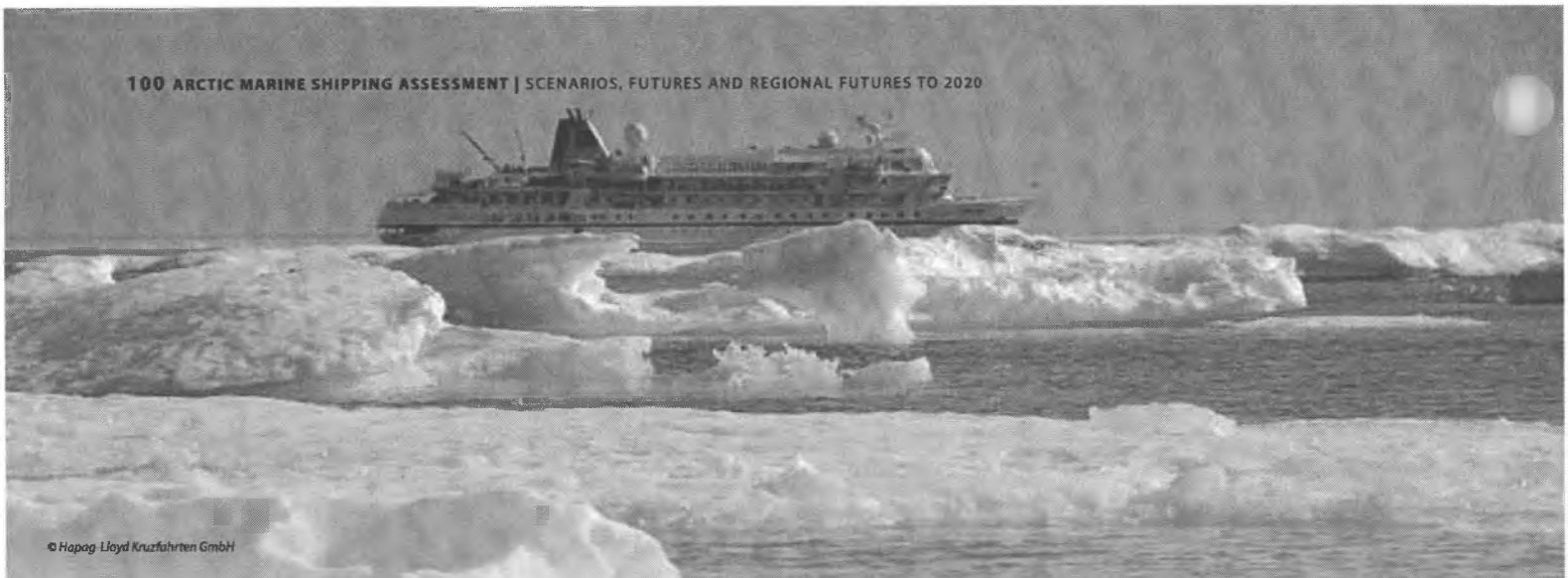
The growing popularity of polar marine tourism and the cruise industry's intentions to expand and diversify its polar market are creating significant management challenges. Foremost among those challenges are ice and weather conditions, lack of reliable hydrographic information, insufficient capacity of infrastructure to respond to emergencies, remoteness of tourist transits and destinations and the sheer size of vessels serving the polar cruise market. The legal and regulatory context defining appropriate ship and tourism operations consists of international treaty conventions, national laws, adopted regulations, industry guidelines and consensus-based guidelines brokered by non-governmental organizations. Governments, the tourism industry and non-governmental organizations are all determining the operational parameters for polar marine tourism through a variety of mechanisms.

National Laws and Regulations

The eight Arctic nations have enacted and enforce numerous laws and regulations governing marine operations and pollution. Based on international regulations, the national laws provide a framework to protect the Arctic environment, promote human safety and provide for a coordinated response to marine incidents, as well as enabling cooperation among the Arctic states. National attempts to regulate marine tourism extend from exceedingly stringent controls to considerably more flexible management techniques. Norway's government, for example, plans to significantly restrict cruise ship traffic around the Arctic archipelago of Svalbard and prohibit the use of heavy fuel oil. The new rules will limit to 200 the number of passengers allowed on board each ship that enters nature preserves on East Svalbard, and those tourists who are allowed entry are paying a special environmental tax. Another approach to the management of marine tourism, currently implemented by the U.S. government and the State of Alaska, is the use of onboard rangers who perform monitoring and pollution enforcement responsibilities. Some Arctic governments find themselves with the challenge of simultaneously trying to protect the environment while also promoting tourism.

Self-Imposed Industry Guidelines and NGO Codes of Conduct

Expedition cruise ship companies operating in both the Arctic and Antarctic are utilizing self-imposed guidelines to enhance marine operations, visitor safety and provide environmental and cultural resource protection. The creation and application of self-imposed industry guidelines for the conduct of environmentally responsible and safe polar tourism began with the formation of the International Association of Antarctic Tour Operators (IAATO) in 1990. The guidelines specifically address the management issues of ship operations, visitor behavior ashore, emergency response plans, the protection of Antarctica's marine and land resources and the preservation of



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the southern continent's heritage resources. IAATO's *Emergency Contingency Plan* has been successfully implemented on several occasions and is constantly updated to improve emergency response capabilities. Given the fact that these guidelines are directly relevant to polar conditions, marine tourism operations and the management of tourists when ashore, Arctic governments, communities and tour operators should benefit from their application to Arctic tourism.

The Association of Arctic Expedition Cruise Operators (AECO) was founded in 2003 for the purpose of "managing respectable, environmentally friendly and safe expeditions in the Arctic. The members agree that expedition cruises and tourism in the Arctic must be carried out with the utmost consideration for the vulnerable natural environment, local cultures and cultural remains, as well as the challenging safety hazards at sea and on land. AECO members are obligated to operate in accordance with national and international laws and regulations and agreed upon AECO by-laws and guidelines." AECO's offices are located in Longyearbyen, Svalbard, Norway and its geographical range in 2008 was Svalbard, Jan Mayen and Greenland. AECO developed its guidelines with considerable input from the Governor of Svalbard, Norwegian Polar Institute, World Wildlife Fund for Nature's Arctic Program, as well as Greenland Tourism, Greenland Home Rule, The Environmental and Nature Agency, and others. Participation by all Arctic coastal states would strengthen the association and its goals.

The WWF's program, in cooperation with tour operators, conservation organizations, managers, researchers and representatives from indigenous communities, has created the *Principles and Codes for Arctic Tourism*. The 10 principles encourage tourism development that protects the environment as much as possible, educates tourists about the Arctic's environment and peoples, respects the rights and cultures of Arctic residents and increases the share of tourism revenues that go to northern communities.

The Importance of Infrastructure

Infrastructure, defined for the purpose of marine tourism management, includes both the physical and human resources needed to prevent harm potentially arising from ship operations. Polar tourism currently operates in regions of the world that have either few or no infrastructure resources (See page 154). In many regions of the Arctic, the capacity to prevent loss of human life, protect property, contain environmental contamination, monitor sensitive resources and enforce laws is greatly diminished by remoteness, lack of capacity and severe environmental conditions.

Arctic nations, both individually and collectively, are legally responsible for providing infrastructure in order to prevent loss of life, property and environmental damage. These responsibilities are clearly within their sovereign domain of providing for the health, safety and welfare of their citizens, visitors and their environmental resources. The amount of information, facilities, equipment and human resources is not sufficient to meet the Arctic's current and anticipated volume of vessel traffic. For example, the number of passengers aboard polar cruise ships far exceeds the capacity of search and rescue assets, medical facilities and shelters needed to protect evacuees from the cold.

Factors Influencing the Future

A plausible future for Arctic marine tourism is that it will continue to grow, diversify and geographically expand as current obstacles are overcome. The most significant barriers influencing Arctic tourism include physical access, the ability of tourists to pay, the time and cost associated with traveling to remote destinations, the availability and capacity of infrastructure, environmental conditions and jurisdictional restraints that prohibit or restrict entry.

Arctic marine tourism's most likely future is that larger numbers of tourists, traveling aboard increased numbers of ships of all types, will be spending more time at more locations. The Arctic's environment, community infrastructure, social institutions and cultural values will be increasingly vulnerable to tourism-caused

Trans-Arctic Container Vessel Shuttle Option

Using the most modern container vessel design for the Arctic, it is technically feasible to establish a container traffic link between North America and Europe via the Northern Sea Route, a 2005 study concluded.

The evaluation, funded by the Institute of the North and executed by Finnish-based Aker Arctic Technology, used ice operational simulations and only evaluated the feasibility of vessel design, not the economic feasibility of the concept. Such economic analysis is still needed before a trans-Arctic shuttle operation can be considered as a serious alternative to today's route via the Panama Canal.

Assuming twin trans-shipment ports in Alaska and Iceland, the study evaluated vessels that were 750 TEU and 5,000 TEU. The simulations were based on two different kinds of years, average winter ice conditions and severe winter ice conditions, for both vessels. The evaluation used the double-acting operation design which allows the vessel to travel the traditional bow ahead in open water and, by using a propeller system that turns 180 degrees, to go stern ahead in ice-covered waters.

The 750 TEU Arctic container vessel for the study was a modified version of the Norlisk Nickel's *Arctic Express*, which moves nickel plate year-round and without icebreaker assistance between the ports of Dudinka and Murmansk in the Russian Federation (See page 82). The theoretical study vessel was modified from carrying nickel plate to container storage both below and above deck. The design also doubled the size of the fuel storage due to the longer sailing required. The ship could ply the shallow waters near the coastline of northern Russia, but simulation runs indicated it would need some traditional icebreaker assistance in severe winter conditions.

The 5,000 TEU vessel used the same icebreaking design, just on a larger scale. While the larger vessel will accommodate more containers, the size and especially the draft of 13.5 meters would prohibit it for use along the traditionally shallow-draft route of the NSR.

While the study does not look at the cost of fairway fees in this scenario, it does note that the current fee structure along the NSR is based on the paradigm of using icebreakers and "paying potential. Therefore, today the movement of natural resources along the NSR pays high fees whether using icebreaker assistance or not. This type of fee policy is not suitable for cargo vessels that are capable of independent operations, as the fee should be paid if the icebreaker assistance is needed, according to the study.

As noted, it is anticipated that the smaller study vessel would need icebreaker support some of the year, while the larger vessel would not. However, if the 5,000 TEU ship needed assistance it would require two icebreakers due to the width of the vessel. Another issue the larger study vessel poses is the ability to travel outside the traditional NSR routes.

Using only economic input related to the cost of the vessel, the operational costs, the amount of cargo that could be delivered and other related issues, the transport cost from the Aleutian Islands in Alaska to a port in Iceland via the NSR for the larger study vessel would be between $US354 TEU and $US526 TEU, and between $US1,244 TEU and $US1,887 TEU for the smaller container ship. It needs to be noted again that these figures do not include all of the economic considerations that are needed to make an accurate evaluation, such as fairway/icebreaker fees, port infrastructure costs, terminal and harbor costs and the cost to offload cargo onto the shuttle vessel, as well as transferring it back to an open-ocean vessel after reaching the twin port.

"All of these factors are unclear, uncertain and difficult to estimate," the study [illegible] "[illegible] of them might be the fairway fees, of which a current estimate of $US900 to $US1,000 TEU can be given for traffic" in 2005. "The second could be the cost for building and running the terminals which could be in the same category as the cost of the vessels. Of course, the terminals for the large and effective 5,000 TEU vessel are much more expensive than those for the 750 TEU vessel, but cost per container may be lower for the larger traffic volume. Of less importance and even more difficult to clarify and estimate may be the feeder link cost. Even the existing system using the southern route includes feeder links to the container hub ports and how this picture would be changed for the Arctic Shuttle Container Link remains to be clarified. However, it is expected that extra costs compared to the prevalent system could be created."

impacts. Simultaneously, Arctic governments, communities and businesses increasingly promote tourism and invest their resources to expand this type of economic development. The cruise ship industry, responding to the popularity of polar tourism and clear evidence of profitability, is committed to send more ships with larger passenger capacities to Arctic destinations. All of these significant investments and aggressive promotion by industry, governments and communities insures that Arctic marine tourism will continue to grow and that its management is essential.

Challenges of Trans-Arctic Navigation

For more than three centuries explorers and entrepreneurs have envisioned a direct route across the top of the world between the Pacific and Atlantic oceans. However, the Arctic sea ice cover - more than 2,100 nautical miles of sea ice present except in summer - has always been a significant physical barrier to developing such a global trade route. Although no commercial cargo ship has yet to cross the central Arctic Ocean, there have been trans-Arctic voyages during the summer season along the Russian Federation's Northern Sea Route and the Northwest Passage in the Canadian Arctic. Support was normally required by modern icebreakers leading ice-strengthened merchant ships in convoy. This system of transport was particularly the norm during the era of the Soviet Union when cargoes were carried during a short summer navigation season across the length of the NSR. In recent years, there were no cargo ships undertaking trans-Arctic voyages along either the NSR or NWP. Several ice-strengthened cruise ships and icebreakers have carried tourists on recent trans-Arctic voyages in summer. The fact remains that only six, high-powered polar icebreakers (nuclear and diesel-powered) have successfully navigated across the central Arctic Ocean and each of these voyages was conducted in summer.

The AMSA is focused on marine safety and environmental protection consistent with the Arctic Council's mandates of environmental protection and sustainable development. Neither the Arctic Council nor this assessment are the appropriate vehicles to determine the economic viability of any potential Arctic trade route, whether destinational or regional, intra-Arctic or trans-Arctic using the NSR, NWP or the central Arctic Ocean. For the purposes of the AMSA, the marine safety and environmental protection measures to be developed and implemented in accordance with international laws are essentially independent of the mode of Arctic marine transport. It is the global maritime industry that will decide if and when the potentially shorter Arctic routes can be safe, efficient, reliable and economically viable in comparison to other routes across the world's oceans. The marine insurance industry and ship classification societies will have significant influence in these route determinations, as will a host of other stakeholders and actors including investors and shipbuilders.

The AMSA has indicated, using a scenario-based strategic approach, that the primary mode of marine transport throughout the Arctic Ocean is destinational traffic related to natural resource development and regional trade. New economic linkages in the Arctic to global markets are influenced by commodities prices for scarce natural resources such as oil and gas; nickel, zinc, palladium, copper, platinum and high grade ore. Current and new Arctic marine transport systems and commercial ship traffic are primarily tied to the global demand for these resources.

The international media and proponents continue to provide broad visibility to the possibility of trans-Arctic navigation, postulating that commercial routes will be viable and fully functional in the near future. This premise is based in large measure on the recent and extraordinary retreat of Arctic sea ice that has garnered worldwide attention. Touted are the large distance savings on global trade routes by using the Arctic Ocean; one example is the nominal 11,200 nautical mile route between Rotterdam and Yokohama (using the Suez Canal), versus a 6,500 nautical route across the top of the world. Many maps are shown promoting these potential marine trade routes without indicating a key factor - that the Arctic's sea ice cover will be present for a majority of the year during the century. Just how plausible is trans-Arctic shipping given that the Arctic sea ice cover remains, but is a less imposing physical barrier?

Arctic nations, both individually and collectively, are legally responsible for providing infrastructure in order to prevent loss of life, property and environmental damage.

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The Presence of Arctic Sea Ice

The observed record of Arctic sea ice noted in Section 2 indicates decreases in both extent and thickness during the past five decades. Global climate model simulations of Arctic sea ice indicate trends of increasing areas of the coastal Arctic Ocean that may be partially ice-covered or even open water. No credible scientific source, though, is arguing that there will be a complete disappearance of the Arctic sea ice cover. The models do indicate a strong possibility of an ice-free Arctic Ocean for a short period of time in September sometime in the future. Again, the significance of this physical change is that multi-year ice would disappear - no sea ice would survive the summer melt season and only new ice would grow through the autumn and winter months during the long polar night. It is uncertain how long the ice-free period will be during the late summer or exactly when it will occur in any given year. It could be a window of time as brief as a few days or several weeks, or nearly ice-free conditions could last longer in the central Arctic Ocean. However, most of the potentially navigable spring, summer and autumn months should remain ice-covered with ice that may be thinner, but more mobile, than in previous decades. The year-to-year variability of sea ice in coastal seas and straits, such as those along the NSR and NWP, will surely remain a challenge in evaluating risk for insurance purposes and determining the overall reliability of Arctic marine routes. The length of the navigation season in all Arctic regions remains uncertain from a sea ice perspective, before other factors such as ship performance and icebreaker support systems are applied.

Key Questions for Trans-Arctic Shipping

The complexity of the trans-Arctic navigation can be viewed through the lens of a range of key questions and issues:

* From the previous discussion, if all or some regions of the Arctic Ocean will remain ice-covered for much of the year, the need for polar ships designed for at least limited ice operations is obvious. The question of whether these ships will be icebreaking carriers in their own right and capable of independent ice operations is important. Will such ships require icebreaker convoy support and who will pay for the escorting icebreakers? Both are significant economic and safety issues. Relevant is the issue of whether polar icebreakers in support of navigation would be funded by commercial interests or Arctic state governments. Such commercial polar ships will also be more expensive to build and operate, and many questions remain as to their utilization beyond the Arctic Ocean on potentially long marine routes in the open ocean. Shorter routes in the Arctic imply that there is a potential for lower stack emissions into the lower Arctic atmosphere during transits. However, the presence of sea ice may require higher propulsion levels and ultimately similar or greater emissions during voyages compared with open ocean routes.

* Can the trans-Arctic routes be used year-round in a reliable and safe manner? This is a significant question as many global fleets would wish to integrate seamlessly the new route with established marine routes. If an Arctic route is only viable for part of the year,

will it be economically viable to use *Polar Class* ships on other routes? How viable and competitive would be a two to three month Arctic navigation season? How will shippers change and adapt their global shipping flows to a potentially seasonal operation along new and shorter Arctic routes? And what might be the response by the Suez and Panama canals to a seasonal route across the Arctic? Might they adjust their fee structures to accommodate this new competition?

* Are Arctic routes economically viable today or in the near future? For nearly two decades the NSR has been open for international business under a fee structure. However, a limited navigation season presents the most significant challenge to the global maritime industry. The economic viability of all trans-Arctic options will be based in part on what ship speeds can be maintained in both ice-free and ice-covered waters to take full advantage of the shorter transit distances involved.

* What are the risks assumed with using Arctic routes? For the marine insurers the risks could be higher if ships confront voyages of hundreds of nautical miles in ice. Higher risks for ice damage to ships and potential damage to cargoes in extreme cold temperatures, and the insufficient maritime infrastructure in the Arctic (such as salvage, ports and emergency response) will most likely be factors in determining future insurance rates. Navigation risks may also be compounded by operations in the polar night or during the spring/autumn seasons where night operations in ice will be required. Shippers may also face risks with the possibility of schedule disruption and other reliability issues due to the inherent uncertainty of Arctic ship navigation. Many of these risk factors can be mitigated with the use of highly capable polar ships with experienced Arctic mariners.

* Trans-shipment of cargoes may be a plausible option for using the Arctic Ocean for trans-Arctic shipments (See page 101). Which ports would be likely termination points at the ends of the Arctic voyages is a key question. The investment in terminals and in a fleet of Arctic ships that would operate year-round across the Arctic Ocean would be sizable. However, a key factor would be that the Arctic ships would be fully and solely employed on Arctic voyages. The addition of trans-shipment ports in the northern latitudes could add a new dimension to global trade routes and might add options for select cargoes to be carried from the Pacific to European ports, depending on the time delays associated with cargo transfers.

Potential Operators on Trans-Arctic Trades

The variability of Arctic sea ice and the uncertainties associated with sailing times make predictions for use by marine operators and certain vessel types (and trades) highly speculative. During the assessment's scenarios creation effort, it was identified that large LNG carriers and oil tankers would not likely use trans-Arctic routes for trading. Today, all such ships sail from western Siberian ports and northern Norwegian ports westbound for North America and European ports. Future pipelines across Eurasia and additional pipelines to central Europe appear to be strong competitors to oil and gas carriers potentially sailing eastbound along the NSR.

The challenges for container traffic and carriers using trans-Arctic routes are many, including schedule reliability and the need to satisfy very tight customer supply chains. The potential safety of the ships and cargoes, and the actual fuel costs and time savings (with ice navigation required on portions of the routes) are significant considerations that are not well understood. The investment in ice class ships would also be a major issue since their operation would be sub-optimal in non-Arctic trades if year-round Arctic operations could not be achieved.

It is plausible that several types of dry bulk and break-bulk carriers could conceivably use seasonal trans-Arctic routes. Bulk metal ores and concentrates (many can be stockpiled at the mine or the destination port) could be shipped along the NSR and even across the central Arctic Ocean if spot charters could be arranged on an opportunistic basis. However, suitable ice class ships would have to be built or be readily available for charter. Break-bulk carriers of forest products and pulp might use the Northern Sea Route to trade from northern Europe to Pacific and North American ports. It is reasonable to assume that experimental voyages of a commercial icebreaking carrier could take place within the decade to test the operational and technical challenges associated with trans-Arctic navigation.

The Need for Economic, Comparative and Technical Studies

There is a dearth of rigorous economic studies related to the evaluation of trans-Arctic shipping routes. Comprehensive economic studies using cost-benefit-risk analyses are needed for all three potential routes of trans-Arctic shipping (central Arctic Ocean, NWP and NSR). Such studies need to fully identify the global demands and key economic needs for use of these polar routes. Additional related studies are necessary to determine the economic benchmarks and indicators for viable seasonal and year-round trans-Arctic traffic. What might be the key commodities suitable and economically

viable for trading during even a partial or summer navigation season? Further economic research should be conducted on the potential for trans-shipment of cargoes across the Arctic Ocean in icebreaking carriers. An important component of such an analysis would be the economics of trans-shipment terminals/ports in Alaska, Iceland, northwest Russia and northern European sites.

Operational and technical studies are also lacking. A comparative analysis of icebreaker-assisted convoys versus independently-operated, icebreaking carriers for all trans-Arctic options is required as new Arctic ship technologies emerge. Risk assessments related to Arctic ship operational challenges, the general lack of marine infrastructure throughout the Arctic Ocean and the potential for ice damages would be useful to the marine insurance industry and all ship owners contemplating trans-Arctic navigation. Cost effectiveness studies for different icebreaking propulsion systems, including nuclear propulsion, should also include analyses of future emissions controls that are socio-economic responses to global climate change. The increasing size of ships (on global trade routes) may also have significant implications for all modes of Arctic marine transport including the trans-Arctic option. Studies should identify any maximum limitations, technical challenges and operational constraints for these very large ships on Arctic trade routes.

The uncertainties and complex interactions of many driving forces of trans-Arctic navigation require significant research. While it may be technically feasible to cross the Arctic Ocean today by modern icebreaker or even using an advanced icebreaking carrier, the operational, environmental and economic implications and challenges for routine trans-Arctic voyages are not yet fully understood.

Research Opportunities

- Comprehensive economic research including cost-benefit-risk analyses for all potential routes of trans-Arctic shipping.
- Comparative analysis of using Arctic marine transport in *Polar Class* ships versus pipelines for the carriage of Arctic oil and gas to world markets. Summarize the existing regional studies conducted for these comparisons.
- Comprehensive, comparative analysis of ice-assisted convoys versus independently-operated, icebreaking carriers for all modes of Arctic marine transport.
- Continued marine research on the changing nature of Arctic marine ecosystems related to climate change and the retreat of Arctic sea ice to determine the future level and operational impacts of fishing vessels in higher latitudes.
- Research on the socio-economic responses to global climate change (for example, ship emissions controls) and their potential impacts on Arctic natural resource development and Arctic marine transport.

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REGIONAL FUTURES TO 2020: BERING STRAIT REGION

The Bering Strait is a narrow international strait that connects the North Pacific Ocean to the Arctic Ocean and forms the only corridor between northern and east-west transportation routes (Map 6.1). At the strait's narrowest point, the continents of North America and Asia are just 90 km apart. With diminishing summer sea ice in the Arctic Ocean, the Bering Strait region may experience increased destinational traffic to the oil and gas exploration areas in the Beaufort and Chukchi seas, and to the Red Dog Mine in northwest Alaska.

Sea Ice

Seasonally dynamic sea ice conditions are found in this natural bottleneck. Typically, sea ice develops along the coasts in October and November. During May-July the ice edge retreats northward through the region. First-year sea ice can develop to more than 1.2 meters thick during the winter. Except for shorefast ice, sea ice movement in the Bering Strait region is dynamic and forced by winds and currents. Ice has been observed to move through the region at speeds as high as 27 nautical miles per day. The seasonal ice field does not contain icebergs from land-based glaciers; however, multi-year ice from the Arctic ice pack has been observed to flow southward through the strait and into the Bering Sea. The future sea ice extent in the vicinity of the Bering Strait is projected to change only slightly in spring (April and May); however, a significant reduction (later freeze-up) is projected for the future in November and December.

Ecosystem and Bio-resource Considerations

The Bering Strait region is a highly productive area extensively used by many species, including several species listed under the U.S. Endangered Species Act. The prolific continental shelf seasonally supports a rich array of benthic feeders, such as gray whales, Pacific walruses and seabirds. Ice-dependent marine mammals seasonally move through the region as sea ice retreats in the summer and advances in the fall.

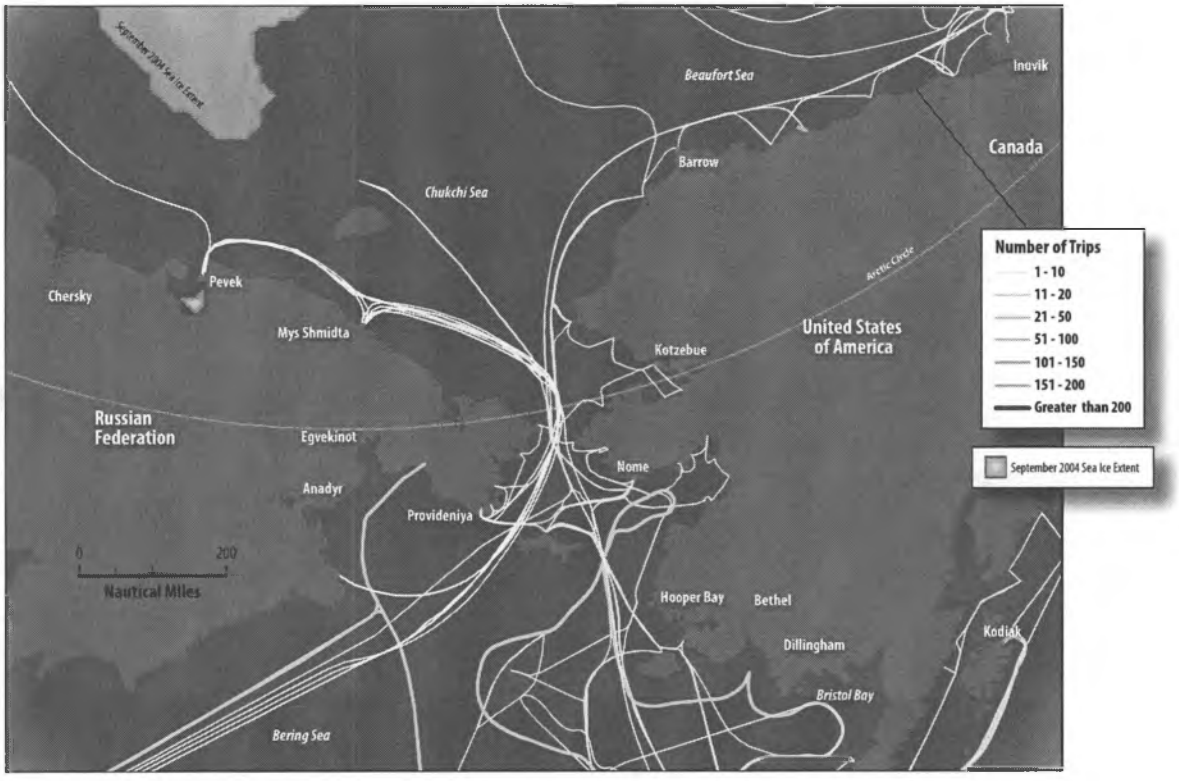
Many species depend upon primary productivity associated with sea ice, and the juxtaposition of the seasonal ice, shallow depth and productive benthos serves to support a unique diversity and high density of marine life. It is a dynamic region, and the physical constraints of the Bering Strait serve to seasonally concentrate species associated with the ice edge. The region is the only migration corridor for many species of fish, birds and marine mammals. Potential conflicts between increased ship traffic and large marine pinnipeds and cetaceans in the region are associated with increases in ambient and underwater ship noise, ship strikes, entanglement in marine debris and pollution (including oil spills).

Indigenous Marine Use

The Bering Strait region is home to three distinct linguistic and cultural groups of Eskimo people in Alaska: the Inupiaq, Central Yupik and Siberian Yupik on Saint Lawrence Island. The coastline of the Bering Strait region has been continually occupied by indigenous people for several thousand years. Human populations in this region have been dependent on marine resources, including mammals, fish, birds, macro algae, shellfish and other invertebrates. The hunting of large marine mammals has been the primary adaptive subsistence strategy of Bering Strait human populations for more than 1,000 years.

Currently, the population of the Bering Strait region is greater than 10,000 people, with Alaska Natives comprising more than three-fourths of the population. There are 15 year-round villages along the U.S. coast that range in population from approximately 150 to more than 750 residents.

The use of different marine resources occurs throughout the year. However, use strategies change seasonally with the animal migrations and life history stages. Regions where marine resources are gathered include beaches, coastal waters and/or nearshore waters, and may include offshore waters. For example, to adapt to the rapidly changing accessibility and availability of sea ice, hunting of large marine mammals (i.e., walruses) can take place up to 50 to 80 nautical miles offshore. Travel to these offshore locations is typically conducted in small open boats and a hunt can span several days before a vessel returns to its port of origin.

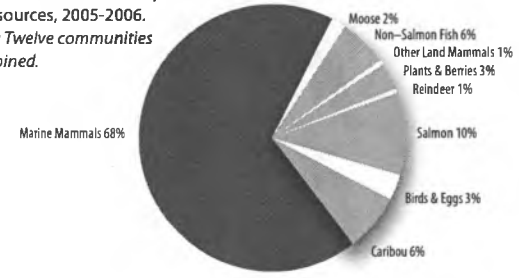


Map 6.1 Vessel traffic in the Bering Strait during the summer of 2004. *Source: AMSA*

Marine resources are of vital importance to peoples of this region. Not surprisingly, today's U.S. communities in this region, except White Mountain, are situated on the shores of the Bering or Chukchi seas and are strongly tied to subsistence lifestyles. This maritime reliance for subsistence in the Bering Strait region is very significant and, for marine mammal species such as walruses, whales and seals, comprises a significant portion of the total U.S. harvest. Additional marine-based resources are obtained through beachcombing, clamming, gathering seabird eggs, fishing, birding, gathering greens and other activities.

While Bering Strait region communities exhibit unique socio-economic, cultural and political differences, they all use the marine resources for nutritional reliance, cultural customs and economic dependence (for example, clothing, equipment, handicrafts, commercial fishing and hunting and limited ecotourism). The general patterns of large marine mammal hunting and reliance on other marine resources (i.e., fish, crabs, birds, beachcast invertebrates, macro algae) persist to the present time, despite technological changes.

Table 6.3 Harvest composition of resources, 2005-2006. *Note: Twelve communities combined.*

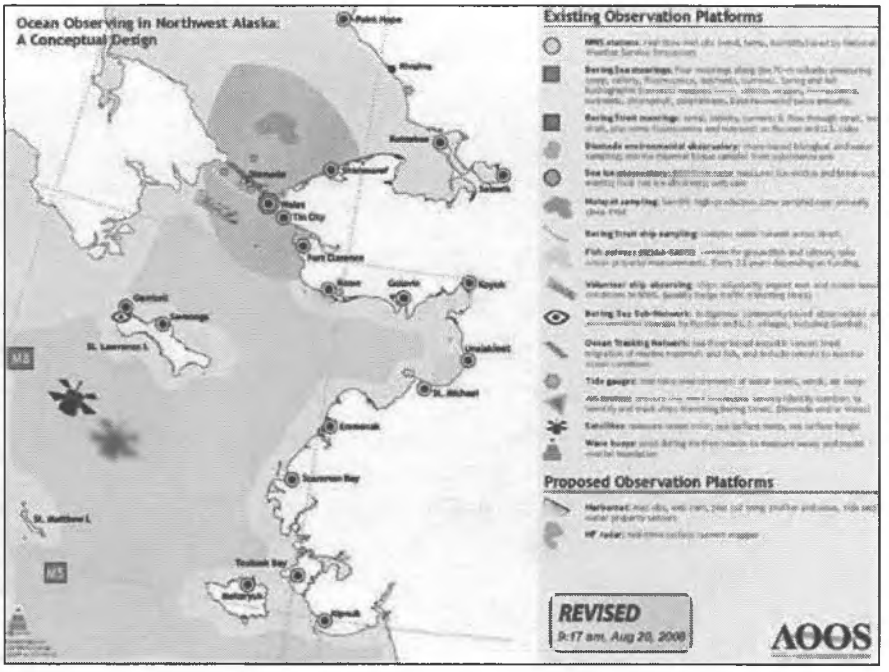


Source: Kawerak, Inc., North Pacific Research Board, Alaska Department of Fish and Game, 2005-2006 Comprehensive Subsistence Harvest Survey, Bering Strait/Norton Sound Region

Table 6.3 graphically demonstrates the maritime reliance for subsistence in the Bering Strait region with more than 85 percent of the harvested resources being marine-derived. The regional reliance on marine mammals is very significant.

The communities closest to proposed vessel traffic in the Bering Strait region (Gambell, Savoonga, Shishmaref and Wales) have a high

reliance on ocean-based resources. The St. Lawrence Island communities of Gambell and Savoonga are most dependent on marine resources, with the marine mammal harvest totaling over one million kilograms. More than 95 percent of their total subsistence harvests are marine-based resources (i.e., seabirds, eggs, fish and marine mammals). Shishmaref, on Sarichef Island, and Wales, on the mainland, demonstrate a high reliance on marine resources with more than 75 percent of their total harvest derived from the sea. In contrast, the coastal communities of southern Norton Sound, especially Stebbins and Unalakleet, demonstrate a higher reliance on fish, especially salmon, which is indicative of the highly productive river influences.



Map 6.2 A potential observing system for the Bering Strait region. *Source: Alaska Ocean Observing System (AOOS)*

Though current environmental patterns and predictions indicate a profound and long-term ecosystem change to the Bering Strait region, human reliance on marine resources for subsistence remains essential. The importance of the cooperative hunting of large marine mammals and the use of all available marine resources for nutritional, cultural and economic needs will persist in the region.

In 2001, Russia and the U.S. signed the *Agreement between Government of the Russian Federation and United States of America on Cooperation in Combating Pollution in the Bering and Chukchi Seas in Emergency Situations*. This agreement establishes cooperation in oil spill preparedness and response in the Bering Strait region.

Potential conflicts between increased ship traffic and indigenous marine resource use in the Bering Strait region include but are not limited to an increased amount of:

- Ambient and underwater ship noise - recognized as one of the primary concerns to marine mammal populations, especially within the narrow and shallow migration corridor;
- Ship strikes on large marine mammals;
- Entanglement of large marine mammals in commercial fishing gear;
- Potential for collision between coastal and offshore large ship traffic and small open boats using marine resources;
- Pollution affecting the availability and quality of offshore, coastal and beachcast marine resources, due in part, but not limited to:
  - lack of navigational and rescue infrastructure in an extremely challenging physical and marine environment;
  - concern for infrastructure to secure a large vessel in distress;
  - concern for infrastructure to assess and respond to an oil and/or chemical spill; and
  - language (for example, English, Russian, Siberian Yupik) and cultural communication barriers.

In spite of the intensive subsistence use of resources, dynamic ice conditions and biological richness, there are currently no operational ocean-observing platforms in this region. Map 6.2 describes a potential observing system for the Bering Strait region, building upon existing (mostly research) assets.

Commercial Marine Uses: Fishing, Oil and Gas, Minerals, Tourism and Shipping

In the Bering Strait region, there are three primary U.S. ports: Nome, Kotzebue and the DeLong Mountain Transportation System (DMTS) port serving the Red Dog mine. The main ports on the Russian side are just south of the Bering Strait, as they are on the U.S. side. The three largest ports are Provideniya, Anadyr and Egvekinot. The water depth in most U.S. and Russian ports in this region is about 10 meters or less.

Overall, approximately 150 large commercial vessels pass through the Bering Strait during the July-October open water period, with transits of these vessels most frequent at the beginning (spring) and end of the period (autumn). This estimate excludes fishing vessels, which are generally smaller, as well as fuel barges serving coastal mining activities and coastal communities.

Potential offshore development north of the Bering Strait region in the Chukchi and Beaufort lease sale areas could plausibly increase the numbers of support and supply ships transiting the region. There is no indication or information in support of ships transiting the Bering Strait on trans-Arctic voyages by 2020.

Infrastructure, Navigation and Communication

There are currently no established vessel routing measures in the Bering Strait region. A Traffic Separation Scheme (TSS) may need to be established in the region as vessel traffic increases. There is currently no active Vessel Traffic Service (VTS) or other traffic management system in place in the waters of the Bering Strait. Shipboard Automated Identification System (AIS) capability is currently limited. Presently the Marine Exchange of Alaska has established and is expanding AIS reception capability throughout portions of the Bering Sea.

There are no shore-based very high frequency (VHF) FM communication services available in the Bering Strait region. The U.S. Coast Guard does maintain VHF-FM sites in the Bering Sea, and maintains a HF radio guard for emergency and distress calling, but HF coverage of the Arctic region is poor. There are only three U.S. Coast Guard maintained navigational aids at the Bering Strait along the north side of the Seward Peninsula into Kotzebue Sound. There are no navigational aids north of Kotzebue Sound.

There is 100 percent coverage of the Bering Strait region from the Global Positioning System-Standard Positioning Service (GPS-SPS). However, the GPS constellation is not configured for optimal positioning in high latitudes, resulting in a potential degradation of position accuracy. There is currently no Differential GPS (DGPS) coverage of the area.

In the Bering Strait region, limited capabilities exist to respond to an incident, whether it is for lifesaving or oil recovery. Weather and oceanographic observations necessary to support search and rescue and oil recovery operations are also minimal. Even if a U.S. Coast Guard operating team were seasonally deployed to an Arctic coastal community, weather and distance to an incident site would remain huge challenges. Under present circumstances, vessels in distress must depend on other vessels or local communities in the area for assistance or wait until aid arrives. Few viable salvage vessels are available north of the Aleutian Islands.

Findings
Regional Futures to 2020
Bering Strait Region

1] The Bering Strait region is an international strait for navigation and a natural chokepoint for marine traffic in and out of the Arctic Ocean from the Pacific Ocean.

2] The region, seasonally ice-covered, is a highly productive area extensively used by many species of seabirds, marine mammals and fish. The highly productive continental shelf supports a rich array of benthic feeders; ice-dependent species also move through the region as sea ice retreats and advances. The Bering Strait serves to concentrate species associated with the ice edge and is the only migration corridor for many species.

3] The Bering Strait region is a prolific location for nesting seabird colonies, making it a vulnerable location for ecological disruptions.

4] Indigenous people have continually inhabited the coastline of the Bering Strait region for several thousand years. Marine resources today are of vital importance to coastal American and Russian populations throughout the Bering Strait region. They are dependent on marine resources including marine mammals, fish, birds, macro algae, shellfish and other invertebrates. Hunting of large marine mammals can take place 50-80 nautical miles offshore.

5] Ships related to a spectrum of uses are found in the Bering Strait region: fishing, hard minerals/mining, science and exploration, tourism and offshore oil and gas development. Approximately 25 large commercial ships (bulk carriers) annually sail north through the Bering Strait region (in the ice-free season) to the DeLong Mountain Terminal off Kivalina in northwest Alaska.

6] There are no formally established vessel routing measures in the Bering Strait region and there are very few visual aids to navigation in the region. Any future voluntary set of traffic routes, or a vessel traffic system, could be proposed by the United States and the Russian Federation to the International Maritime Organization.

7] Offshore oil and gas development may lead to increased marine traffic in the Bering Strait region during the next several decades. Multiple use management practices and measures to mitigate potential impacts (noise, emissions, ship strikes, discharges, etc.) from these new uses would be useful.

Breaking the Ice: Arctic Development and Maritime Transportation

Organized by the Icelandic Government, March 2007

Hosted by Iceland's Ministry of Foreign Affairs in March 2007, the "Breaking the Ice: Arctic Development and Maritime Transportation" conference provided the first opportunity under the International Polar Year banner for marine specialists and stakeholders to exchange information on Arctic shipping and the prospects of a trans-Arctic route between the North Atlantic and the Pacific oceans.

Designed as a contribution to the Arctic Marine Shipping Assessment, 90 delegates from all the Arctic countries, the United Kingdom, China and the European Commission discussed and debated issues on three key policy issues: the future of research and monitoring in the Arctic, the status of emergency prevention and response and the viability of trans-Arctic shipping.

The following are some of the observations made at the seminar:

- The extraordinary retreat of Arctic sea ice and the rapid decrease in multi-year ice has increased marine access throughout the Arctic basin and coastal seas.
- The development of "double acting Arctic ships," equally fit for open ocean and navigation through ice without icebreaker assistance, opens the possibility of year-round trans-Arctic container traffic between the North Atlantic and the North Pacific oceans. A number of double acting tankers and containerships are already operating in the Arctic. The economics and icebreaking capacity of such ships improve with larger size.
- Improved remote sensing technologies will make it possible to provide information on ice thickness and ice ridges. The emergence of ice forecast services can be used for plotting sailing routes through the ice.
- The globalization of world economy and rapid growth in international trade has led to capacity constraints of the Panama and Suez canals, hampering the integration of North Atlantic economies with fast growing economies in East and Southeast Asia. Trans-Arctic shipping would supplement present transportation routes and spur economic development.
- The opening of a trans-Arctic route would enhance economic security of the world. Present transportation links between the North Atlantic and emerging economies in the Far East are precarious. They are subject to delays because of accidents, mechanical breakdowns and maintenance, and they are vulnerable to disruption because of terrorist activities, regional conflicts and piracy.
- The high cost of technical development and infrastructure make it unlikely for private stakeholders to commence regular trans-Arctic transportation without governmental support.
- International cooperation for the development of trans-Arctic shipping should include stakeholders outside of the Arctic. Chinese delegates at the conference expressed a willingness to cooperate with the Arctic states in the research and development of Arctic shipping.
- Changing ice conditions may make it challenging to maintain tight transportation schedules and ensure the punctuality of certain cargoes. Enhanced monitoring, improved sea ice information and more efficient icebreaking carriers would significantly improve the situation.
- A comprehensive feasibility study is needed to estimate the commercial viability of trans-Arctic shipping, taking into account a wide range of economic and natural variables, including vessel cost, ice conditions, sailing speed on different routes, etc. New shipping routes and technologies should be pioneered with experimental voyages in order to gather better information on the shipping conditions and viability of new shipping routes.
- Care must be taken to minimize environmental effects of increased shipping activity in the Arctic. The capacity of the Arctic states for emergency response must be increased with appropriate equipment, materials and sufficient towing capacity, made available for various situations close to development sites and shipping routes. The Arctic Council can play a role in coordinating response to emergencies related to the shipping through the EPPR working group.
- While voluntary or recommended guidelines for Arctic shipping have been adopted by IMO, the movement toward mandatory rules for Arctic shipping must be accelerated.

- One presenter proposed the use of nuclear ships for trans-Arctic shipping to decrease the release of greenhouse gases and prevent the "graying" of the ice. Furthermore, nuclear ships would be relatively cheaper to operate in view of high and rising fuel costs.
- The participants agreed in general that Iceland could play a role in the opening of a trans-Arctic sea route because of its location in the middle of the Northern Atlantic. The new shipping routes that pass near Iceland (routes of commercial ships from Northwest Russia and northern Norway sailing to North America) could be linked by Iceland serving as a hub for container traffic in the northern Atlantic region.

The participants in the seminar concluded that experimental and limited trans-Arctic commercial voyages through the central Arctic Ocean could start during the summer navigation season within a decade; and that a year-round trans-Arctic marine transportation route between the North Atlantic and the North Pacific oceans could plausibly open in one or two decades, considering security, economic and environmental factors.

REGIONAL FUTURES TO 2020: CANADIAN ARCTIC AND NORTHWEST PASSAGE

General Description of the Region

The Canadian maritime Arctic is located across the north of Canada from the Beaufort Sea in the west to Hudson Strait in the east, covering approximately 2.1 million km². The Arctic Archipelago comprises approximately 36,000 islands, including three of the world's 10 largest islands. The coastal area is sparsely populated with fewer than 30,000 people. The Canadian Arctic also provides important habitat for a range of permanent and migratory species of marine mammals, seabirds and terrestrial animals such as caribou. Throughout this region there are many ecologically sensitive areas where animals gather in large numbers at certain times and may be vulnerable to impacts from shipping.

The Canadian Arctic has a long and rich history of marine use, beginning with its indigenous residents many thousands of years ago. Shipping in the Canadian Arctic has always been the safest and most economically effective means of moving goods to, from and within the region. It is a vast area with virtually no roads, no rail lines and where air services are both infrequent and very costly. There are also unique geographic and climatic conditions that make the region challenging for maritime navigation, including the presence of ice for most of the year, as well as the many narrow and shallow, often uncharted, areas through the archipelago. Canada has for many years strived to achieve a balance between development and environmental protection in its Arctic areas and for this purpose has a unique and extensive regulatory scheme in place to enhance marine safety and environmental protection in its Arctic waters. This regulatory scheme was ahead of its time when it was first established in the 1970s and is now in need of updating in order to bring it in line with recently developed international standards.

Sea Ice Conditions

Sea ice observations for the past three decades from the Canadian Ice Service show negative trends in coverage for the eastern and western regions of the Canadian maritime Arctic. The observations also show a very high, year-to-year variability of sea ice coverage in all regions, an important factor of uncertainty when considering marine insurance, investment, ship construction standards and other aspects of Arctic marine transport. Due to the unique geographic characteristics of the Canadian Arctic Archipelago (with many channels oriented north-south), the region is also expected to be one of the last areas of the Arctic Ocean to have a significant summer ice cover. It is plausible that if sea ice melt in the central Arctic Ocean continues, as many climate models indicate, there is a potential for more mobile multi-year sea ice to be swept southward through many of the northern passages of the archipelago. For the whole of the Arctic Ocean, including the Canadian maritime Arctic and Northwest

Canadian Arctic Shipping Activity

Expectations to 2020 may be summarized as follows:

- ***Dry bulk carriage*** **stimulated by resource development: definitive forecasts of substantive marine transportation projects are, for now, Mary River and High Lake developments.**
- ***Liquid bulk carriage*** **stimulated by resource development: minimal forecasts due to expectations that any substantive products in the Beaufort Sea will move out by pipeline.**
- ***Supply/resupply:*** **some important but manageable expansion in shipping activity is forecast, related to growing populations and for movement of supplies and equipment in support of exploration projects.**
- ***Cruise shipping:*** **projections of modest but largely unpredictable growth.**
- ***Container, bulk transit traffic:*** **no substantive activity seen in this sector in the timeframe under examination.**
- ***Other:*** **unknown activity for fishing, seismic, etc.**

Table 6.4 Canadian Arctic shipping activity expectations to 2020. *Source: AMSA*

Passage, global climate models indicate that sea ice will be present throughout the winter and for approximately nine months during each year. The Canadian maritime Arctic will have a generally more favorable sea ice situation in a short, summer period, but will be ice-covered for a majority of the year, a significant factor for Arctic transport regulation and protection of the marine environment.

Indigenous Use

The sea is very important to the way of life and culture. Inuit do not distinguish the water from the land in terms of their hunting and culture. All of the communities in the Canadian Arctic are coastal or situated on major waterways. Whether traveling in a boat or over the ice, the water provides a means of transportation, a connection between communities and a source of food. Though their technologies and style of living may have changed dramatically in the past hundred years, the Inuit are still by and large hunters who rely on country foods for a large portion of their diet. Some of the most important country foods are seal, walrus and whale, all of which are harvested on the ice edge or by boat. Any disruption of the ecosystem, such as an oil spill, dumping of waste or noise from machinery or ships could have effects on the animals and, therefore, the health and well-being of the Inuit. Despite the benefits of increased community re-supply, general shipping is a cause for concern to the Inuit. Vessels may scare away mammals needed for subsistence; they break ice tracks, disrupting travel on the ice via snowmobile and ships may affect wildlife in harbors and elsewhere.

Current Commercial Use

The types of commercial shipping activity currently taking place in the Canadian Arctic consist of community re-supply; bulk shipments of raw materials, supplies and exploration activity for resource development operations; and tourism. Commercial re-supply activities are serviced by southern points of origin, one in the west and several in the east. In the western Arctic, most cargo is moved by tugs and barges from Hay River down the Mackenzie River to Tuktoyaktuk for transfer and consolidation. Conventional ocean-going

general cargo vessels typically handle cargo in the eastern Arctic. Cargo is lightered ashore using small tugs and barges that are carried with the ships. Currently, there are no commercial vessels that regularly transit the Northwest Passage, aside from a few small specialty cruise operators. Other commercial shipping activities in the Canadian Arctic include a single-base metal operation in Deception Bay that ships nickel concentrates to Quebec, and grain shipments from Churchill to international markets. Exploration and resource development is ongoing. Recently, there has been heavy demand for logistics and supplies in both the eastern and western Arctic, particularly in the Beaufort Sea and at the Mary River iron ore mine, which shipped 120,000 tonnes of bulk cargo to European mills during the 2008 season.

Future Use

Destinational shipping is anticipated to increase in the Canadian Arctic. This will be driven largely by the demand for goods by growing communities, expanding resource development projects, as well as increasing tourism. The changing climate will result in increased accessibility and a longer shipping season, which will in turn also affect future activity levels. By 2020, it is projected that annual re-supply demand will increase enough that the current fleet will not be sufficient to meet the needs, despite the likelihood of a longer shipping season. In addition, the current fleet is aging and most ships would likely need to be replaced within that timeframe.

It is anticipated that the primary areas of increased marine activity will be resource driven. The lack of infrastructure and high operational costs have, until recently, made this region uneconomical for large-scale resource development. However, during the next 20 years, new bulk exports are expected to include: Mary River iron ore from a port at Steensby Inlet in the Foxe Basin, with possible commencement in 2010; Roche Bay magnetite from a port near Igloolik in the Foxe Basin, possibly beginning in 2015; and High/Izok Lake lead/zinc/copper concentrate shipping from either Gray's Bay or Bathurst Inlet, possibly starting in the same year. Imports will likely include logistics and fuel for the primary resource operations noted above; logistics and fuel, as well as barge-mounted production modules for the proposed Mackenzie pipeline; and delivery of production modules to the Alberta Oil Sands, among others. High operational costs in the Canadian Arctic are a limiting factor in this region. As a result, it may be many years before the Canadian Arctic matches the volume of resources extracted from Alaska or the Russian Arctic regions.

While the summer climate in the Canadian Arctic region is changing, ice will be present during most of the year and especially during the long, cold polar nights each winter. As a result, access to the Northwest Passage will continue to be controlled by ice conditions. Despite widespread speculation, the uncertainty of conditions in the Northwest Passage due to seasonal variability, changing ice conditions, complexity of routes, depth restrictions, lack of adequate charts and other infrastructure, high insurance and other costs, will diminish the likelihood of regular scheduled services. With the exception of nuclear icebreakers, very few ships have been built that could safely carry out year-round commercial navigation in the Canadian Arctic. The continued presence of ice even in open water will mean that operational costs will continue to be high.

Findings
Regional Futures to 2020
Canadian Arctic & Northwest Passage

1] The Northwest Passage is not expected to become a viable trans-Arctic route through 2020 due to seasonality, ice conditions, a complex archipelago, draft restrictions, chokepoints, lack of adequate charts, insurance limitations and other costs, which diminish the likelihood of regularly scheduled services from the Pacific to the Atlantic.

2] Destinational shipping is anticipated to increase in the Canadian Arctic, driven by increasing demand for seasonal re-supply activity, expanding resource development and tourism.

3] In the Canadian Arctic, ice conditions and high operational costs will continue to be a factor into the future. Irrespective of the warming climate, ice will remain throughout the winter, making viable year-round operations expensive.

4] Canada has a specific regulatory system for shipping in Arctic waters that is in need of an update in line with recently developed international standards.

Regional Futures to 2020: Northern Sea Route and Adjacent Areas

In 2003, participants representing the shipping industry, research community from five EU countries, Russia and Norway began a three-year research project: the Arctic Operational Platform (ARCOP). ARCOP was not to be re-negotiated by PAME, did not have a direct linkage to the AMSA objectives and did not express the views of the Russian Federation.

During the same period "JANSROP Phase II" in 2002 began a three-year program. In conjunction with INSROP (1993-1999), JANSROP II, funded by Japan's Nippon Foundation, emphasized the eastern part of the Northern Sea Route (Siberia, Far East Russia and the Sea of Okhotsk). INSROP (See page 46) was supported by the Russian Federation and funded by a consortium of Norwegian, Japanese and Russian sources. Four hundred and sixty experts participated in INSROP in economics, navigation, meteorology, hydrography, military operations and environmental protection from: Russian Federation, Norway, Japan, United States, United Kingdom, Denmark, Sweden, Germany and Finland. INSROP results included an experimental Arctic voyage from Yokohama to Rotterdam, international conference, three books and 167 peer-reviewed papers.

ARCOP, funded by the EU Commission and European shipping interests, examined the different elements of oil and gas transportation between northwest Russia and Europe. ARCOP included six separate work packages, each concentrating on a specific topic but also using one selected transportation task as a focus of the research. Fifty-seven research reports were produced by ARCOP and all reports can be found on the ARCOP website, www.ARCOP.fi. The contents of this section represent the views of the experts who worked within ARCOP and is presented as one of the assessments in the field.

Work Package 1, *The Ice Information System*, was started in early 2005. The research part of this work package was performed jointly with the Ice Ridging Information for Decision Making in Shipping Operations (IRIS) project, which is a separate EU-funded project coordinated by the Helsinki University of Technology (HUT). It developed methods to acquire online ice information and create accurate ice condition forecasts in a short time span. Kaeverner Masa Yards participated in this project and the results from IRIS were applied to ARCOP. Within ARCOP, the information from IRIS was compared to the experience within the Russian Arctic. The potential of the enhanced ice information system was demonstrated by economic analyses in the NSR conditions.

Work Package 2, *Administrative Measures for Marine Transport*, covered a large number of topics, varying from international law to rules and fees applicable in the Russian Arctic. Within international law, the regime in force in the Russian Arctic is in line with UNCLOS Article 234 and thus the situation regarding commercial shipping is more or less clear. It was also considered that UNCLOS Article 76, dealing with the extended continental shelves, does not really affect commercial shipping, since sailing in the central Arctic Ocean means passing through areas covered by Article 234.

Within the World Trade Organization and the *General Agreement on Trade in Services* (GATS), there are a number of issues that are not yet clear. But since the whole GATS regime covering shipping is still open, this is not a specific Arctic problem. Of interest to the Arctic shipping community is the question of icebreaker services. In some countries, this is considered a service that should be open for competition within the WTO. In the Russian Federation, as well as in Sweden, this is considered to be part of the infrastructure that the coastal state provides. A potential solution to this question will be realized only when large-scale transportation is in place.

The question of ice rules caused much discussion during the ARCOP workshops, and it appears the current system of rules is not consistent. When dealing with hull strength, the IMO recommendations refer to *Polar Classes*. But these *Polar Classes* in fact do not exist, since IACS has not published their Unified Requirements. Additionally, the Unified Requirements do not say anything about propulsion power. Among the national authorities like in Finland and the Russian Federation, there are, and obviously will be, requirements for minimum power. This puts the shipowners and ship designers in a

Non-commercial Partnership of the Coordination of the Northern Sea Route Usages: Facilitated Discussion

Formed in 2001, the Non-commercial Partnership of the Coordination of the Northern Sea Route Usages is a Moscow-based organization comprising federal and regional government officials, Russian shipping companies and international research and/or educational institutions.

Arthur Chilingarov, deputy chairman of the State Duma, is president of the Partnership with Mikhail Nikolaev, deputy chairman of the Council of Federation, as the vice-president. Captain Vladimir Mikhailichenko, former head of the Northern Sea Route Administration, is the managing director.

The organization has 32 members whose aim is to expand the use of the NSR, assist in safe navigation of Russian and international commercial use along the route, ensure adequate environmental protection in the region, stimulate research and development activities associated with the route; as well as addressing issues such as tariffs, taxation, insurance and other economic factors in the Arctic zone and the NSR.

In order to incorporate the thoughts of the partnership members into the AMSA, partnership member Institute of the North, in conjunction with the U.S. Arctic Research Commission, held a facilitated discussion during the organization's quarterly meeting in St. Petersburg, Russia in February 2008.

The participants were asked what opportunities and challenges they anticipated for the Northern Sea Route in the next 20 years, or longer. The following ideas were captured during the 2 ½ hour discussion and placed into seven topic areas: Emerging Routes, Infrastructure, Technological Considerations, Development and Shipping Economics, International Cooperation and Marine Environmental Safety, Training and Education and Arctic Ocean Observing Network/Monitoring.

Concerning emerging routes, participants generally agreed that the intermodal transportation system (rail and shipping) within Russia is poised to make "colossal" changes and that all Arctic shipping will be influenced by the developing intermodal transportation systems. There was agreement that there will be a greater increase in the shipment of oil and gas of western Russia through the Barents and Norwegian seas, and that regional development in the Russian Far East could reasonably tie rail and shipping in the Lena River with Chinese products going into the Russian Far East and possibly natural resources going out. All of the participants agreed that economics, not Arctic climate change, will drive increased shipping in the NSR.

When talking about infrastructure, the group agreed there is a need for better ice forecasting because ice is very difficult to predict. They envisage the icebreaker fleet in the future will be a mixture of a few large federal icebreakers and smaller commercial multi-purpose icebreakers to support offshore oil and gas development. They noted that shallow draft along the NSR coast and inland rivers made access difficult and challenging; however, the European Union ARCOP project indicated winter marine access along the Ob' River. The lack of major ports along NSR is one limiting factor in increased shipping and is compounded by the need for port improvements throughout the North. The members were adamant there is a need for better search and rescue resources deployed, as well as places of refuge identified. In addition, the capability of ships to provide assistance should be considered of prime importance, having due regard to the lack of repair facilities, the limited number of dedicated towing ships available and the response time.

As to technology, the group said the likely future for shipping in the NSR will occur with independent icebreaking cargo ships and a small number of federal icebreakers used to facilitate traffic, if necessary. Some members of the partnership believe there continues to be a need to maintain a federal icebreaker fleet, with the lead icebreakers of 100,000 shaft horsepower; while others see a different role for a smaller icebreaker fleet that are used to assist, when needed, independent icebreaking cargo ships.

Concerning development and shipping economics, some members suggested the NSR tariff structure needs to be evaluated with the goal of making it more competitive within the global maritime industry and economically sustainable. All operations, whether they are from within the Russian Federation or outside the country, should be subject to the same tariff structure. The group said redundancy of critical systems should be incorporated into ships operating in the NSR. Government should work closely with and be supportive of regional commercial icebreaking systems and regional relationships in the Barents Sea region (between nations and regional organizations) are important linkages for the future of the NSR.

When discussing international cooperation and marine environmental safety, the partnership members agreed there is a need to address the key challenges in combating oil spills in ice-covered waters. They called for the International Maritime Organization to create mandatory, not voluntary, regulations for all ships plying the waters of the Arctic and Antarctica. The partnership plans to work

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with the noncommercial organization Association Northwest, which includes 11 independent regions. They believe it is important that all ships in the NSR meet or exceed the voluntary *Guidelines for Ships Operating in Arctic Ice-covered Waters*. They also said that the Arctic environment imposes additional demands on ship systems, including navigation, communications, life-saving, main and auxiliary machinery, etc. They emphasize the need to ensure that all ships systems are capable of functioning effectively under anticipated operating conditions and providing adequate levels of safety in accident and emergency situations.

In the training and educational area, they suggested ice navigation simulators are needed to improve ice navigation and enhance marine safety. They emphasized the human factor is very important in all of these issues, but especially true when recruiting and training crew. Such training should include knowledge of cold water survival gear and other unique issues crew may be exposed to while navigating in ice-covered waters.

As to the Arctic monitoring, the partnership urged support for a future Arctic Ocean Observing System, recognizing that a robust and effective Arctic Ocean Observing System is essential to enhancing marine safety and environmental protection in the NSR and throughout the Arctic Ocean. They also supported obtaining reliable and detailed hydrometeorological and sea ice information in the near-real time as necessary for supporting safe ship navigation.

difficult situation since there is no generally approved basis for the requirements. A great deal of work is still required to unify and make the requirements consistent.

The issue of fees seems also to be a difficult one. Generally, it is considered that the current level of fees in the Russian Federation - for example, $US16 per ton of oil cargo - is far too high. The problem is that the fees are set based on the current cargo flow, which is less than two million tons per year. If the cargo flow should increase to 40 million tons or more per year, the fees could decrease to a level of $US1 per ton. This fee would be consistent with fees collected in Finland on the Baltic Sea.

The other issue is that the system defining the fee level in the Russian Arctic is not as transparent as it is in Finland. It is impossible to track how the funds collected as fees are used. Also criticized was that the fee system does not encourage the use of improved ship technology. A simple calculation shows that using a more expensive vessel, which requires less icebreaker assistance, is not beneficial to the shipowner since he is forced to pay for the icebreaker service that is not needed. Hopefully, this issue will be reconsidered in the future.

Work Package 3, *Integrated Transportation System*, was the actual core of the ARCOP project. This work package looked at the different elements that are needed, from tankers and icebreakers to loading systems, traffic management and crew training; and the economics of transportation were analyzed. The scenario for which the development work was done was selected to be realistic, but not yet commercially in operation.

The task was to transport 330,000 barrels per day of oil production from Varandey in northwest Russia to Rotterdam in Europe. Two different operational tanker modes were used, independent and assisted. There were three alternative designs of icebreakers, each capable to assist the tankers up to 120,000 DWT. The route alternatives used were either direct transportation to Rotterdam, or shuttle service to Murmansk and trans-shipment from there to open water tankers to Rotterdam. The result was that assuming a fee level of 1.2 Euros per ton, a cost level can be achieved of 12 Euros per ton. This is considered feasible when compared with the pipeline costs for similar routes that are approximately 20 Euros per ton. What is important to notice is that the difference between the best and worst alternative is nearly 100 percent. This means that with optimization, a savings of more than 100 million Euros per year can be achieved. Over the lifetime of the project, this would amount to more than 2.5 billion Euros.

The work with the Vessel and Traffic Monitoring and Information System (VTMIS) showed that there are a number of information services that could be combined in a system for the Arctic. In the future, ice information must be part of any VTMIS system.

The lack of crew training was an issue that was strongly identified in ARCOP. Although many international codes including IMO recognize the issue, there is no international standard or even training service available. The need for trained crews for ice operations is increasing: an estimated 3,000 positions require Arctic training in future years. The subject of adequate Arctic crew training is also strongly related to the issue of Arctic marine safety.

Work Package 4, *Environmental Issues*, primarily looked at the risk levels of Arctic marine transportation. With the scenarios that were created, it seems that the risk levels were quite low when compared to experience from other sea areas. It must be noted, however, that there is no existing experience with large-scale transportation in the Arctic conditions. The experience on ice damages is mainly based on Baltic conditions. This is an issue that needs to be thoroughly studied in the future. The second issue studied was oil drift after an accident. The several scenarios produced showed that depending on the accident location, either high capacity or quick response time is important. This means that the response strategy must take both of these into account. What was satisfactory was that the different simulation methods gave consistent results and thus at least the experts are confident that the methods are reliable. The third issue was the actual oil spill countermeasures. Knowing that the use of in-situ burning and dispersants is efficient, but their use limited due to other reasons, the project concentrated on bioremediation and mechanical oil recovery. In bioremediation, the problem still exists that the type of bacteria available today is not efficient in temperatures below freezing. This means that the development of more specific PAH-degrading cold-adapted bacteria needs to be continued. Within mechanical oil spill recovery several options were studied. It seems that none of them is proven in a large-scale oil spill. There are efficient methods like the LAMOR Arctic Skimmer, but they have been designed for a limited size of oil spills and need further development.

The original idea within ARCOP was to arrange a large-scale validation voyage with a large-size tanker to the Russian Arctic. Unfortunately, no commercial cargo was available for a large tanker by the time the voyage was planned. What was done instead was that the Russian participants in the project analyzed some of the ongoing

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activities in areas that can be considered relevant. The current cargo operations at the Varandey terminal show that the downtime estimates used in the ARCOP economic analyses were quite close to those that are experienced today. Also, the time that is needed to perform the customs and other administrative formalities were realistic.

The analyses related to the operation of icebreakers with large tankers were done from experience in the Baltic. These analyses show that, at least in Baltic conditions, one icebreaker is often enough to assist one large tanker through the ice. Thus, the assumption that was used in ARCOP calculations may be slightly pessimistic.

During the project, eight workshops were arranged within the Work Package 6. The workshops gathered 401 specialists, representing 89 different organizations from 12 different countries during the whole project.

The workshops were an efficient tool to bring together different interest groups from industry, science and authorities. And although ARCOP was an EU-project, the workshops brought a circumpolar dimension into the work.

In general ARCOP managed to achieve most of its strategic objectives:

- The workshops formed a forum for continuous discussion between the EU and Russia with some circumpolar dimension toward the end.
- The review of the legal aspects resulted in a common understanding of the legal status of the Arctic sea routes, while raising a number of issues that need to be taken into consideration as the GATS regime for shipping is developed.
- The research of the rules, regulations and requirements brought some clarity to the consistency of the regulatory basis of Arctic shipping in the Russian Federation, while noting current IMO and IACS regulations were not fully satisfactory.
- The economic analysis of transportation showed how different factors, such as technology, fees, efficiency of the border formalities and the way of operating the icebreakers, were critical influences in decision-making.
- The studies on environmental issues gave a clear warning that readiness for accidents must be further developed and that all the safety-related factors have to be taken seriously.
- The work between the EU and Russian researchers improved the understanding between the cultures and led to the development of common recommendations on a number of topics.

ARCOP was considered a part of the EU-Russia energy dialogue. The results of the project will be of help when developing energy transportation policies from Arctic Russia to global markets.

Findings

Regional Futures to 2020 Northern Sea Route and Adjacent Areas

1] The marine transportation of oil from the Pechora Sea to Europe is considered to be both technically and economically feasible. Today cargo flow is more than 1.5 million tons per year. With future increases in cargo, the charge for every passing ship along the NSR will be decreased accordingly.

2] Russian rules and requirements are mostly consistent with international law and requirements (for example, UNCLOS and IMO Conventions). However, taking into account Russia's experience with navigation in the Arctic, it has adopted rules pertaining to vessels operating in the NSR that contain certain provisions that go beyond international rules and standards (for example, inspections, requirements for ice pilots and transit fees).

3] The estimated volumes of maritime traffic on the NSR are expected to be about 40 million tons of oil and gas per year by 2020, which may contribute to improved economic effectiveness of cargo transportation via the NSR.

4] New Arctic marine technologies can help solve some of the problems related to transportation economics. With proper technologies, marine transportation costs in the region will be lower than those of pipeline transportation of oil and gas.

5] The probability for major accidents is considered to be low even with the increased traffic volumes; however, the consequences of a major accident would be serious due to the sensitivity of the fragile Arctic environment, remoteness of the area, harsh environmental conditions and difficulties in conducting oil spill cleanup operations.

6] There are several, key infrastructure challenges for the region: the ice information services require support; adequate hydrographic services may become an issue and lack of adequate search and rescue capabilities along the NSR. Regional SAR agreements between Norway and Russia, and the U.S. and Russia, have improved response and coordination in the Barents Sea and Bering Sea accordingly.

Findings

1] Natural resource development and regional trade are the key drivers of increased Arctic marine activity. Global commodities prices for oil, gas, hard minerals, coal, etc., are driving the search for Arctic natural wealth. New Arctic resource discoveries are highly probable and most new developments will require marine transport and operational support.

2] Exploration and development of new Arctic natural resources take place in continually changing and hugely complex physical, economic, social and political environments. Few (if any) predictive/forecast capabilities of this broad scope and magnitude are available to provide quantitative information on these global sectors interacting together (and their relationships to Arctic marine transport requirements).

3] A large number of uncertainties define the future of Arctic marine activity. These uncertainties include: the legal and governance situation, degree of Arctic state cooperation, climate change variability, radical changes in global trade, insurance industry roles, an Arctic maritime disaster, new resource discoveries, oil prices and other resource commodity pricing, multiple use conflict (indigenous and commercial) and future marine technologies.

4] It is anticipated there will be a slow movement of Arctic marine ecosystems northward with retreating seasonal sea ice, which may open new fishing grounds in higher latitudes in the future.

5] Plausible longer seasons of navigation will have significant implications for multiple uses in regional Arctic waterways. The overlap and/or competing indigenous and new marine uses will provide many challenges for the Arctic coastal states.

6] There is anticipation that new Arctic ship technologies will set a norm for more independently operated, icebreaking commercial ships; however, icebreaker assistance will remain the principle element of Arctic infrastructure.

7] Increased marine traffic in the central Arctic Ocean is a reality - for scientific exploration and tourism. The future holds increasing exploration voyages, plausible increases in tourism and fishing and plausible trans-Arctic voyages in summer on an experimental basis.

8] Arctic voyages through 2020 will be overwhelmingly destinational (regional trade), not trans-Arctic. These destinational voyages are driven by natural resource development, marine tourism and supply/import of materials/goods.

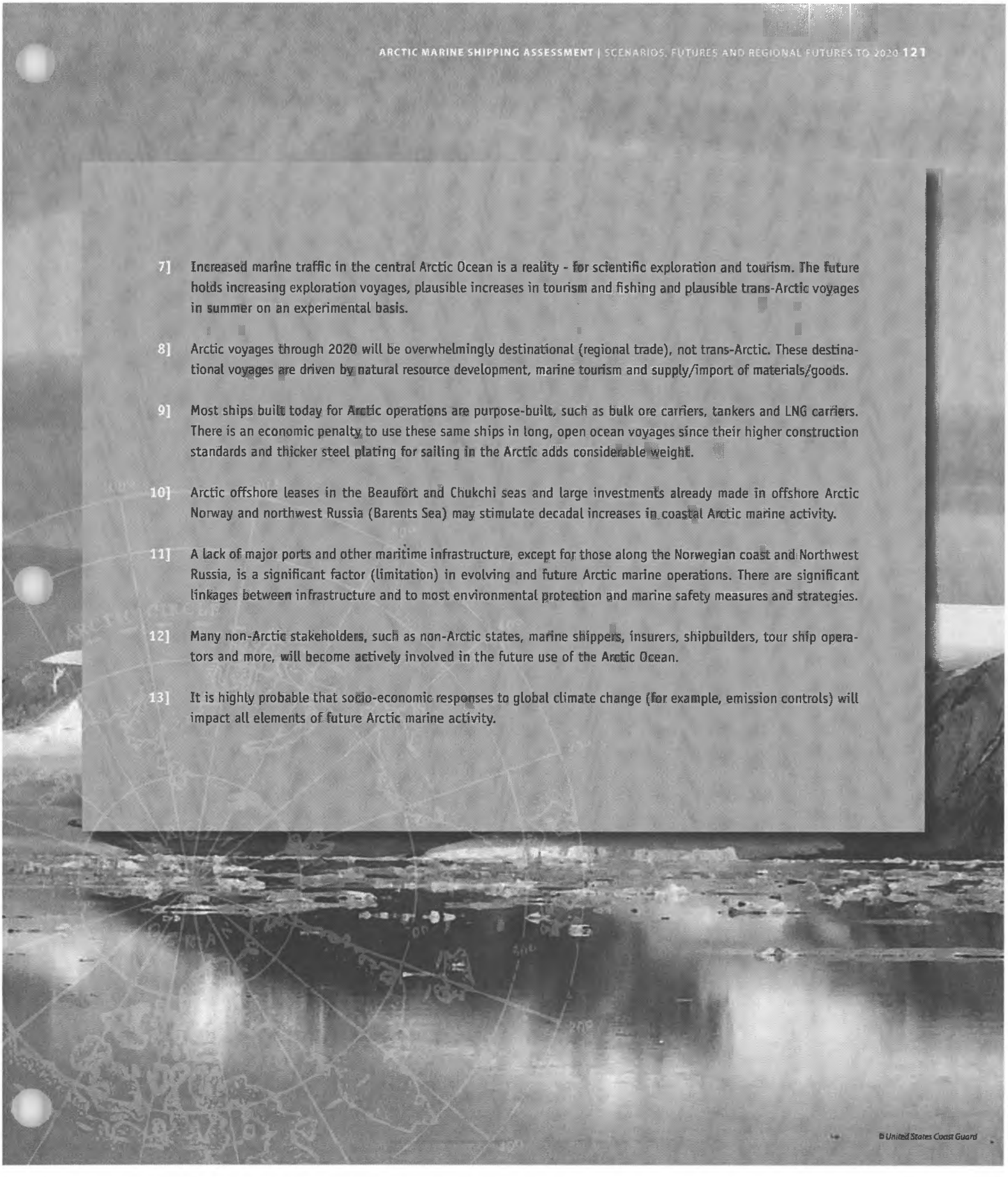
9] Most ships built today for Arctic operations are purpose-built, such as bulk ore carriers, tankers and LNG carriers. There is an economic penalty to use these same ships in long, open ocean voyages since their higher construction standards and thicker steel plating for sailing in the Arctic adds considerable weight.

10] Arctic offshore leases in the Beaufort and Chukchi seas and large investments already made in offshore Arctic Norway and northwest Russia (Barents Sea) may stimulate decadal increases in coastal Arctic marine activity.

11] A lack of major ports and other maritime infrastructure, except for those along the Norwegian coast and Northwest Russia, is a significant factor (limitation) in evolving and future Arctic marine operations. There are significant linkages between infrastructure and to most environmental protection and marine safety measures and strategies.

12] Many non-Arctic stakeholders, such as non-Arctic states, marine shippers, insurers, shipbuilders, tour ship operators and more, will become actively involved in the future use of the Arctic Ocean.

13] It is highly probable that socio-economic responses to global climate change (for example, emission controls) will impact all elements of future Arctic marine activity.



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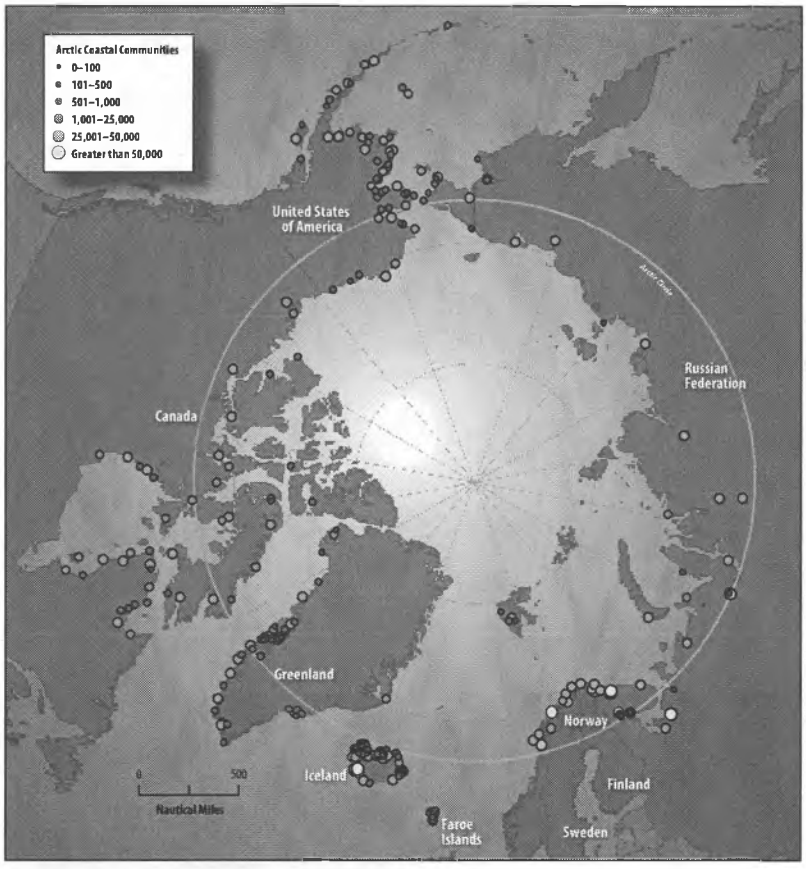
HUMAN DIMENSIONS

Human dimensions refer to the interrelationships of people and the environment, particularly with respect to environmental change. Often, human dimensions concern broad issues such as government policies or institutional responses to change. In the Arctic, human dimensions research has typically looked at local or regional cases. For marine shipping in the Arctic, both the broad and the local approaches are important to consider. Shipping will occur across the entire region, requiring national and international policies to provide effective management and regulation. Because trans-Arctic shipping will be driven largely by global economic factors, as will more local shipping for resource development, the role of institutions such as shipping companies, regulatory agencies and local or regional organizations who may be affected will all be pertinent.

This chapter addresses primarily the local aspects of human dimensions of Arctic marine shipping, with a particular focus on indigenous communities and traditional activities in the marine environment. Arctic marine shipping will occur in the context of many other changes affecting Arctic residents. Climate change, which will make the Arctic more accessible to marine shipping, will affect most aspects of the lives of Arctic residents, from traditional livelihoods to infrastructure to the spread of disease. Social and economic change will come from national and global trends in trade and communication. Impacts to the environment and society are most likely to stem from the interactions of human and environmental change, particularly as human choices influence the trajectories of change. In this context, shipping may play a significant role not only on its own, but also, and perhaps even more likely, through combining with other drivers of change.

Arctic marine shipping involves several distinct activities, each with different interactions with local residents and thus different implications and likely impacts. Trans-Arctic shipping of cargo, using the Arctic merely as a corridor between distant ports, has some potential for environmental impact, depending on cargo carried and volume, and thus for affecting local societies that depend on a healthy marine environment. The infrastructure required to support such shipping may include port facilities, search and rescue or emergency response capability, and mechanisms of governance



Map 7.1 Circumpolar coastal human population distribution. *Source: AMSA*

Economically, more shipping may increase trade or lower costs for Arctic communities, while increased resource development can provide employment and income for Arctic residents and regions.

or enforcement, which may include military presence to preserve sovereign claims over certain waters. Such facilities may provide employment and other economic opportunity for local communities, but could also lead to social disruption if many people move to small communities to take new jobs. Local shipping, to and from Arctic ports, is likely to have more direct influence on communities. Indeed, local shipping today provides for substantial shipments of cargo and fuel to remote communities, allowing for a higher standard of living and lower prices than would be possible by air or land shipment alone. Longer shipping seasons could reduce prices further, or allow greater access by visitors.

Another form of local shipping is that in support of resource development in the Arctic. Supplying mines, oil and gas installations, and other development sites, and transporting the materials that are produced there, is the dominant form of marine shipping in the region today. While it is not clear whether reduced sea ice will have a major influence on development trends, increased shipping is unlikely to constrain development. If indeed development increases, it will have far-reaching economic consequences for the regions in which it occurs, and will likely have environmental impacts as well.

In addition to mineral and petroleum extraction, fishing in Arctic waters is likely to increase as a result of greater access to ice-free waters. In Greenland in particular, the development of a shrimp fishery has had major impacts on coastal communities and indeed on the national economy, as shrimp constitute a major export from Greenland. In Alaska, participation in commercial fisheries has substantial social and economic impacts on communities, implying that increased involvement in fisheries by more northern communities could have major impacts both positive and negative.

One non-extractive industry likely to benefit from increased shipping access is tourism. For local communities, tourism can be a source of revenue but also a disruption, both from direct (though

A Container of Hazardous Materials Washes Ashore in the Commander Islands, Russian Federation

Bering Island, one of the Commander Islands, lies east of the coast of Kamchatka and west of the U.S. territories in the Aleutians. The only Aleut community on Russian soil and the only inhabited village on the Commander Islands is the village of Nikolskoye with about 750 residents, 300 of them Aleuts. The following is an account of an accident that should serve as a warning sign and an opportunity to examine the Achilles heel in shipping regulation and disaster preparedness, pointing the way toward policy changes to prevent worse disasters.

In July 2003, a 20-ton container filled with a hazardous chemical used in cement (tetraeth[illegible] glycol diheptanoate) washed up off the western coast of Bering Island, near the northwestern fur seal rookery and 15 kilometers from the local fishing grounds. The container, owned by the DuPont Corporation, was being shipped from South Africa to Korea and was lost at sea in March 2003.

When the container was discovered on the beach, there was no disaster response plan in place. Individuals who got close to the container to examine it did not have any training in the handling of hazardous materials or the necessary equipment and clothes. They were poisoned and needed medical assistance.

The first attempt to move the container away from the area where tidal waves could throw it on the rocks and break it was unsuccessful. The container cracked and approximately 15 tonnes of the chemical leaked, creating a 400 square-meter oily spill. A later survey counted 40 dead birds and one dead seal.

The Anchorage office of the Aleut International Association, after receiving first news of the accident, made a round of calls to maritime attorneys in an attempt to find legal counsel for the village of Nikolskoye. Finally a firm with appropriate expertise was located in Juneau, Alaska. A telephone conversation, however, was abruptly interrupted by the news that the firm had been hired to represent DuPont.

DuPont provided funds for clean up, environmental assessment and some emergency response equipment. The nature and size of this work was mostly determined by DuPont itself.

This particular accident was small, but it exposed potential problems. Governments may want to identify measures that can help prevent accidents and address response, especially in light of expected increases in shipping.

© Aleut International Association, from the Nikolskoye Administration

The container of tetraethylene glycol diheptanoate that washed ashore on Bering Island.

Reflections from the Kola Coast

Shipping is but one of the many aspects of the history of northwestern Russia, one of the many factors shaping today and tomorrow. Murmansk was a bustling seaport during the Soviet era, when at the height of the Cold War it was the fishing capital of Northern Russia. The Murmansk Region is home to about 2,000 Saami, who continue their traditional culture in the inland parts of the Peninsula.

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In the Murmansk Region, history has been witnessed, lived, forgotten, suppressed, remembered and altered. Kola Bay, with its nuclear fleets, is poised to be the jumping off point for Arctic opportunities of shipping and mineral development. The Kola coast is a smaller version of the multi-faceted, complex and layered coastal landscape and seascape that is the Russian Arctic coast today.

As a part of the time of transformation, the Kola Saami are witnessing a painful rebirth of their culture and nation. Since the formation of the Russian Federation, they can collaborate with the Saami in neighboring countries. They can participate in the Arctic Council and influence, for example, the development of marine and ocean policies. Even though the seasonal salmon harvest along the fjords of Kola is over and seals are no longer harvested by the Kola Saami, many elders still remember the sites, places and songs of the Kola coast. They remember the yearly cycle of the ocean, birds, fish and other beings.

The Kola Saami are afraid that the increased shipping and construction of new pipelines will ruin the remaining wilderness areas of the Kola. Atlantic salmon spawning rivers, such as the Ponoi, are vital traditional fishing areas for the Saami and their productivity is directly related to the ecological status of the Russian sector of the Arctic Ocean. The Kola Saami are engaging in planning and decision-making to make sure that the people of the Sun Deer will be here now and forever.

likely inadvertent) interference with traditional and other activities, and also from greater attention to some local practices that may not conform with the values or expectations of non-Arctic societies. The presence of large cruise ships and their visits to communities that may have a fraction of the population of the ship itself cannot be ignored. An emergency involving such a ship could easily overwhelm local response capacity. Tourism, like fishing but unlike other forms of shipping, is likely to be focused on some of the same living resources (seabird colonies, marine mammals) that sustain local communities, thus increasing the potential for disruption and conflict.

The local human dimensions of Arctic marine shipping appear to be extensive, but there have been relatively few studies that have considered the implications either of current shipping activities or projections of what is likely to occur in the next few decades. The AMSA's description of human dimensions of Arctic marine shipping is neither comprehensive nor exhaustive, but is intended to demonstrate how and why marine shipping matters to Arctic communities and to consider what additional work is needed to be able to prevent, mitigate, or otherwise manage shipping to reduce negative impacts and maximize potential positive benefits.

In recent decades and today, Arctic coastal people travel far on sea ice and water, both along coastlines and also out to sea. A comprehensive, up-to-date catalog of indigenous use of the Arctic marine environment does not exist. Compilations of data from Canada and Alaska are two to three decades old. Some more recent studies have examined use patterns near individual communities, but even these are few and dispersed. It is thus impossible to present an overall map or description for the entire Arctic. This section provides instead a few examples of various uses of the Arctic marine environment and

"The Sea Ice Is Our Highway"

Canadian Inuit Perspective on Transportation in the Arctic

Within Canada, Inuit view the Arctic as the places where Inuit have traditionally lived: Nunatsiavut along the coast of Labrador, Nunavik in Northern Quebec, the entire territory of Nunavut, and the Inuvialuit settlement region along the northern coast and around the northern islands of the Northwest Territories.

Life in the Arctic is dependent on movement, and sea ice is integral to this movement. The Inuit have been a nomadic people living in the Arctic since ancient times. As such, our entire culture and identity is based on free movement on the land and sea. Much of the traditional knowledge passed down from generation to generation is meant to hone the skills necessary for hunting and fishing. In order to hunt and fish safely and effectively in the Arctic, we train our young people to recognize different types of ice and to know the dangers associated with different seasons. Inuit hunters spend much of their time out on the ice, mostly in small groups or even alone; therefore, reliable knowledge of the ice can be a matter of life and death.

Interviews conducted by ICC Canada in March 2008 indicate that despite the increased difficulty in finding and harvesting big game and sea mammals due to thinning and less predictable sea ice, Inuit communities are persistent in maintaining their traditional diets. When asked whether changes in ice conditions were affecting their traditional diets, respondents spoke of having to travel further or in a different month than usual; they spoke of dietary substitutions such as hunting more musk-oxen when the caribou migration shifted away from their area; or they explained how melting permafrost has made the natural ice cellars used to age and store meat less effective. Not one of them said anything to suggest they were giving up on hunting despite the considerable challenges some were facing in getting out on the ice and land.

When asked how his life might change because of poorer ice conditions in the future, Tommy Qaqqasiq from Pangnirtung, Nunavut said: "Then we'll use other equipment. People will still hunt. It's part of our life. When things change, you just have to go with it."

After describing in detail how climate change is forcing his community to deal with new challenges, John Keogak of Sachs Harbour shared this idea on how he can continue his harvesting practices:

"A buddy of mine is into making little sleds out of aluminum, which you can use as a little kayak or boat. If you're out on the ice and you have to cross an open lead or something you can use that. It's one of the things that can help. I'm going to get one of those. It's combined as a little sleigh and, if you have to, you can use it as a boat. That's one way I can adapt."

With few exceptions, Inuit settlements are located on sea coasts or on major waterways with easy access to the sea. This clearly reflects the importance of the sea to our Inuit way of life. Whether thickly frozen or open for the summer, the sea is our primary means of transportation. The usually ice-covered sea is our highway, the only physical connection between many of our communities and the only way we can access many of the animals we depend on for food (Table 7.1).

As climate change and reductions in sea ice affect the migration routes of the land and sea animals we rely upon, it may be necessary for us to travel even further than before in order to reach them. Inuit hunters are reporting many changes in the locations and times that our traditional animals can be found. In some communities this is reducing the territory that hunters need to cover, while in others they have to travel much further than before in order to harvest enough food for the communities. This is why we are very concerned that sea ice routes remain passable for hunters, as well as the migratory game they follow, and that the entire Arctic environment be kept free from contamination – both in the areas we are now using regularly and in those areas where we may need to hunt in the future.

The primary resource for Inuit is the animals. Our people have always known how to care for this resource. We live in harmony with the land. When we hunt, we only take what we need and make sure to leave enough of the herd so that it can replenish itself. When we talk about the future, we are not talking about a five-year plan or even a 10-year plan. We are talking about our children and our children's children. We are talking about living in the same communities where we can see the evidence of our ancestors. We are talking about preserving our way of life and the natural environment it depends upon for hundreds and thousands of years.

Ships coming through our seas are a cause for concern. On the one hand, they can be used to supply our communities with building materials and goods for our stores, which might bring a welcome reduction in the high cost of living in the Arctic. However, ships have also caused a lot of damage, as hunter Tommy Qaqqasiq of Pangnirtung explains:

"In recent years, all kinds of cruise ships are coming in to our area. Last year alone, there were maybe five or six cruise ships that came into town. More are coming every year. There's a national park here in Pangnirtung, further inside the fjord, that's what they are coming to see. The tourists come into town and buy all kinds of

art, like carvings, craft work, soapstone, whatever they can afford to buy. They help the artists. [All hunters have been complaining about those ships because they go all over Cumberland Sound even to the campsites. People are saying they are scaring away the animals, the mammals and whales. We are really noticing this because in the past couple of summers we hardly saw any narwhals around. Usually we catch our quota, but not in these past years."

Another example of the difficulties related to shipping comes from the community of Tuktoyaktuk on the Beaufort Sea coast. Tuktoyaktuk has long been a key hub for supply ships servicing many of the Inuit communities in Canada. Because the harbor is also teeming with various species of fish, Tuktoyaktuk is an instructive example of colliding interests between economic activities and Inuit use of the sea. Inuit hunter, trapper and fisherman Chucky Gruben describes the issues:

"We have a hunters and trappers committee here, we take care of the wildlife. We deal with the people, we deal with the shipping companies. We have done some things where, after freeze-up, the ships are not allowed to come into the harbor. But this past year, because of late shipping to other communities, we had to keep our harbor open longer than usual because the supplies hadn't gone out to the other communities.

"The community of Tuktoyaktuk is right in a harbor where a lot of fishing takes place. The east entrance is a place where a lot of people here that do their fishing set their nets right in the channel. Because the ships had made a ship track through the east entrance, they kept it open up right until November sometime, and the people couldn't set their nets there because of the ships going back and forth. That is one of the impacts of shipping on our harvest.

"Usually with that kind of thing, we do have a say on whether the ships can use the area, but times are changing and every year we get applications to come into the harbor later and later. They wanted to do that the year before last, too, but we had to say no. Last fall we didn't really have a choice because there was still fuel and a lot of supplies that needed to go out to the other communities, so we had no choice."

The point [illegible] accounts from various Inuit communities is that the environment is vital to our entire way of life as Inuit. If something were to happen to our fragile Arctic ecosystem, our way of life would be lost and we as a people would be lost. Therefore, any activity in the Arctic, whether it is resource extraction, tourism or military-related, must be undertaken according to the Inuit definition of sustainability – it must support the continuation of the Inuit way of life for thousands of years to come.

Table 7.1 Socio-economic projections for the Canadian North from the 2007 Canadian Arctic Shipping Assessment *Source: Transport Canada*

Region	Demographics	Transportation	Economy
Nunavut	• 2006 population: 29,500 • Growth rate 1.8% in 2005 to 2020	• No all-weather roads or rail links between communities • Most communities receive 2 re-supply calls per year	• Dominance of public sector for economic output and jobs • Significant non-wage and subsistence activity • >100 active resource exploration sites • Limited tourism • Growth at 4.7% to 2010, slowing thereafter
Northwest Territories (NWT)	• 2006 population: 41,861 • Most communities not expected to grow by 2020	• Mackenzie River communities served by all-weather or winter roads	• High unemployment in coastal communities • Presently no resource projects for river communities • Any shipping impact centred on Mackenzie Gas Project • High Arctic oil and gas potential, but not before 2020 • Some diamond mine development opportunities
Nunavik	• 2006 population: 10,783 • Population younger than Canadian average • Growth rate of 2.4% to 2018, to slow thereafter	• Community port programme receives fed/prov support • No all-weather road links to the 14 communities	• Significant non-wage and subsistence activity • Like Nunavut, wage economy is growing through govt., fishing and sealing, tourism, construction and resources • Resource development slow due to lack of road infrastructure
Coastal Cree Communities (in Quebec, Ontario, and Manitoba)	• 2006 population: 18,654 • Young population • Declining or levelling growth rates expected post-2010	• Port of Churchill • Limited all-year road access	• Largely subsistence economies • Some benefiting from hydro-electric developments • Resources on the horizon (diamond, gold, uranium) • Churchill – a viable link to Russia?

resulting interactions with marine shipping activities in different forms. These examples are intended to illustrate some of the range of potential interactions and effects.

Arctic marine shipping is one of many factors affecting, or with the potential to affect, the lives of Arctic residents. Predicting exactly how various developments in shipping will affect Arctic communities is difficult at best. For example, there is insufficient information to describe current local human uses of the Arctic marine environment adequately enough to assess the range of likely effects of marine shipping, and researchers cannot anticipate all potential information needs when conducting studies in advance. Rather, findings of the kind presented in this section can be used to identify areas of potential conflict or interaction between local uses and marine shipping, but further studies should be done of specific areas where shipping activities are planned, in which the details of shipping and current local uses can be compared and evaluated for potential impacts and mitigation strategies.

In the face of uncertainty about what activities will take place, what effects those activities will have and what other factors will be involved, a collaborative management approach and careful planning are required to identify and respond to negative impacts and to identify and harness positive benefits. One hallmark of the collaborative

Extent of Use of the Marine Environment by Aleut Communities

The marine environment is vital for coastal Arctic communities. This is especially true in the Aleut region, where communities are on islands or along the Alaska Peninsula, providing excellent access to the sea but relatively few options on land. As with other regions, the extent of marine use by Arctic indigenous communities, the information from the Aleut region is not consistent, comprehensive, and up to date for all communities. Instead, some reports are over a quarter century old, and more recent information does not cover all communities or all species. Nonetheless, tribal representatives confirm that the general pattern of marine use continues today.

Table 7.2 shows the results of surveys concerning traditional harvests in three predominantly Aleut communities in Alaska. Other studies have found that the overwhelming majority of households in Aleut communities use birds and eggs. In Nelson Lagoon, 92.3 percent of households used at least one bird or egg during the study period. In Akutan, the figure was 97.9 percent, compared with 88.9 percent in Nikolski and 74 percent in False Pass. Sharing of harvested birds and eggs was considered to have great cultural importance in all four communities.

Zenia Borenin, president of the Tribal Council for the Native Village of Akutan, described local use of the marine environment:

"The northeast near coastal waters of Akutan Island are important for black bass, chitons, halibut, salmon, razor clams, and sea lions. The southeastern-most near coastal waters is a viral cod and salmon fishing area. There is a sea lion haul out area on the eastern coast of Cape Morgan. A cod and halibut fishing area is located in the near coastal waters northeast of Talus Point.

"Akutan utilizes the coastal waters around Akun Island as well. Seagull eggs are harvested on the northwest shore of the island (Akun Head), and on the small islands southeast of Akun. Salmon and halibut are taken in the area of Lost Harbor. Halibut is harvested in the near coastal waters southwest of the island, and in several areas east of the island. Salmon are taken in Surf Bay, Trident Bay, and in Akun Bay in the area of Heliantinus Cove. Akun Bay is an important area for halibut, crab, cod, octopus, and sea bass."

Community	Per capita harvest (kg)	% from salmon	% from other fishes	% from marine invertebrates	% from birds and eggs	% from marine mammals
Sand Point	115.9	54	21	7	2	2
King Cove	116.0	53	17	8	4	1
False Pass	186.9	47	15	6	4	6

Table 7.2 Per capita harvests of wild resources from three Aleut communities, with percent contribution from various classes of marine resources.
Source: Fall et al. 1993a, b, 1996

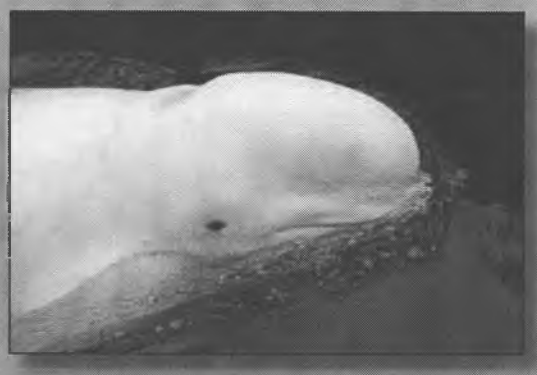
approach is that it is adaptive in the sense that it allows for adjustments and alterations based on experience and evaluation as changes take place, rather than creating a fixed system for addressing anticipated issues that may turn out to be ineffective when unanticipated events occur.

An advantage of substantive local involvement is that local residents are often best positioned to weigh the many factors affecting them. The example of the container that washed ashore in the Commander Islands describes the consequences when local capacity for addressing a problem is lacking, a situation exacerbated in that case by the lack of any larger precedent or system for response or accountability. In cases where local involvement in planning or carrying out shipping-related activities was higher, communities generally experienced better results.

One component of local involvement is communication. Many of the participants in the AMSA town hall meetings asked for better information about cruise visits and trans-Arctic shipping plans. Effective communication and continued interaction has been found to be important in oil and gas activities and in tourism in the Arctic. Communication can help reduce the number of surprises for all involved, and early identification of problems can allow more time for resolution.

As noted earlier, projection of shipping activities and their impacts is difficult due to the interactions of numerous factors in the environment and in human society. To some extent, researchers need to develop better methods for studying combined effects of these kinds, just as regulators need to develop better methods for balancing multiple management objectives. Just as importantly, those involved in marine shipping in any capacity need to recognize that flexibility and adaptiveness will be required to recognize and address challenges, problems and opportunities that arise.

Marine shipping encompasses a wide range of activities, taking place in different locations and seasons and with differing degrees of local involvement and effects. The quantity of shipping, likewise, may determine whether effects are largely beneficial or otherwise, and also who is most affected. For example, limited tourist traffic may provide a modest economic opportunity for local artists and handicraft makers, whereas higher levels of traffic may have environmental or other impacts that offset any benefits. As noted earlier, the details of effects will depend greatly on the details of shipping and the characteristics of specific times and places. Nonetheless, the case studies in this section and studies of other types of activities, such as mineral and petroleum development, suggest some observations about what can be expected from increases in Arctic marine shipping.



Beaufort Sea Beluga Whales

Local and Distant Effects of Shipping

The Beaufort Sea population of beluga whales, numbering in the tens of thousands, migrates from the Bering Sea through the Bering Strait into the Chukchi Sea and then eastwards into the Beaufort Sea. The animals pass through the Mackenzie Delta region and into the waters among the western islands of the Canadian Arctic Archipelago. This migratory path takes them through the waters of Russia, Alaska and Canada. The belugas are hunted in all three regions.

During their migration, Beaufort Sea belugas traverse several areas where shipping may be a major presence. The Bering Strait is a crucial chokepoint for any trans-Arctic shipping. The Mackenzie Delta area already sees extensive tug and barge traffic. Shipping through the Northwest Passage will pass through narrow waterways where belugas gather in summer. Offshore oil and gas activities, including shipping, may affect belugas throughout much of their range.

Shipping may also interfere with hunting activities and opportunity, compounding any effects at the level of the beluga population. Further work is needed to examine exactly where and when shipping will overlap with hunting and with key stages of the beluga migration. This information can be used to develop specific management and mitigation plans, perhaps including limitations on shipping to protect belugas and those who hunt them.

In addition to local initiatives, a broader management plan is required to address impacts in one region that may affect other regions. For example, a disaster in the Bering Strait could affect hunters in the Mackenzie Delta region, 2,000 kilometers away, undermining any conservation efforts they have made in their area.

Town Hall Meetings

Town hall meetings were held in various locations in the Arctic as part of the outreach effort of the Arctic Marine Shipping Assessment. The intent of these meetings was two-fold. First, the organizers presented the plans for the assessment and the expectation of increased marine shipping that was driving the study. Second, the organizers sought input from participants regarding their observations, concerns and questions related to marine shipping. This section presents a summary of the main themes that emerged from these meetings.

Arctic residents think about shipping, not by itself, but in a broader context of economic, environmental, political and social change. In the town hall meetings, shipping did not appear to be a cause of great hope or fear, but rather as an additional factor that would influence the future of Arctic communities in various ways. In addition, discussing the future of Arctic marine shipping raised concerns about the ability of small indigenous communities to influence large-scale economic activities.

Environmentally, shipping is seen as a potential source of disruption to marine species. Marine mammals, in particular, are seen as vulnerable to disturbance. In Resolute, Nunavut, a period of increased shipping in the 1990s pushed walrus away from the community, too far for hunters to reach them. Saami fishermen in northern Norway are concerned about impacts to fisheries and fish stocks, particularly from pollution or oil spills. Oil spills are, in fact, one of the largest concerns, especially with the lack of response capability in nearly all areas of the Arctic. Ship traffic also raises the possibility of introductions of invasive species.

Hunters are concerned about impacts to the animals and to their practices. Too much ship traffic could be dangerous for hunters in small boats. In many cases, hunters traveling over sea ice have been cut off by icebreakers, an impact that remains a big concern, especially when travelers' lives could be at risk from unexpected open water. In some areas of the Canadian Arctic Archipelago, caribou migrate over sea ice and could be affected by icebreaker traffic. On the other hand, hunters in Resolute and Iqaluit noted that some marine mammals follow ships. In Iqaluit, the arrival of a ship was often a signal to beluga hunters to look for whales that may have come into the bay. As one hunter in Cambridge Bay, Nunavut, said, hunters are going to adapt, but they cannot survive without healthy animals to hunt.

Economically, shipping offers many benefits. Participants in many communities spoke of the prospect of lower shipping costs if cargo ships can come more frequently or if larger ships can be used. Increased shipping and port activity can also provide jobs. In Canada, ports for mines have often been located away from communities at the communities' request, to avoid social impacts from the influx of workers. Communities may reconsider that approach or seek other ways to gain economic benefits from port activities. On a smaller scale, cruise ships provide an opportunity for carvers to sell their artwork, making their visits welcome to at least some Arctic residents.

The relative costs and benefits of shipping depend greatly on volume. Modest amounts of traffic, or a few visits by cruise ships, may be seen as largely positive. Increasing numbers of ships and visits, however, pose the threat of greater disruption and little time in between to recover. Culturally and socially, shipping can be a catalyst for disturbance if many newcomers arrive in the Arctic, as has been seen with other forms of development. The Arctic is already experiencing rapid social and cultural change, and additional pressures will only make adjustment harder.

In this context, many participants expressed concern over having little voice in shipping, development and other activities that have so much effect on their lives. In Norway, development of onshore mineral resources and offshore oil and gas are seen as major threats to the Saami way of life. With the extent of global environment, economic and social change, many Arctic people feel they have little ability to influence major developments like Arctic marine shipping. When shipping companies ignore local residents, the feeling of powerlessness is compounded. By contrast, when shipping companies or cruise lines communicate with local residents, the effort is well received and makes people better informed and thus better able to make any adjustments they need to in order to minimize the impacts of ship traffic.

An additional insight from the town hall meetings is that few Arctic residents are aware of the scope of activities that may be coming to their region soon. The meetings were able to provide some information, but many additional questions were raised about the scale of environmental change, the prospects of mineral development and other changes that can be expected in the near future. For Arctic residents, these influences are not separate things that can be treated one by one. Instead, each new factor merely joins the others in shaping people's lives. The degree to which Arctic people retain the ability to determine their own futures remains to be seen. Communication and the ability to exercise at least local influence are seen as key components of sustaining traditional ways and practices.

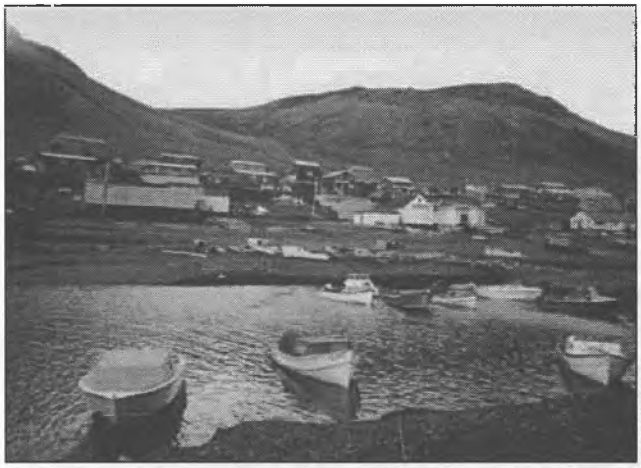
First, the impacts of shipping depend greatly on the type of shipping, the season(s) in which it occurs and the locations. Trans-Arctic shipping done in ice-free conditions and largely offshore may have few or no local effects, barring an accident. Nonetheless, as the Aleutian region has experienced, accidents can and should be expected, prepared for and responded to promptly and effectively. This is especially true in narrow waterways of the Arctic. In these places, ships must travel close to land and may well encounter local hunters or travelers out in boats. In addition, proximity to communities means proximity to hunting areas and the animals that people depend upon, so the potential for environmental impacts is correspondingly higher in these areas. Tourism, too, is likely to take place largely or exclusively in the ice-free season (with the exception of icebreaker voyages to the North Pole), though cruise ships are likely to visit communities or areas of high biological activity such as bird colonies or marine mammal haul-outs.

Shipping to and from destinations within the Arctic is also largely done during the ice-free season, with important exceptions in the Russian Arctic as well as occasional icebreaker transits throughout the region. Ice-breaking can interfere with over-ice travel by hunters and others and so is potentially a more significant impact than are open-water transits. Icebreaker activity may increase as mineral and petroleum resources are developed in the region, which might make interactions with local travelers more common. Here, too, the potential for environmental impacts is high, both from accidents and from destruction to key habitats such as areas where seals or polar bears make ice dens for bearing young. As with trans-Arctic shipping, the potential for local impacts is greatest near shore, particularly in narrow passages and straits.

Effects, too, come in several forms. Economically, more shipping may increase trade or lower costs for Arctic communities, while increased resource development can provide employment and income for Arctic residents and regions. As has been noted with regard to oil and gas activities in the Arctic, economic benefits may be considerable and can have a number of secondary effects, such as increased local capacity to provide social, cultural and health services as well as construct and maintain infrastructure.

Socially, increased economic activity and resource development can, but does not necessarily, lead to population growth through immigration, which can create social tension between newcomers and indigenous or other long-time residents. Often, those moving to the Arctic for employment are young men, creating a gender imbalance in the local population, which can exacerbate tensions and social problems. Changes in income, too, are often associated with increases in drug and alcohol abuse, as well as domestic violence and other crime. Many of these negative impacts can be addressed largely or in part, by establishing rotational work schedules, with workers traveling to the region for work shifts of one to several weeks and returning to their home communities during the periods they are off or by physical separation between a community and a development site.

Environmental effects are often the greatest concern from increased industrial activity of any kind, whether resource development or shipping. The environmental effects of Arctic marine



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shipping are addressed in other sections of this assessment, but it is important to note that loss of hunting opportunities and degradation of the environment can have substantial impacts on local communities. Concern about these types of impacts can by itself cause stress, especially when hunting and other traditional activities are seen as pillars of cultural continuity but also under threat from other social and environmental changes.

The cultural effects of shipping and development may, therefore, be generally anticipated to be negative, but this is not necessarily the case. Environmental impacts and greater assimilation from exposure to outside influences can cause cultural loss, but tourism can boost local cultural awareness and pride and greater economic well-being can allow investments in cultural programs.

As noted earlier, the difference between negative impacts and positive or neutral ones is often a question of planning and preparation. A large influx of cash into a community can create a boom-and-bust atmosphere, with minimal investment for the long-term and a host of social problems in the short-term. The same economic boom can also be harnessed to produce lasting benefits. Doing so successfully requires extensive local involvement in the planning process, so that local concerns and ideas can be fully incorporated. Not all marine shipping activities will be beneficial for Arctic residents, and some are likely to have negative impacts. Nonetheless, careful attention to good communication and collaborative approaches to management can help keep increases in shipping activity from causing undue stress and harm to Arctic people and may result in benefits to many areas.

Research Opportunities

- Regional analyses of traditional marine use patterns (spatial and seasonal) for application in the development of strategies and measures to reduce potential conflicts and impacts of multiple users of Arctic waterways.
- Research on the impacts of noise/sound on marine mammals in regions where current and future marine operations overlap with indigenous hunting (examples: bowhead whale hunting off Alaska's northern coast and beluga hunting in the Canadian Arctic).
- Detailed, interdisciplinary analyses of the interactions and impacts of marine shipping with Arctic communities. Further assessment of the social, cultural, economic and environmental impacts from shipping to provide insights for planning future Arctic marine systems and operations.
- Mapping and study of changing indigenous use of Arctic sea ice as a transport medium in the face of climate change and sea ice retreat.
- Comprehensive review of changes in Arctic marine technology during the past six decades, specifically for Arctic commercial ships, and how these changes may influence the future of Arctic marine transport systems.

While it is not clear whether reduced sea ice will have a major influence on development trends, increased shipping is unlikely to constrain development.

Findings

1] Marine shipping is one of many factors affecting Arctic communities, directly and indirectly. The variety of shipping activities and the range of social, cultural and economic conditions in Arctic communities mean that shipping can have many effects, both positive and negative.

2] While economic effects of marine shipping may be positive, there are many concerns expressed by Arctic coastal communities about social, cultural and environmental effects.

3] There is insufficient information to identify with any precision the likely effects of marine shipping for most Arctic coastal communities. No current database exists for indigenous use in local Arctic waterways that could be used to develop multiple use management measures and potential mitigation strategies.

4] The costs and benefits from marine shipping will be unevenly distributed among and within communities and regions.

5] Constructive engagement of local residents at the earliest time in a planned Arctic marine development project can help reduce negative impacts, assist in a smooth interaction and increase positive benefits from marine shipping.

6] The marine environment and marine resources have long sustained Arctic communities. Thus, Arctic settlement patterns demonstrate a strong marine influence. Local Arctic residents today depend heavily on marine resources for subsistence and the local economy. A combination of over-the-ice travel (i.e., using ice as a platform and means of travel for hunting and fishing) and boat transport (i.e., for fishing, hunting and travel) allows the use of large Arctic marine areas during much of the year. Life in the Arctic is dependent on movement and sea ice is integral to this movement in the high Arctic. Remote indigenous coastal communities are especially vulnerable to marine accidents as they risk losing not only their vital marine resources, but the natural foundation of their cultures and way of life.

7] AMSA town hall meetings revealed that Arctic residents think about shipping, not by itself, but in a broader context of economic, environmental, political and social change. Shipping did not appear to be a cause of great hope or fear; rather, as an additional factor that would influence the future of Arctic communities in various ways.

8] AMSA town hall meetings indicated that from an environmental perspective, shipping is viewed as a potential disruption to marine species. Oil spills are one of the largest concerns. Hunters are also concerned about the impacts of ships on the animals and on their hunting practices.

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Environmental Considerations and Impacts

Marine shipping, if not properly managed, poses a threat to natural ecosystems. This is especially true for the Arctic. Whether it is the release of substances through emissions to air or discharges to water, accidental releases of oil or hazardous cargo, disturbances of wildlife through sound, sight, collisions or the introduction of invasive alien species, the Arctic marine environment is especially vulnerable to potential impacts from marine activity.

Vulnerability of Arctic Species and Ecosystems

Extreme cold temperatures, ice and strong seasonal variability characterize the Arctic. These extremes have resulted in a range of adaptations among Arctic animals including the ability to store energy when food is plentiful and fast when it is not; highly insulating outer layers such as feather, fur or blubber to keep warm; and a high degree of seasonal migration to and from the region, especially among marine mammals and birds.

The extensive seasonal migrations of marine mammals and birds into and out of the Arctic are key features that determine the vulnerability of Arctic ecosystems. Seabirds, shorebirds and waterfowl move north to breed and feed during the short Arctic summer, exploiting the burst of productivity in the northern ecosystems. Whales and seals have similar migrations to northern feeding areas. Many species aggregate throughout the circumpolar north in very large numbers to feed, mate, give birth, nurture their young and molt. During the periods when Arctic species gather and in the areas where they do so, they are particularly vulnerable to potential environmental stresses, such as accidental discharges from ships and various types of disturbances that ships can cause.

Disturbance during critical stages could disrupt the short feeding season for Arctic species, causing some animals to not get enough food to provide the energy needed for the long migrations they face and for breeding and raising their young. Arctic species, which are reliant on feathers and fur to insulate against the cold, are especially

vulnerable to contamination from oil that will compromise their insulating layers, leaving them exposed and at risk of hypothermia and death. It is the unique adaptations of the various species which live in and migrate to the Arctic that make them vulnerable to potential adverse impacts as a result of shipping and other vessel activities.

The degree of oil pollution in the Arctic marine environment is low, according to the recent Arctic Council Assessment of Oil and Gas Activities, with natural seeps being the largest source of input of oil hydrocarbons. Accidental oil spills were seen as the largest threat. While the Arctic environment is still relatively clean for many types of contaminants, recent assessments by the Arctic Monitoring and Assessment Programme (AMAP) have shown that persistent organic pollutants (POPs) occur at high levels and pose a threat to top predators in marine food chains, including humans. Heavy metals such as mercury, cadmium and lead are also seen as issues of concern in some parts of the Arctic.

Arctic Species: Interactions with Shipping

Arctic marine mammals such as bowhead, beluga, narwhal, walrus and several species of seals migrate south in fall to spend the winter in the southern areas of seasonal ice. In spring, they move north again, using systems of polynyas and leads, often before the break-up of the ice. At this time, these mammals reproduce and give birth to their young. Important wintering areas for marine mammals are in the broken pack ice in the northern Bering Sea, Hudson Strait, Davis Strait and southeastern Barents Sea. From these areas, the mammals follow leads and openings north through the Bering Strait and the Chukchi Sea; north through Baffin Bay into Lancaster Sound, into Hudson Bay and Foxe Basin; and north and east into the Kara and Laptev seas. The leads and openings in the ice are also used by seabirds, eiders and other marine birds on their spring migration to the northern breeding areas.

As climate and sea ice conditions continue to change, the timing and movements of the animals' activity will also be modified, making predictions of the potential interactions between shipping and animals increasingly complex.

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The migration corridors used by marine mammals and birds correspond broadly with the main shipping routes into and out of the Arctic. Currently, there is limited overlap during the spring migrations as all shipping activity will typically occur later in the spring than the animal migrations. In the fall, there is likely more opportunity for interaction between ships and migrating species, as both are leaving the Arctic ahead of the formation of the pack ice. As the Arctic climate continues to change, it is very likely that the shipping season could extend earlier in the spring and later into the fall. The spring migration corridors are particularly sensitive and vulnerable areas to oil spills, ship strikes and disturbances, and could be a time of vulnerability for marine mammals and birds. In the future there will be a need to consider the potential risk and interaction between ships and animals during this vulnerable period.

The geographic area covered by this assessment spans a wide range of environmental conditions, from pack ice in the Arctic Ocean to open subarctic waters in the Bering Sea and the Nordic seas in the northeastern Atlantic. The volume of current shipping traffic also varies considerably across the Arctic. Currently, there is significant year-round traffic along the subarctic coast of Norway, around Iceland, on the southeast coast of Greenland and out of the Yenisei River and Pechora Sea to the port of Murmansk in northwest Russia. There is a moderate amount of seasonal shipping to and from destinations in the North American Arctic, and no established trans-Arctic traffic. Risk of negative interaction between vessels and wildlife varies across the region. The North Pacific Great Circle Route between western North America and eastern Asia is a high volume shipping lane that swings through the Unimak Pass in the Aleutian chain, passing in close proximity to important marine mammal haul-outs, rookeries and nesting sites of marine mammals and seabirds, close to active commercial fishing grounds and one of the largest protected essential fish habitats in the world.

The Arctic is Changing

The Arctic climate is warming. The effects of this are now being seen in the retreating sea ice, melting permafrost and the changing timing of the onset of fall and spring, as well as the increasing variability within each season. These changes are affecting Arctic species and ecosystems. Where caribou used to migrate across frozen rivers, they now have to wade. Polar bears swim farther to find food and wait longer in the fall for the pack ice to reform, extending their fasting. Pacific walrus are now hauling out on land in the Chukchi Sea, where they used to haul out mainly on sea ice.

Arctic species and ecosystems are, by nature, highly evolved in function and finely tuned with the timing of seasonal events. Although some species will benefit from the changes, there are many that are now under stress as a result and, for some, at risk of steep decline. For many species, any potential impacts as a result of current or future shipping activity will be in addition to the stress they are already under due to the changes occurring in their environment. It is beyond the scope of the current assessment to examine the interaction between effects from climate change and effects from future shipping activities. This is in part because of the intrinsic difficulties and the many uncertainties about the future.

Climate experts are projecting that the main change in sea ice will be decreasing ice coverage in the summer along the coastal Arctic seas with the formation of first-year ice occurring later in the fall. Even with a warmer climate, the Arctic Ocean will still remain ice-covered for most of the year. As climate and sea ice conditions continue to change, the timing and movements of the animals' activity will also be modified, making predictions of the potential interactions between shipping and animals increasingly complex.

Ship Based Impacts

Accidental Discharge

The accidental release of oil or toxic chemicals can be considered one of the most serious threats to Arctic ecosystems as a result of shipping. The release of oil into the Arctic environment could have immediate and long-term consequences. Some Arctic animals are particularly sensitive to oil because it reduces the insulating properties of feathers and fur and they can quickly die from hypothermia if affected. This is the case for seabirds, including eiders and other sea ducks, and also polar bear and seal pups. Concentrated aggregations of birds and mammals, often in confined spaces such as leads and polynyas, increase the risk to the animals in the case of an oil spill in the Arctic. Crude and refined oils, including fuel oils used by ships, vary much in their physical and chemical properties. This, in addition to other factors such as temperature, light, waves and ice, plays a major role in the behavior of oil in the environment and the extent of biological effects.

Other potential problems from released oil include the transfer of oil to nests by sea birds landing on oil slicks and the ingestion of oil by animals while preening. This can lead to death or other biological effects both in the short and long term. Even small spills can have large consequences if they occur where marine birds are concentrated.

Chronic seepage of residual oil after a spill can affect the entire food chain in an area because hydrocarbons are taken up by bottom feeding invertebrates, which then end up as prey for sea birds and

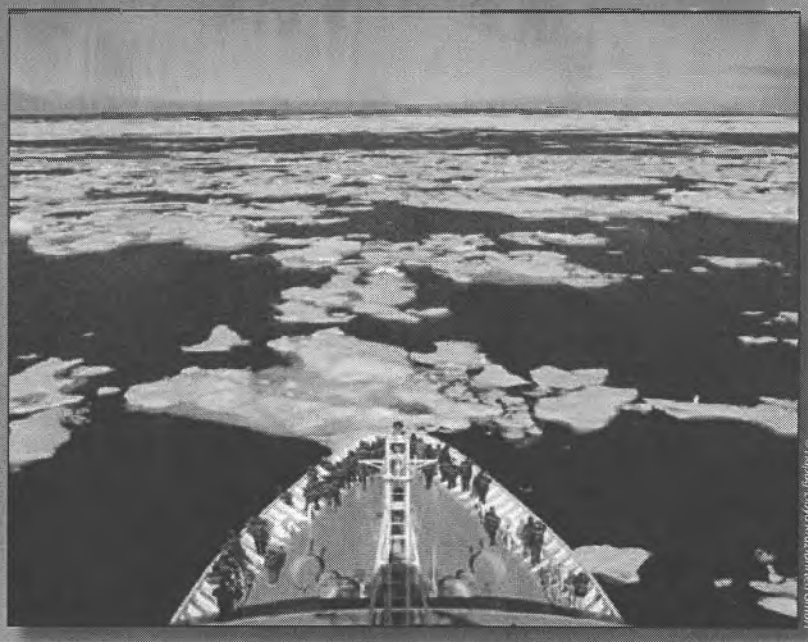
Environmental Impacts and Disturbances from Cruise Ships

The number of cruise ships operating in the Arctic is rapidly increasing. These ships are traveling to the region for the scenery and to actively seek out areas of special interest, including exceptional wildlife viewing opportunities. Wildlife is a primary attraction for polar tourists. Polar ecosystems, particularly in coastal environments, and wildlife migratory events provide tourists with opportunities to view many species of land and marine mammals as well as a remarkable diversity of birds. However, because cruise ships are specifically seeking out such events and opportunities, the potential is created for significant impacts on concentrations of wildlife due to disturbance from the ship.

There are numerous ways passenger ships can cause environmental harm. Emission of substances to the local air and ocean, possible incidents including sinkings and groundings, ship operations unsuitable for polar conditions and the inappropriate behavior of passengers ashore are the most prominent impacts. The 2004 U.S. Commission on Ocean Policy reported that, while at sea, the average cruise-ship passenger generates about eight gallons of sewage per day and an average cruise ship can generate a total of 532,000 to 798,000 liters of sewage and 3.8 million liters of wastewater from sinks, showers and laundries each week, as well as large amounts of solid waste (garbage). The average cruise ship will also produce more than 95,000 liters of oily bilge water from engines and machinery a week.

Sewage, solid waste and oily bilge water release are regulated through MARPOL. There are no restrictions on the release of treated wastewater. MARPOL restrictions typically prescribe the allowed distance from shore and rate at which wastes can be released or requires ships to deposit them in shore-side reception facilities. However, the Arctic region lacks infrastructure to adequately dispose of bilge water, sewage and solid waste. Many Arctic communities do not even have sufficient facilities to deal with the waste of their own communities, let alone that of tourist vessels. When ships are forced to stockpile wastes onboard where reception facilities are lacking, the risk of illegal or accidental release into sensitive areas is heightened. The alternative to depositing waste into onshore facilities is onboard incineration, a practice that also brings with it concerns about localized air pollution.

The extent of the impacts on different Arctic species from cruise ships is difficult to assess due to the lack of Arctic-specific baseline information on wildlife and the relatively recent increase in cruise ship activity. The cruise ship industry has a vested interest in maintaining healthy wildlife populations; however, there are currently no common best practices for the circumpolar Arctic as there is in the Antarctic through the International Association of Antarctica Tour Operators. The Arctic's one cruise organization, the Association of Arctic Expedition Cruise Operators, is limited in scope with its geographic range in the Svalbard, Jan Mayen and Greenland area. Cooperation among cruise ship operators, in partnership with academic and regulatory bodies, is necessary to ensure more sustainable eco-tourism in the Arctic.



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other animals, causing effects higher up the food web. Arctic animals are also particularly vulnerable to spills in certain areas and at certain times of the year when animals aggregate in large numbers to breed, nest, bear young and molt.

The Arctic is an extreme environment with a range of weather, light, hazards and with little human infrastructure. Responding to oil spills in these conditions is a major challenge, especially where ice is present. There are currently limited methods for recovering spilled oil in an ice-covered environment. The options currently available for oil spill recovery in the Arctic include mechanical methods, bio-remediation, dispersants and/or in-situ burning. Consequently, strong prevention measures must be of primary concern, while response measures, being both unreliable and untested, should be secondary. The risk of accidental release of oil and other contaminants increases with any increase in shipping activity that involves the use or transportation of oil or other chemicals.

Regular Discharges to Water

As a part of normal operations, ships produce a range of substances that must eventually be eliminated from the ship through discharge into the ocean, incineration or transfer to port-based reception facilities. Referred to as regular discharges these include oil, ballast water, bilge water, tank washings (oily water), oily sludge, sewage (black water), garbage and grey water. Regular ship discharges are regulated through the IMO's *International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto* (MARPOL 73/78) and other IMO conventions, as well as through domestic regulation by coastal states (See page 59). MARPOL has effectively reduced pollution in the marine environment by regulating the release of regular discharges. However, it has not eliminated discharges into the world's oceans altogether.

Ship Category	Ship Sub-category/ Use	Ship Type-Specific Pollution Sources
Government Vessels and Icebreakers	Coast guard vessels, research icebreakers, private icebreakers, government icebreakers, other research vessels	Accident/incident recovery-produced contaminants, emergency dumping oil/fuel, nuclear icebreaker radiation contamination, explosives/munitions, impacts due to icebreaking activity (disruption of ice formation, marine mammals, etc).
Container Ships	Cargo transport	Hazardous goods in transit, convoy collision hazard, grounding hazard (uncharted waters, lack of experienced ice navigation).
General Cargo	Community re-supply vessels, roll on/roll off cargo	Hazardous goods in transit, accidental cargo release, contaminated cargo.
Bulk Carriers	Timber, merchant, oil, ore, automobile carriers	Release of metal contaminants, radiation contamination from cargo, hazardous goods in transit.
Tanker Ships	Oil tankers, natural gas tankers, chemical tankers	Liquid Nitrogen Gas contamination, chemicals and hazardous goods in transit, spills from oil transfer.
Passenger Ships	Cruise ships, ocean liners, ferries	Large volumes of black and grey water release, garbage disposal, cleaning contaminants, disturbance of wildlife through viewing activities, automotive contaminants w/ vehicles ferries .
Tug / Barge	Re-supply vessels Bulk cargo transport	Increased accident hazard (non-propelled), hazardous goods in transit, spills during oil transfer, heavy emitters of air contaminants (black carbon).
Fishing Vessels	Small fishing boats, trawlers, whaling boats, fish processing boats	Increased fire hazard, introduction of pathogens and other contaminants from released fish offal, accidental release of invasive species/related biological contaminants, release of plastics, ghost nets and other fishing debris, seafloor damage from bottom trawlers, depletion of marine species (if not managed), accidental release of refrigerant contaminants.
Oil and Gas Exploration/Exploitation Vessels	Seismic exploratory vessels, oceanic and hydrographic survey vessels, oil drilling vessels, oil and gas storage vessels, offshore re-supply, portable oil platform vessels, other oil and gas support vessels	Hazardous cargo, explosives, acoustic impacts from seismic activities, oil/hydrocarbon contamination, contamination from extraction chemicals, accidental loading/offloading spillage, fire hazards.

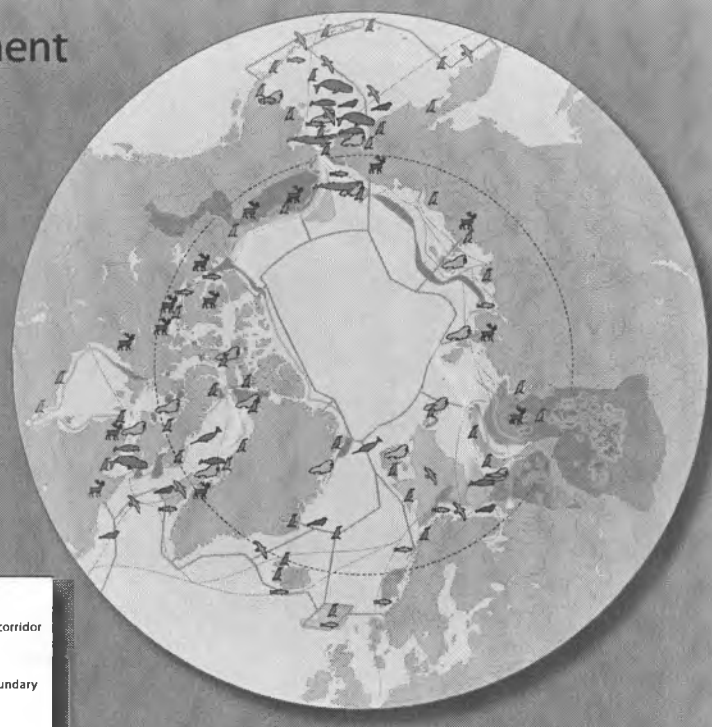
Table 8.1 A range of potential environmental impacts linked to ship types operating in the Arctic. *Note: All ships will have certain impacts linked to the release of grey water, sewage, ballast and bilge water; air emissions; regular and accidental discharge of fuel/oil; introduction of noise and other acoustics such as sonar; and possible strikes on animals. Those listed above are in addition to these and specific to the vessel type.* Source: AMSA

Oil is released with bilge water with a maximum allowed concentration of 15 parts per million (15 mg per m^3) after treatment with an oil separator. Oil is also released with water used for tank washings after required treatment and with restrictions on amount and rate of release to avoid formation of oil film at the surface (i.e., blue shine). Oily sludge, consisting of high molecular hydrocarbon substances, accumulates in fuel tanks in fairly large amounts, constituting typically 1-5 percent of the amount of fuel consumed. Oily sludge must not be released but stored on board and brought to reception facilities in ports.

A recent study of regular discharges from ships in the Norwegian and Barents seas provides an example of the level of discharge expected to be released in an area that has some of the heaviest ship traffic in the Arctic or subarctic region. In this study it was estimated that the amount of oil released via bilge water and tank washings that the MARPOL allowed 15 ppm totaled about two tons of oil per year, a relatively small amount. However, the study found ship operations generate about 13,000 metric tons of oily sludge annually.

Arctic Oil and Gas Assessment

A comprehensive assessment of the oil and gas activities in the Arctic was carried out in 2007 by the Arctic Council under the leadership of the Arctic Monitoring and Assessment Programme working group. This assessment summarized information on the history, current and projected oil and gas activities in the Arctic, and examined socio-economic and environmental effects associated with these activities. The assessment included a detailed description of the main features and species of the Arctic ecosystems and their vulnerability to oil spills and disturbances from oil and gas activities. An illustrative circumpolar map of vulnerable areas based on aggregations of mammals, birds, and fish was produced as an outcome.



An illustrative map from the Arctic Oil and Gas 2007 assessment of areas in the Arctic indicating where selected birds, mammals and fish form major aggregations to breed, stage, migrate or overwinter. When oil and gas activities including transportation occur in such areas, such aggregations are vulnerable to disturbances and oil spills. *Source: AMAP*

1.0%

The 2004 Arctic shipping contribution of CO_2 emissions to the total from the global shipping fleet.

Wild Card – Ship Stack Emissions – NOx, SOx, Black Carbon and Ozone

Ships are powered by engines and fuels that, like other transportation modes, emit CO_2 and water vapor, nitrogen oxides (NOx), sulfur dioxide (SO_2), carbon monoxide (CO) and particulate matter (including black carbon [BC]). Most oceangoing ships burn low-quality residual fuels that tend to contain high amounts of particulates from soot (black carbon), sulfur aerosols, ash and heavy metals.

These are pollutants specifically quantified in the inventory of emissions from Arctic shipping in this assessment. These pollutants are linked with specific environmental effects, and complex interactions occur among these substances in the regional and global atmosphere. For example, NOx is a gaseous contributor to tropospheric ozone formation; SOx gases form particles that contribute to acid rain and cloud effects on regional climate; and other fine particles like black carbon impact air quality, visibility and climate change.

Shipping's contribution to regional and global impacts from emissions such as CO_2, NOx and SO_2 have been evaluated by scientists and shown to be significant enough to motivate policy action. However, environmental and climate effects of NOx and ozone, sulfur aerosols and black carbon particles in the Arctic are only beginning to be understood. Black carbon has been proven to have significant climate forcing effects, in addition to its effects on snow and ice albedo, accelerating the retreat of Arctic sea ice.

Background levels of NOx, the precursor to ozone, are very low in the Arctic and recent studies have found that seasonal increases in ozone are closely linked to seasonal increases in shipping activity. Surface ozone is known to have harmful effects on plant growth and human health and is the basis for photochemical smog.

Ship stack emissions in and near the Arctic will increase along with growth in shipping activity, except where regulations like MARPOL Annex VI require steep reductions in sulfur emissions through fuel sulfur limits or pollution reductions in specially designated regions. The specific benefits of reducing impacts in the Arctic through control of ship emissions need to be further studied, and the AMSA inventory for 2004 provides a good baseline inventory to evaluate scenarios that may achieve these benefits.

Based on AMSA findings, the report recommends continued study of ship-based emissions and trends. Climate change policy is currently focused on CO_2 from ships and the potential climate response to lower ship sulfur emissions is becoming recognized. NOx emission controls may mitigate some of the Arctic regional ozone impacts suggested by one international study and the AMSA inventory provides an opportunity to update previous research findings.

More recently, scientists are recognizing that black carbon particles have potentially significant impacts on the vulnerable Arctic environment and climate that need to be quantified. The AMSA contribution to further research may be very important, given that recent studies suggest that reduction of the positive climate forcing due to BC would decrease both global warming and retreat of the sea ice and glaciers and would therefore provide an opportunity for effective short term mitigation of global warming.

The release and deposition of black carbon in the Arctic region is of particular concern because of the effect it has on reducing the albedo (reflectivity) of sea ice and snow.

Table 8.2 Estimated emissions in the Arctic for 2004 by ship type. *Source: AMSA*
Emission amounts were calculated using the AMSA marine activity database (See page 70), which is based on information reported by Arctic Council member states. Baseline information was provided in different formats and to different degrees of detail between states.

Vessel Category	Fuel Use (kt/y)	CO_2 (kt/y)	BC (t/y)	NOx (kt/y)	PM (kt/y)	SOx (kt/y)	CO (kt/y)
Bulk	354	1,120	122	26.9	17.9	18.6	2.57
Container	689	2,170	239	52.5	35.0	36.2	5.01
General Cargo[1]	590	1,860	202	44.9	29.9	31.0	4.29
Government Vessel	117	368	40.1	8.89	5.92	6.13	0.85
Other Service Vessel	3	11	1.19	0.26	0.18	0.18	0.03
Passenger Vessel	349	1,100	120	26.6	17.7	18.3	2.54
Tanker	269	848	92.5	20.5	13.7	14.1	1.96
Tug and Barge	17	54	3.38	1.32	0.88	0.91	0.13
Fishing[2]	1,020	3,230	363	78.0	52.0	53.8	7.4
Total	**3,410**	**10,800**	**1,180**	**260**	**173**	**179**	**25**

1. A review and comparison of the AMSA estimated fuel use by General Cargo vessels with recent activity-based inventories completed by Norwegian researchers at DNV suggest that this category may be overestimated, due to the world fleet characteristics for general cargo ships reflecting larger vessels with more installed power than typical for Arctic operations.
2. A review and comparison of the AMSA Fishing vessel data with more direct activity-based estimates completed by DNV for Norwegian fishing vessels suggests that this first estimate may be in the range of three to four times higher than what was found by DNV. This is likely because the AMSA fishing vessel estimates are based primarily on days at sea, which assumes the vessel engine runs at varying capacity for the entire period at sea and may overestimate fishing vessel emissions and fuel use.

The amount of legally discharged oil under MARPOL in the Norwegian study indicates that current amounts of legally discharged oil should not pose a significant threat to the local ecosystem so long as the laws are strictly followed. MARPOL requires oily sludge to be disposed of in port-based reception facilities. Norway is unusual in the Arctic region in that it has good port reception facilities in all of its Arctic ports, but that is not the case in many other areas of the Arctic. In some areas, limited port side infrastructure as well as the cost of disposing of waste using port reception facilities provide incentive for illegal dumping of wastes produced on board.

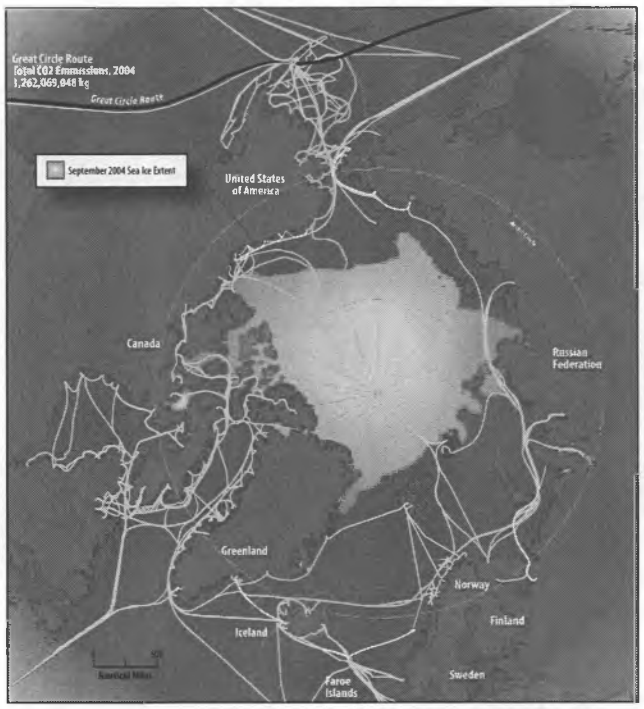
Considering the sheer volume of oily sludge produced in Norwegian waters alone, it would take only a small percentage of the oily sludge produced to be illegally discharged for it to cause environmental damage. Illegal release of oil and oily sludge can cause oiling of animals and birds, can be toxic to marine and terrestrial ecosystems and extremely difficult to clean up. Contamination can last for years in ocean sediment and other compartments of the marine environment, sometimes presenting contaminated prey upward within marine and coastal food chains. Oily sludge is not the only regular discharge that can end up in the ocean. Under MARPOL it is legal to discharge garbage and raw sewage into the water once a ship is a certain distance from shore. The presence of significant amounts of garbage and other debris in the ocean can result in a number of environmental impacts. These range from damage to marine habitat, entanglement of wildlife, introduction of bacteria and disease (from untreated human sewage) and the ingestion of plastics and other unsuitable items by marine mammals and birds. As vessel activity increases in the Arctic, the management of regular discharges from all vessels will need to be seriously considered so that environmental impacts are minimized.

Ship Emissions to Air

Studies assessing the potential impacts of international shipping on climate and air pollution demonstrate that ships contribute significantly to global climate change and health impacts through emission of GHGs (for example, carbon dioxide [CO_2], methane [CH_4], chlorofluorocarbons [CFC]), aerosols, nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO) and particulate matter (PM). Air quality impacts may result from the chemical processing and atmospheric transport of ship emissions. For example, NOx emissions from ships can combine with hydrocarbons in the presence of sunlight to produce ozone pollution, which can potentially affect visibility through haze, human and environmental health and has been associated with climate change effects.

The AMSA has developed the world's first activity-based estimate of Arctic marine shipping emissions using empirical data for shipping reported by Arctic Council member states. Emissions were calculated for each vessel-trip for which data was available for the base year 2004. The 515,000 trips analyzed represent about 14.2 million km of distance traveled (or 7.7 million nautical miles) by transport vessels; fishing vessels represent over 15,000 fishing vessel days at sea for 2004. Some results could be an underestimation of current emissions, given potential underreporting bias and anecdotal reports of recent growth in international shipping and

Map 8.1 Arctic shipping emissions map. *Source: AMSA*



Emission amounts were calculated using the AMSA marine activity database (See page 70), which is based on information reported by Arctic Council member states. Baseline information was provided in different formats and to different degrees of detail between states.

trade through the Arctic. Researchers at DNV recently completed a similar activity based emissions inventory for Norwegian waters (*Operational emissions to air and sea from shipping activities in Norwegian sea areas. DNV Report No. 2007-2030*). A review and comparison of the DNV results with the Norwegian portion of the AMSA results showed good agreement for all vessel types, except for general cargo and fishing vessel estimates. The AMSA results for Norway were sometimes greater than, and sometime less than, the DNV results, generally falling within 10 percent to 30 percent confidence. The AMSA evaluates ship emissions of greenhouse gases and air quality pollutants that may have regional or local impacts; however it does not directly conduct the detailed studies needed to determine the level of impact (Table 8.2).

Results show CO_2 emissions from international shipping in the Arctic region to be approximately 10,800 kilo tons per year tons (kt) CO_2 per year. Given that total CO_2 emissions from international shipping globally are about 1,000 MMT CO_2 per year, Arctic contributions for 2004 amount to about 1 percent of total ship CO_2 emissions, not an amount that would cause significant effects in the global context. However, pollutants such as black carbon (BC), particulate matter, nitrogen oxide (NOx), carbon monoxide (CO) and sulfur oxide (SOx), which may be small contributors to global inventories on a mass basis, may have regional effects even in small amounts. Current IMO regulations under MARPOL Annex VI that place requirements on the sulfur content of marine fuels, once implemented, will dramatically reduce SOx emissions from global shipping. As a result, observable impacts from SOx should decline and there may be indirect effects on the climate forcing properties of other air pollutants such as NOx and BC.

Black carbon is a component of particulate matter produced by marine vessels through the incomplete oxidation of diesel fuel. The release and deposition of BC in the Arctic region is of particular concern because of the effect it has on reducing the albedo (reflectivity) of sea ice and snow. When solar radiation is applied, reduced albedo increases the rate of ice and snow melt significantly, resulting in more open water, and thereby reducing the regional albedo further. In the Arctic region in 2004, approximately 1,180 metric tons of black carbon was released, representing a small proportion of the estimated 71,000 to 160,000 metric tons released around the globe annually. However, the region-specific effects of black carbon indicate that even small amounts could have a potentially disproportionate impact on ice melt and warming in the region. More research is needed to determine the level of impact this could have on ice melt acceleration in the Arctic and the potential benefits from limiting ships' BC emissions when operating near to or in ice-covered regions. The potential impacts of black carbon should also be a point of consideration when weighing the costs and benefits of using in-situ burning of oil in spill response situations.

As part of the AMSA emissions inventory, the amounts of carbon dioxide and black carbon emitted were mapped using the GIS database of shipping routes and areas of fishing vessel activity reported by Arctic states (Map 8.1).

The CO_2 emitted by all vessels was mapped according to the location of activity; emissions from transport vessels (non-fishing vessels) were assigned to reported routes and fishing vessel emissions were assigned to the Large Marine Ecosystem in which the fishing fleet operated. The map shows that the heaviest CO_2

Regional Environment Case Study

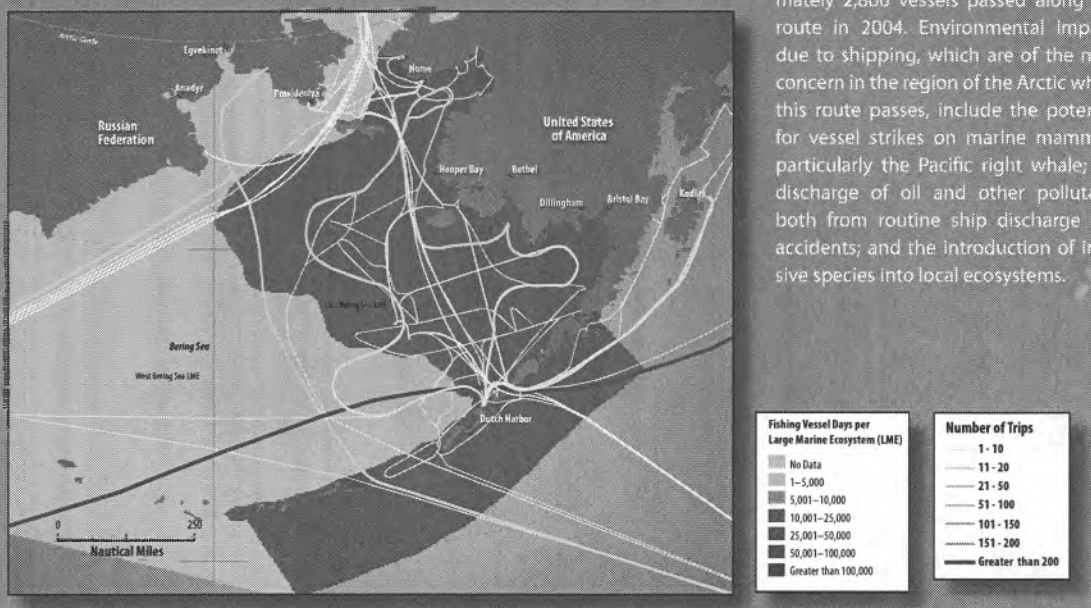
Aleutian Islands/Great Circle Route

The North Pacific's Great Circle Route is the most economic pathway for commerce between northern ports of the west coast of North America to ports in eastern Asia. The segment of this route considered in this analysis is the portion that extends from the western Gulf of Alaska, westward offshore from the Alaska Peninsula and through the Aleutian Islands including the passes at Unimak Pass and the Rat Islands. This portion of the route traverses two Arctic Large Marine Ecosystems (LMEs), the East Bering Sea LME and the West Bering Sea LME.

The East and West Bering Sea LMEs are characterized by their subarctic climate and are strongly influenced by a persistent atmospheric low pressure system that produces intense storm activity and strong ocean currents, particularly through the Aleutian Island passes. The marine and coastal environment in the region where the Great Circle Route passes includes rocky shorelines, fjords and tidal wetlands. This region seasonally supports populations of shorebirds, nesting seabirds, herring and other marine resources as well as millions of salmon during their migrations to streams of origin.

The route also passes through the U.S. Alaska Coastal Maritime Wildlife Refuge, which provides nesting and foraging habitat seasonally for millions of seabirds and year-round habitat for thousands of marine mammals. The populations of several marine species in this region are depressed, declining or otherwise considered particularly sensitive and in danger of potential extinction. Commercial fisheries in the region where the Great Circle route passes provide a large proportion of the annual landings by the U.S. fishing industry. Salmon, halibut, herring, crab, groundfish and many other fisheries are pursued annually in the region. In 2004, Alaska fish landings were 2.43 million metric tons, valued at $US 1.17 billion.

The AMSA estimates that approximately 2,800 vessels passed along this route in 2004. Environmental impacts due to shipping, which are of the most concern in the region of the Arctic where this route passes, include the potential for vessel strikes on marine mammals, particularly the Pacific right whale; the discharge of oil and other pollutants both from routine ship discharge and accidents; and the introduction of invasive species into local ecosystems.



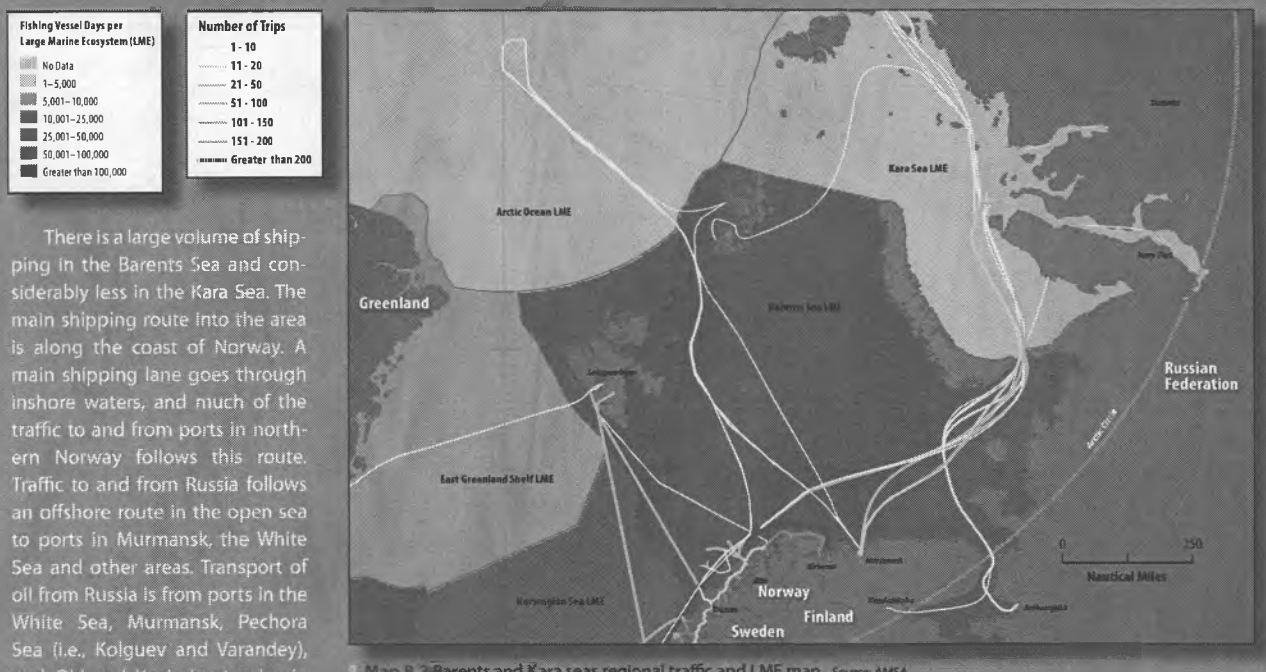
Map 8.2 Aleutian Islands regional traffic and LME map. *Source: AMSA*

13,000

Metric tons – The approximate amount of oil sludge generated annually by ships operating in the Norwegian and Barents seas.

Regional Environment Case Study

Barents and Kara seas



Map 8.3 Barents and Kara seas regional traffic and LME map. Source: AMSA

There is a large volume of shipping in the Barents Sea and considerably less in the Kara Sea. The main shipping route into the area is along the coast of Norway. A main shipping lane goes through inshore waters, and much of the traffic to and from ports in northern Norway follows this route. Traffic to and from Russia follows an offshore route in the open sea to ports in Murmansk, the White Sea and other areas. Transport of oil from Russia is from ports in the White Sea, Murmansk, Pechora Sea (i.e., Kolguev and Varandey), and Ob' and Yenisei estuaries in the Kara Sea. There is also year-round shipping of nickel ore by Norilsk Nickel from a port in the Yenisei estuary. In the western Barents Sea, there is a shipping route to Svalbard with seasonal traffic of cargo ships supplying the communities, bulk carriers transporting coal and cruise ships. There is also a substantial number of fishing vessels that operate year round in the ice-free part of the southern and central Barents Sea, while there is little fishing activity in the Kara Sea.

In 2006, Norway adopted an integrated management plan for the Norwegian part of the Barents Sea and adjacent waters off the Lofoten Islands. In the preparatory work for this plan, an assessment of environmental impacts from shipping was carried out and valuable and vulnerable areas were identified. The plan established a forum on environmental risk management headed by the Norwegian Coastal Administration, which is tasked with providing better information on risk trends in the area, especially as regards acute oil pollution from ships and other sources. In July 2007, the IMO established regulations that require larger cargo vessels and tankers transiting the Norwegian coast of the Barents Sea to operate further away from the coast than in the past. This requirement is intended to allow a longer response time in case of accidents that could impact the Norwegian coastal environment and resources.

Vulnerable areas in the Barents and Kara seas have been identified in relation to oil and gas activities, based on where there are aggregations of animals that could potentially be impacted by oil spills or disturbances from activities. The Barents Sea holds more than seven million pairs of breeding seabirds, with major colonies on Svalbard, the western section of Novaya Zemlya off the coast of northern Russia and along the coast of northern Norway. The oceanographic polar front and the ice edge in the western and central Barents Sea is a concentrated zone of life in spring and summer with aggregations of seabirds and seals. The polar front area is also the wintering area for the large Barents Sea capelin stock and for

seabirds such as thick-billed murre. Svalbard and Franz Josef Land in the northern Barents Sea are important breeding and feeding areas for seabirds, walrus and seals, and denning areas for polar bear. The southern and eastern Barents Sea is a wintering area for many seabirds and sea ducks that breed further east in the Russian Arctic. The Pechora Sea area and the southern Kara Sea lie adjacent to tundra and wetlands that are important breeding grounds for geese, ducks and shorebirds. Many of these use coastal habitats for staging during spring migration and after breeding when they prepare for the fall migration out of the Arctic.

The southern Barents Sea is a rich fisheries area with large stocks of cod, haddock, capelin, juvenile herring and shrimp. A major stock of polar cod spawns under ice in the Pechora Sea region, and this region is also the main wintering area for white whales of the Karskaya population that is migratory between the Barents, Kara and Laptev seas. The smaller White Sea beluga population has its wintering area in the Voronka and Gorlo area at the entrance to the White Sea. The Barents Sea harp seal population has its whelping and molting areas on the ice also at the entrance to the White Sea. The Novaya Zemlya population of Atlantic walrus has its wintering area in the pack ice in the Pechora Sea region. White whales and walrus migrate north in spring following lead systems west of Novaya Zemlya, and the white whales continue east through the northern Kara Sea and into the western Laptev Sea in early summer. There are two subpopulations of polar bears in the Barents and Kara seas with seasonal migrations following the ice.

There are no documented negative impacts on animals in this area from shipping activities. Accidental oil spills have occurred and have been associated with high local mortality of seabirds. However, these incidents have not had material impacts at the population level for the affected species. Ship strikes of whales could occur in some areas but there are no reports to suggest that the level of impact is significant. The greatest concern is the threat from accidental oil spills that could have a large impact on seabirds and other marine birds, and also on marine mammals such as polar bear and on spawning polar cod. If shipping activities increase in the future, potential disturbance of wintering marine mammals and ship strikes of whales will become a concern.

and black carbon emissions were found in the Bering Sea region, around Iceland, along the Norwegian coast and in the Barents Sea. There are also moderate emissions along the western coast of Greenland.

Potential Disturbances from Ships and Shipping Activity in the Arctic

Sound and Noise Disturbance

All vessels produce sound as a by-product of their operation. Typically, vessels produce low frequency sound from the operation of machinery onboard, hydrodynamic flow noise around the hull and from propeller cavitation, which is typically the dominant source of noise. The sound a vessel produces relates to many factors including size, speed, load, condition, age and engine type. The larger the vessel and/or the faster it is moving, the more noise it produces. Many vessels also employ hydroacoustic devices such as commercial sonar, echosounders, side scan sonar for navigation, depth finding, seafloor mapping or to detect biologics as a regular part of their operations. These types of devices produce short pulses and use frequencies ranging from low to high, depending on their utility.

For most marine vertebrates, making, hearing and processing sounds serve critical biological functions. These include communication, foraging, reproduction, navigation and predator-avoidance. In particular, toothed whales have developed sophisticated biosonar capabilities to help them feed and navigate; large baleen whales have developed long-range communication systems using sound in reproductive and social interaction; and pinnipeds (i.e., seals, sea lion, walrus, etc.) make and listen to sounds for critical communicative functions. Many fish utilize sounds in mating and other social interactions.

The introduction of noise into the environment can adversely affect the ability of marine life to use sound in various ways and can induce alteration of behavior; reduction of communication ranges for social interactions, foraging, and predator avoidance; and temporary or permanent compromise of the auditory or other systems. In extreme cases, too much noise can lead to habitat avoidance or even death. Noise can also affect physiological functions and cause more generalized stress. Determining when impacts of noise exposure from any source become biologically significant to a species is often difficult. Nevertheless, this is an area where additional research is ongoing and needed in key areas.

Many environmental effects resulting from ship disturbances can be effectively mitigated through the use of best practices and the implementation of management measures.

Where there is an overlap between potential noise sources and the frequencies of sound used by marine life, there is particular concern as to how sound sources can interfere with important biological functions. The predominately low frequency sounds associated with large vessels is similar to the general hearing sensitivity bandwidths of large whales and many fish species. The ambient noise environment in the Arctic is more complex and variable than in many other ocean areas due to the seasonal variability in ice cover. In addition to natural sources contributing to background levels, anthropogenic sources, like vessel traffic, can also have a profound impact on these levels. In most regions in the northern hemisphere, shipping noise is the dominant source of underwater noise below 300 hertz.

Many environmental effects resulting from ship disturbances can be effectively mitigated through the use of best practices and the implementation of management measures. With regard to noise disturbances, such measures could include rerouting to avoid some areas in sensitive periods, lower speed, and alternative engine and hull designs to make ships more silent. There may be a need to plan potential future shipping lanes in the Arctic so as to avoid large seabird colonies, marine mammal haul-outs and other areas where animals are aggregated. In late 2008, the IMO's Marine Environment Protection Committee (MEPC) formed a correspondence group that is now working to identify and address ways to minimize the introduction of incidental noise into the marine environment from commercial shipping in order to reduce the potential adverse impact on marine life. This group aims to develop non-mandatory technical guidelines for ship-quieting technologies, as well as potential navigation and operational practices for all IMO member states. This work will be aimed at the global shipping industry and is not likely to contain Arctic specific considerations.

Icebreakers and Disturbance

All icebreaking operations, whether by independent commercial icebreaking ships or government icebreaker escort, can potentially cause disturbances to wildlife and local communities both through the noise they create and the trail of open water left astern. Compared to other vessels, icebreakers produce louder and more variable sounds. This is because of the episodic nature of the icebreaking, which involves ramming forward into the ice and then reversing to begin the process again. Some icebreakers are equipped with bubbler systems to aid in clearing ice from the vessel's path and these can create an additional noise source. Noise from bubbler systems and propeller cavitation associated with icebreaker movement has the potential to alter animal behavior and to disrupt the hearing ability and vocalization of marine mammals.

Wildlife has been found to exhibit a range of behavior in the presence of icebreakers. For example, beluga whales were found to be aware of the icebreaker vessels presence at distances of more than 80 kilometers away, and exhibit strong avoidance response at 35 to 50 km away. However, narwhal whales were found to display only subtle responses to the same disturbance.

The opening of channels through the ice by icebreaking vessels can impact Arctic residents and alter animal behavior. Open water channels take time to freeze and this can disrupt the movements of animals and people over the ice. In many areas of the Arctic in winter, the only naturally occurring ice openings are polynyas caused by winds or ocean currents. Artificially opened water channels can be problematic for marine mammals and other species, which confuse them for polynyas and can get trapped too far from the ice edge as the channel eventually refreezes.

Vessel Strikes on Marine Mammals

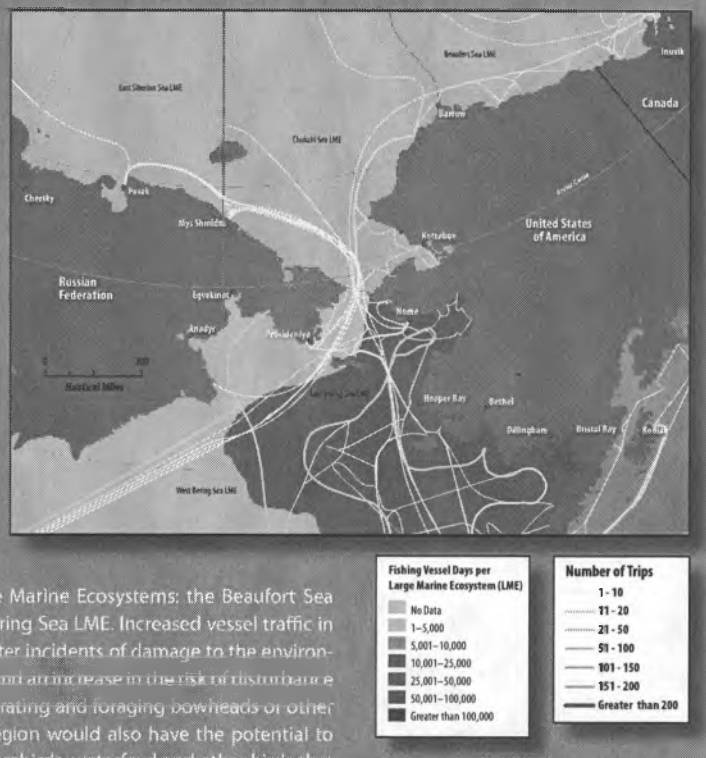
Vessel collisions, resulting in death or serious injury of marine mammals, are a threat to marine organisms worldwide. Vessel collisions or ship strikes occur mainly with large whale species, small cetaceans (i.e., dolphins, narwhal, beluga), marine turtles and sirenians (i.e., manatees, dugongs). Records indicate that nearly all large whale species are vulnerable to ship strikes. Vessel collisions with marine mammals can result in death, massive trauma, hemorrhaging, broken bones and propeller wounds.

Databases have been constructed which track the number of ship strikes occurring. These report more than 750 known cetacean vessel strikes through the world's oceans, including nearly 300 incidents involving large whales. Virtually all motorized vessel types, sizes and classes are represented in these databases. It should be noted, however, that any database will likely underestimate the number

Regional Environment Case Study

Bering Strait

Map 8.4 Bering Strait regional traffic and LME map. *Source: AMSA*



Current shipping activity in the Bering Strait and Chukchi Sea predominately comprises community re-supply and destinational traffic.

Traffic plying the Bering Strait, one of the narrowest sea lanes in the world, also traverses remote areas with difficult access for incident response, rescue and contaminant or debris cleanup. The U.S. Beaufort Sea coast has no port facilities or harbors suitable for refuge for medium to deep draft vessels and there are also very limited facilities on the Russian side of the strait. Given its restricted geographic nature, confounded by ice movement and strong ocean currents, the Bering Strait area is a major chokepoint for vessels transiting the region. The Aleutian Low creates persistent high winds and stormy conditions that elevate risk to vessels and cargo transiting the Aleutian and Commander islands area. These severe weather patterns may reduce the effectiveness of response to spills or other incidents.

This region includes four of the Arctic Large Marine Ecosystems: the Beaufort Sea LME, the Chukchi Sea LME, and East and West Bering Sea LME. Increased vessel traffic in the Beaufort and Chukchi seas may result in greater incidents of damage to the environment from ships, including pollutant discharges, and an increase in the risk of disturbance effects such as ship noise and ship strikes on migrating and foraging bowheads or other marine mammals. Any vessel incidents in this region would also have the potential to adversely affect major populations of nesting shorebirds, waterfowl and other birds that utilize breeding, nesting and foraging habitat along the coastal Beaufort and Chukchi seas and along the coast of western Alaska.

The eastern Bering Sea supports some of the largest commercial fisheries in the world. Increased vessel use of the eastern route that traverses the eastern Bering Sea may increase potentially adverse interactions with this region's rich fishery resources, fishing communities and hundreds of fishing vessels and support vessels. Spills due to accidental or illegal discharge from vessels could drift ashore to western Alaska areas where seasonal herring and salmon fisheries occur.

The Western Arctic stock of bowhead whales seasonally migrates through the Bering Strait, Chukchi and Beaufort seas. In the Bering Strait, they are physically constricted to a relatively small corridor, exposing them to increased interactions with vessels transiting this area during spring and fall. Bowhead whale migration could also potentially be disrupted by icebreakers. Whales could move further offshore following the open leads created by icebreaking vessels, putting them out of reach of coastal whaling communities. Any disruption of the spring and fall hunts, or any injury or mortality to bowheads would be considered a major issue to coastal Alaskan and Siberian communities.

Ice-dependent marine mammals in this region, such as polar bear, walrus and seals, already stressed due to sea ice retreat, may be at increased risk from any additional ship-sourced stressors or contamination, as populations will become increasingly concentrated around retreating sea ice.

Regional Environment Case Study

Canadian Arctic

For many years shipping has been the main link to the outside world for remote Arctic communities in Canada and yearly sealifts remain the key source of goods and necessities for many communities. Shipping in the Canadian Arctic has been occurring in a safe and relatively environmentally sustainable way for many years. This has been due to the historically low level of activity, as well as the regulatory restrictions that have been in place to protect Canadian Arctic waters from shipping since the 1970s in the form of the *Arctic Waters Pollution Prevention Act*. The types of shipping activity occurring in the Canadian Arctic during 2004 can be grouped into the following activities: community re-supply (i.e., tug-barge, cargo, fuel tankers), Canadian Coast Guard and research activity, cargo and re-supply support for resource development operations, cargo shipments in and out of the Port of Churchill and tourism.

The Canadian Arctic remains one of the last frontiers for natural resources and one of the last areas of relatively pristine wilderness on earth. It is a region with virtually no roads, no rail lines and where air services are infrequent and very costly. The lack of infrastructure and the extreme climate have, until recently, made this region uneconomical for large-scale resource development. Rising prices of oil, gas and other commodities and the changing climatic and geographic restraints may combine to allow significant and rapid increases in resource development

Map 8.5 Canadian Arctic regional traffic and LME map. *Source: AMSA*

activity in the Canadian Arctic which would lead to increased destinational shipping traffic in the region and intra-regional traffic. How this potential increase may impact the local environment is not known. However any increase in activity brings with it a corresponding increase in the risk of damage to the environment both from normal ship operations and accidents or emergencies. Due to the current relatively low levels of shipping activity occurring in the Canadian Arctic, any increase in activity in this region will be significant.

Currently four of the Arctic's 17 Large Marine Ecosystems occur in Canadian waters: Hudson Bay, Baffin Bay/Davis Strait, Arctic Archipelago and Beaufort Sea. The Canadian Arctic is home to a diverse range of wildlife that thrives across this variety of ecosystems. These populations are now under stress to varying degrees due to the changes occurring in the Arctic environment as a result of global climate change.

Areas that are vulnerable to new developments include wintering areas of bowhead and beluga in Hudson and Davis straits, spring migration routes for those whales into Hudson Bay and Foxe Basin and north into Lancaster Sound. Seabird breeding colonies and staging areas for migratory waterfowl and shorebirds occur in several locations throughout the region.

Specific adverse impacts associated with shipping activity that are of the most concern in the Canadian Arctic include the discharge of pollutants into the marine environment and the disruption or disturbance of migratory patterns of wildlife that would, in turn, impact indigenous hunting activity. In this region, icebreakers leave behind open water channels that may disrupt the movements of wildlife and people traveling on the ice. Icebreakers or other ships traveling through ice-covered waters where seals are whelping can impact nearby seals through flooding dens and wetting baby seals with their wakes. Marine mammals are known to congregate in shallow bays and migrate through the Canadian Arctic Archipelago. As shipping traffic increases in this region there will be increased potential for conflict between ships and marine mammals in narrow and geographically restrictive areas. Other ship impacts outlined in this section such as noise impacts, introduction of invasive species and ship emissions are also of concern.

of actual occurrences because many go either undetected or unreported. In some cases carcasses are found, but because injuries are internal or due to advanced decomposition, it may be difficult to determine cause of death. When large vessels are involved, the mariner may not be aware that a strike has occurred.

There are relatively few known incidents of Arctic or ice-adapted marine mammal species being involved in ship strikes. The relatively infrequent occurrence is a result of relatively lower vessel traffic in high latitudes as compared to major trading routes and human population centers in lower latitudes. However, of consideration is that certain Arctic species, such as the bowhead and Pacific right whale, have features that make them potentially vulnerable to ship strikes, particularly as vessel traffic increases in their waters. Arctic toothed whales, namely narwhals and beluga whales, are probably less vulnerable to ship strikes, given their greater maneuverability and social behavior that lends them to aggregating in large groups enhancing their detection. It should be noted, however, that records of roughly comparable mid-sized species such as pilot whales, killer whales and various species of beaked whales also appear in ship strike databases.

Vessel speed has been implicated as a key factor in the occurrence and severity of vessel strikes with large species. Several independent studies indicate that vessel speeds of 10-14 knots increase by one-half or greater the probability that a whale will survive a collision with a ship.

As vessel traffic increases in the Arctic, modifications to customary vessel operation in key cetacean aggregation areas or vessel speed restrictions can be an effective measure to mitigate potential impacts on vulnerable species such as bowhead whales and, to a lesser extent, narwhals, beluga whales and other Arctic marine organisms. Where feasible, vessel routing measures may also be applied in order for ships to avoid known cetacean aggregation areas. A number of steps have been taken by some states outside the Arctic region to reduce the threat of ship strikes to endangered large whale species, including shifting shipping lanes and applying to the IMO to establish a vessel "Area to be Avoided." The IMO's MEPC is currently working on development of a non-mandatory guidance document for minimizing the risk of ship strikes on cetaceans which will be aimed at the global maritime industry.

Light Disturbance

Birds of all species appear to be attracted to lights. This puts them at risk of collision with lighted structures. The attraction to light and resulting risk of collision varies depending on the weather, season and the age of the bird. The fall migration in the Arctic is

when most bird attraction and collision issues emerge, as young birds are traveling for the first time and inclement weather becomes more frequent. Light attraction of marine birds is not yet a significant issue in the Arctic. This is because most birds are in the Arctic in the summer months to breed, when there is little or no darkness; and most Arctic-breeding seabirds are diurnal and, therefore, less active at night.

Despite these factors, there are still risks. During the non-breeding period in ice-free waters and as the presence of lighted ships and structures increases, risks are heightened. A wide variety of nocturnal species nest in the North Pacific, especially in the Aleutian Islands. Storm-petrels are vulnerable in late summer and early fall, when hundreds have been known to pitch on a vessel during foggy conditions. These problems are not unique to the smaller nocturnal species. Common and king eiders, both large ducks, have collided with large shrimp vessels in waters off western Greenland, causing injury or death.

Research Opportunities

- Investigate the effects of ship noise and physical presence, including avoidance behavior on Arctic marine animals at the individual and population level. Such research would contribute to determining distances at which animals are disturbed from ships, the potential for ship strikes and assessment of the need for mitigation strategies if adverse effects are predicted.
- Complete regional modeling of ship emissions in order to investigate the current and potential impacts from these emissions along major routes and near key port regions in the Arctic. This will contribute to more accurate assessment of regional impacts on air quality, pollution, haze and visibility, and climate forcing due to the release and deposition of black carbon and other aerosols.
- Conduct baseline surveys of aquatic species in major recipient ports in the Arctic region and research the potential survival of species introduced through different vectors. Carry out a risk assessment of invasive species introduction under current international standards in order to determine the need for Arctic specific protections.
- Conduct further research on the transport, fate and effects of oil in ice-covered waters, and on technology, methods and procedures to clean-up and remove spilled oil to reduce environmental impacts.

Introduction of Invasive Species

The introduction and spread of alien invasive species is a serious problem that has ecological, economic, health and environmental impacts, including the loss of native biological diversity worldwide. Although the introduction of invasive species into the Arctic environment has been minimally studied, it is an issue that deserves further study in the context of a changing climate and potential increased shipping in the Arctic region.

The risk of introduction of invasive species will increase as shipping volume increases in this region. As with ship operations in non-Arctic areas, the threat of introduction comes from four sources: ballast water discharge, hull fouling, cargo operations and casualties or shipwrecks.

- **Ballast Water**
  The IMO's *International Convention for the Control and Management of Ships Ballast Water & Sediments* addresses ballast exchange and treatment. As of November 2008, 16 states including Norway, representing about 3.6 percent of the world's merchant shipping, have ratified this convention. Under the IMO convention standard, a small percentage of viable organisms will still be discharged.
- **Hull Fouling**
  In subarctic waters, transfer of aquatic invasive species on the hulls of ships has become a serious threat to the environment, rivaling ballast water discharge. However, hull coatings on ice-capable vessels may be effective antifouling agents, as would the scouring effects of passage through ice.
- **Cargo**
  Most international movements of goods are regulated by fumigation and biosecurity provisions to prevent the movement of invasive species in cargo. This is also applicable to the Arctic region. Much of the sealift and re-supply movements into the Arctic are palletized, increasing the potential for unwanted organisms to be entrained in the cargo.

MARPOL 73/78

Regular ship discharges are regulated through the IMO's *International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto*

- **Casualty**
  Ship accidents and sinkings can introduce invasive species into the local environment. As an example, shipwrecks in the Aleutians have caused significant ecological damage through the introduction of predatory rat species onto islands that have large aggregations of nesting seabirds.

Due to climate change and the potential increase in shipping activity, the introduction of invasive species may require more attention than it has received in the past. In particular, trans-Arctic shipping between the North Atlantic and North Pacific could potentially represent a vector for transfer of species in ballast water or on hulls to new areas where the environmental conditions resemble those in their home waters. Introduction of rodent species to islands harboring nesting seabirds, as evidenced in the Aleutian Islands, can be devastating. With limited baseline data on what species might actually be at risk from ship operations such as ballast water discharge, the use of the precautionary approach and proactive preventative actions are encouraged.

Green Ship Technology in the Arctic

Technology has a role to play in the mitigation of environmental impacts in the Arctic and elsewhere. Many of the potential impacts from shipping that have been discussed in this assessment can be effectively reduced or eliminated through the use of current or developing technologies, as well as best practices. Examples include stack scrubbers that remove harmful substances such as sulfur and black carbon from a ship's emissions; water treatment systems for sewage, bilge water, ballast water and other discharges; technologies that harness wind or solar power to reduce fuel consumption; or the use of cleaner fuels that emit less harmful substances when burned. Given the sensitivity of the Arctic environment and the potential impacts from shipping, the development and application of green ship technologies should be a priority. These new technologies can be expedited through industry incentives, such as the green ship technology fund in Norway; or regulatory requirements, such as the IMO *International Convention for the Control and Management of Ships Ballast Water & Sediments.*

Selendang Ayu Impact

On December 8, 2004, the cargo ship *M/V Selendang Ayu* lost power as it was transiting the North Pacific's Great Circle Route and eventually came ashore near Dutch Harbor in the Aleutian Islands, where it broke into two sections (See page 88). Operations to rescue the crew from the *Selendang Ayu* resulted in loss of life for both rescuers and crew, increasing the adverse effects of this incident. Despite removal and recovery efforts, the ship eventually discharged its cargo of 66 million metric tons of soybeans, an estimated 1.7 million liters of intermediate fuel oil, 55,564 liters of marine diesel and other contaminants into the environment.

For three weeks the weather delayed response to the environmental hazards of the incident. Strong winds, rough seas and the remoteness of the spill stalled the clean-up and search for oiled animals.

To study the impact of the spill on shorebirds, the U.S. Fish and Wildlife Service released 162 bird-size blocks of wood from the grounding site more than a month after the incident. The blocks helped determine where contaminated dead birds might have drifted. The exercise led to the immediate recovery of 29 oiled birds, 19 that were dead or dying and 10 that were recovered and released. During the course of the clean-up, 1,603 bird carcasses and six sea otter carcasses were recovered. Because of the delay in the recovery efforts, it is likely the number of wildlife impacted was greater. By mid-February 2005, 38,000 bags of oily solid waste had been reclaimed. The clean-up effort was ongoing until June 2006, and the long term impacts on local populations are yet to be fully assessed. This information was drawn from a recent U.S. Fish and Wildlife Service report on the incident.

Findings

1] From an environmental point of view, Arctic shipping poses a threat to the region's unique ecosystems. This threat can be effectively mitigated through careful planning and effective regulation in areas of high risk.

2] Release of oil into the Arctic marine environment, either through accidental release, or illegal discharge, is the most significant threat from shipping activity.

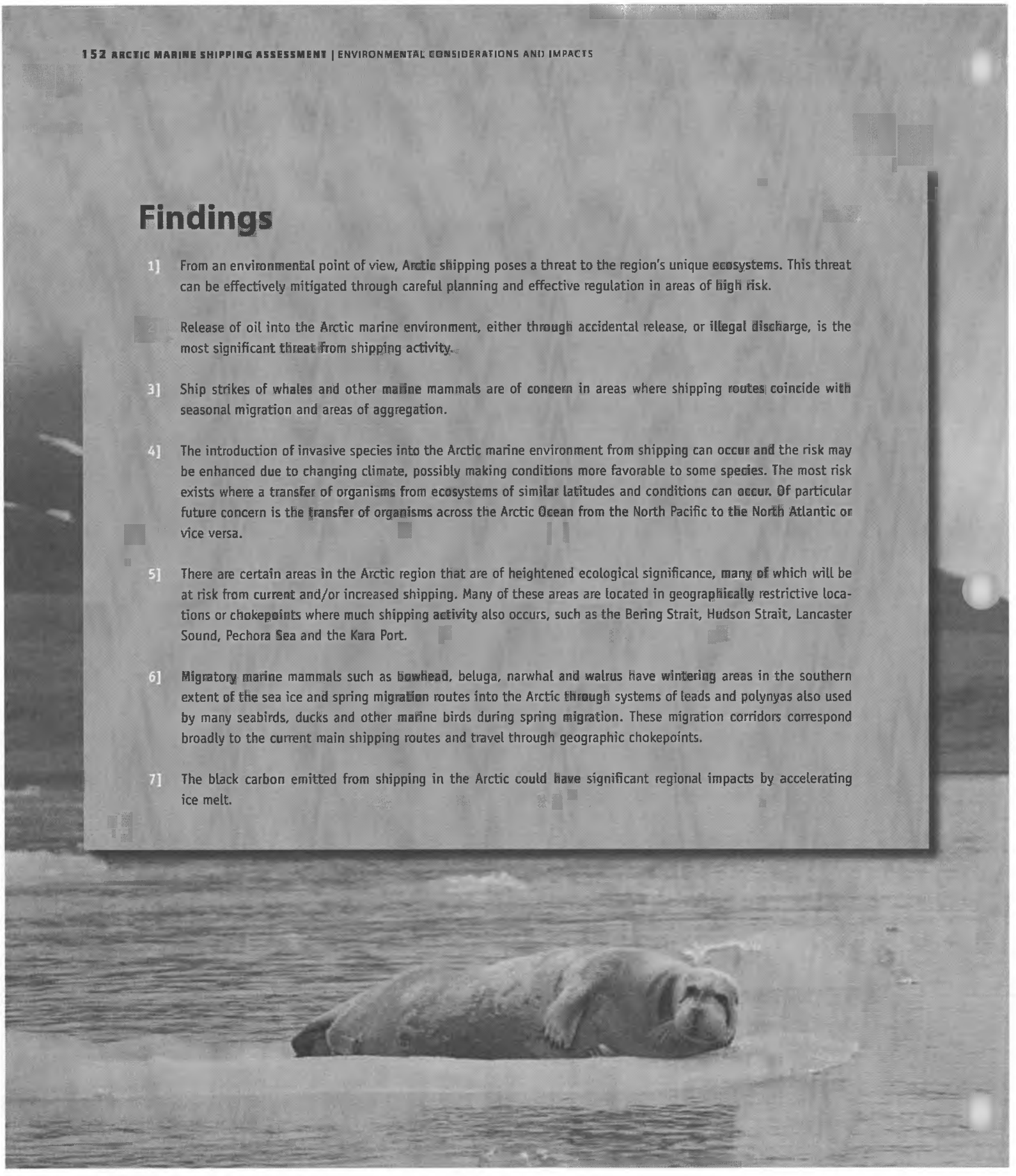
3] Ship strikes of whales and other marine mammals are of concern in areas where shipping routes coincide with seasonal migration and areas of aggregation.

4] The introduction of invasive species into the Arctic marine environment from shipping can occur and the risk may be enhanced due to changing climate, possibly making conditions more favorable to some species. The most risk exists where a transfer of organisms from ecosystems of similar latitudes and conditions can occur. Of particular future concern is the transfer of organisms across the Arctic Ocean from the North Pacific to the North Atlantic or vice versa.

5] There are certain areas in the Arctic region that are of heightened ecological significance, many of which will be at risk from current and/or increased shipping. Many of these areas are located in geographically restrictive locations or chokepoints where much shipping activity also occurs, such as the Bering Strait, Hudson Strait, Lancaster Sound, Pechora Sea and the Kara Port.

6] Migratory marine mammals such as bowhead, beluga, narwhal and walrus have wintering areas in the southern extent of the sea ice and spring migration routes into the Arctic through systems of leads and polynyas also used by many seabirds, ducks and other marine birds during spring migration. These migration corridors correspond broadly to the current main shipping routes and travel through geographic chokepoints.

7] The black carbon emitted from shipping in the Arctic could have significant regional impacts by accelerating ice melt.



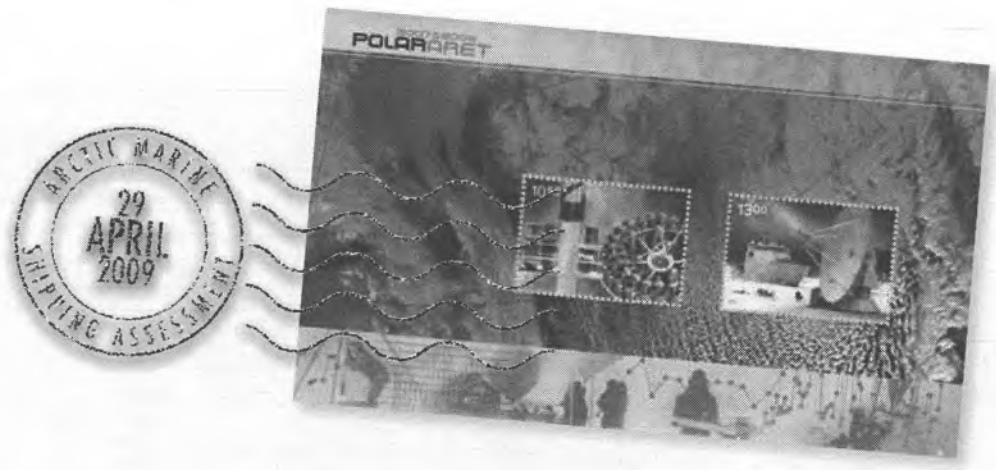
8] Ship emissions including greenhouse gases (GHGs), Nitrogen Oxides (NOx), Sulfur Oxides (SOx) and Particulate Matter (PM) may have negative effects on the Arctic environment and will increase in the Arctic region proportionately with increased shipping activity. Effective reduction of ship emissions can be achieved through the application of feasible and best available technologies, through air emissions reduction techniques and, most importantly, through effective implementation of relevant IMO regulations.

9] Sound is of vital biological importance to marine mammals and anthropogenic noise produced through shipping and other vessel activity can have various adverse effects on Arctic species.

10] Subarctic seas support some of the richest fisheries in the world in the Bering Sea and the Barents Sea. These two areas are also the location of the heaviest shipping traffic now occurring in the Arctic region. A potential accidental spill of oil or other hazardous and noxious substances in these areas could have large economic, social and environmental impacts.

11] Environmental effects on marine mammals, seabirds and fisheries from ship sourced disturbances, noise, or potential accidental/illegal release of oil and other hazardous and noxious substances may impact culturally and economically significant subsistence harvests of these animals.

12] The most immediate impacts of climate change in the Arctic will be the reduction of summer sea ice, longer open water seasons in the fall and the reduction of the year-round presence of multi-year ice. These changes may have far reaching implications for Arctic ecosystems and will also result in the lengthening of the current shipping season. Shipping in the future may be occurring much later into the fall and possibly earlier in the spring, thereby increasing the possibility of interaction between migrating and calving species and ships.



ARCTIC MARINE INFRASTRUCTURE

When compared with marine infrastructure in the world's other oceans, the Arctic is significantly lacking throughout most of the circumpolar north. The current increase in human activity in the Arctic is placing new demands on Arctic infrastructure needed to support safe marine shipping, protect the environment and respond to emergencies. Anticipated increases in Arctic marine shipping during the coming decades will place additional demands on infrastructure and require innovative, cooperative solutions that best use the limited resources available in this remote region.

The findings contained in this section are the result of extensive input received across a wide spectrum of interests from those experienced in Arctic marine operations, including representatives from the Arctic states. The analysis of current Arctic infrastructure included surveys based on information from the Arctic states regarding Arctic ports, capabilities for handling larger vessels, search and rescue assets and icebreaker capacity. In addition, an international workshop was held at the University of New Hampshire in March 2008 to consider infrastructure needs and gaps associated with emergency response to Arctic incidents. Workshop participants represented a broad spectrum of expertise including governmental agencies, industry, non-governmental organizations and indigenous people from the Arctic nations. The workshop, "Opening the Arctic Seas: Envisioning Disasters and Framing Solutions," considered five realistic emergency scenarios in diverse locations throughout the Arctic. Incidents envisioned involved vessels caught in ice or in a collision, oil spills, search and rescue, environmental damage and disruption of indigenous communities. The workshop report provides a qualitative analysis of risk factors for Arctic marine incidents likely to happen as shipping, tourism, exploration and development of natural resources such as oil, gas and minerals increase with the retreating ice cover (See page 176).

Major Arctic infrastructure themes emerged and are reflected throughout this section and its findings. Currently, vast areas of the Arctic have insufficient infrastructure to support safe marine shipping and respond to marine incidents in the Arctic. This includes such critical infrastructure components as the accuracy and availability of timely information needed for safe navigation; availability

of search and rescue assets, pollution response assets and supporting shoreside infrastructure to respond appropriately to marine incidents; port reception facilities for ship-generated waste; and availability of deepwater ports, places of refuge and salvage resources for vessels in distress. While there are notable exceptions, where infrastructure is more developed, they are the exception rather than the rule. To assist with ship navigation, locating refuges, pollution response and other activities, adequate weather forecasting and warning capabilities are essential and necessitate adequate observations, models and forecasts.

Emergency response is particularly challenging in the Arctic for a variety of reasons, including the remoteness and great distances that are often involved in responding; the impacts of cold, ice and a harsh operating environment on response personnel and equipment; and the lack of shoreside infrastructure and communications to support and sustain a response of any significant magnitude. Prevention of marine accidents, and actions designed to strengthen the effectiveness of preventive measures, are especially critical for Arctic marine shipping given the difficulties of responding once an incident has occurred. Preventive measures include ensuring that vessels operating in the Arctic meet appropriate design, construction and equipment standards; that vessel personnel have the specialized skills needed for operating in Arctic conditions, including operations in ice-infested waters where applicable; and that information needed for safe navigation is available, from accurate charts to timely information on meteorological and ice conditions and on other vessel traffic and activities in the area.

While there are many challenges associated with strengthening Arctic marine shipping infrastructure, there are also opportunities to develop measures to improve safe marine shipping operations and protect the Arctic environment in anticipation of the continuing increase in Arctic marine activity, rather than responding after an incident has occurred. Considering the long lead time to put marine infrastructure in place, this should be considered early in the prioritization process.

Systems Related to Safe Navigation

To the mariner, there are several environmental factors that make the Arctic uniquely difficult to navigate compared to temperate waters. These include: presence and movement of sea ice, icebergs, cold air and water temperatures, variable and often unpredictable severe weather, magnetic variation, solar flare activity and extended daylight or nighttime conditions. These environmental conditions, combined with the remoteness of the region from commercial shipping centers and shipping lanes, highlight the need for improved systems to support safe navigation in the Arctic region.

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Ship Name	Country of Ownership	Year Entered Service	Propulsion Plant*	Operations
ARKTIKA	Russian Federation	1975	N:75,000	NSR
ROSSIYA	Russian Federation	1985	N:75,000	NSR
SOVETSKIY SOYUZ	Russian Federation	1990	N:75,000	NSR; Arctic tourism
YAMAL	Russian Federation	1993	N:75,000	NSR; Arctic tourism
50 LET POBEDY	Russian Federation	2006	N:75,000	NSR
POLAR STAR	United States	1976	GT:60,000 DE:18,000	Arctic and Antarctic research and logistics
POLAR SEA	United States	1977	GT:60,000 DE:18,000	Arctic and Antarctic research and logistics
TAYMYR	Russian Federation	1989	N:47,600	NSR
VAYGACH	Russian Federation	1990	N:47,600	NSR
KRASIN	Russian Federation	1976	DE:36,000	NSR; Antarctic

Table 9.1 Ten most powerful icebreakers in the world. *Note: DE = Diesel-Electric; GT= Gas Turbine; N= Nuclear; NSR = Northern Sea Route.* Source: AMSA
* *shaft horse power*

Arctic Charting

Hydrography is the oldest science of the sea. The earliest explorers were often hydrographers and cartographers who recorded their discoveries on marine charts, sometimes to claim new territory, and always to ensure safe passage.

Modern marine charts are compiled from accurate hydrographic surveys conducted onboard specialized vessels equipped with echo sounders that measure water depths and satellite navigation systems, such as the Global Positioning System (GPS), that determine the geographic positions of these soundings. Numerous other sources of information are used in the creation of charts, such as shoreline location, details of navigational aids, place names, conspicuous land-based features, overhead cables and underwater pipelines. Data on navigational charts are also corrected for the movement of tides, such that the depth portrayed is normally the minimum the mariner will find under the keel. Expert information specialists combine all these various sources of data into navigational charts, taking extreme care to ensure the information is clear and accurate for use by mariners. The collection of the hydrographic data required and the process to produce a new navigational chart can often take years.

In light of the limited amount of marine traffic, the historical survey methods (ship-based and ice-based) and the significant costs and the volatility of the weather conditions, hydrographic surveys in the Arctic have not achieved the same level of coverage and quality as surveys in southern latitudes. As a result, Arctic charting base hydrographic data is not adequate in most areas to support current and future marine activities. This situation could improve if collection methods and platforms were developed that would be minimally affected by the Arctic conditions of weather, ice and isolation.

For hundreds of years, navigation at sea has relied upon the manual plotting of vessel location on traditional paper charts. Modern Electronic Chart Display and Information Systems (ECDIS), combined with satellite-based positioning, bring hydrographic data into onboard computers, greatly improving the navigation information available to the mariner and potentially reducing the reliance on traditional aids, such as floating buoys and fixed lights. Advances are also being made in consolidating information such as weather and ice conditions into electronic charting systems, further assisting mariners.

Recognizing the benefits of electronic charts, the International Maritime Organization (IMO) has proposed compulsory carriage of ECDIS and Electronic Navigational Charts (ENCs) on high speed craft from July 1, 2008 onward for all new craft and from July 1, 2010 onward for existing craft. In addition, IMO's Safety of Navigation Subcommittee has reached consensus to implement the mandatory carriage of ECDIS on new passenger ships above 500 gross tonnage by 2012, with a broadening of this requirement in subsequent years.

Arctic nations report various levels of ENC coverage for their northern waters (Maps 9.1, 9.2, 9.3). The presence of an ENC does not guarantee adequate information for safe navigation, however, as they are normally created using the same information available on traditional charts. As previously mentioned, the hydrographic data in many Arctic locations is either non-existent or in serious need of improvement.

10%

The portion of the Canadian Arctic that the Canadian Hydrographic Service says has been surveyed to modern standards.

Arctic Marine Infrastructure Terminology

For the purpose of this assessment, "infrastructure" is defined broadly to address all major aspects of marine shipping, including vessels and crews, the systems needed to gather and supply accurate and timely information for safe navigation and operations, the personnel and resources needed to respond to a variety of potential emergencies, port reception facilities for ship-generated waste and the shoreside facilities needed to provide supplies and logistics in support of marine shipping and emergency response. "Vessels" include tankers, passenger vessels (ferries, large and small cruise ships) and pleasure craft, bulk carriers, container ships, fishing vessels, tug and barge combinations, offshore supply vessels, research ships, icebreakers and other watercraft. "Officers and crew" includes vessel personnel with special expertise for operations in cold and ice-infested waters, such as ice navigators or ice pilots, and considers the training, experience and expertise required for all vessel personnel when confronting the unique challenges of Arctic marine operations. "Emergency response resources" include response assets such as aircraft, vessels and specialized equipment; the logistics and supply chains needed to support these operations both at sea and ashore; and the availability of related shoreside facilities and resources such as port, medical, refueling facilities and living quarters to accommodate emergency responders. "Shoreside facilities" include ports and port facilities, particularly ports with adequate depth to accommodate larger vessels, potential places of refuge, airports and shoreside transportation systems.

© United States Coast Guard

Increased Arctic activity, coupled with the difficulties in deploying and maintaining navigational aids in the region, presents an opportunity to implement ECDIS to improve navigation safety and save costs. The benefits of ECDIS, however, are wholly dependent on the underlying hydrographic navigational charts and consequently the hydrographic data on which they are based. Coverage of GPS, or other means of positioning, is also crucial to take full advantage of the system.

Canada, the United States, the Russian Federation and Denmark are carrying out charting activities that include portions of the Northern Sea Route and the Northwest Passage. These countries, as well as Iceland and Norway, are all member states of the International Hydrographic Organization (IHO) whose mission "is to facilitate the provision of adequate and timely hydrographic information for worldwide marine navigation."

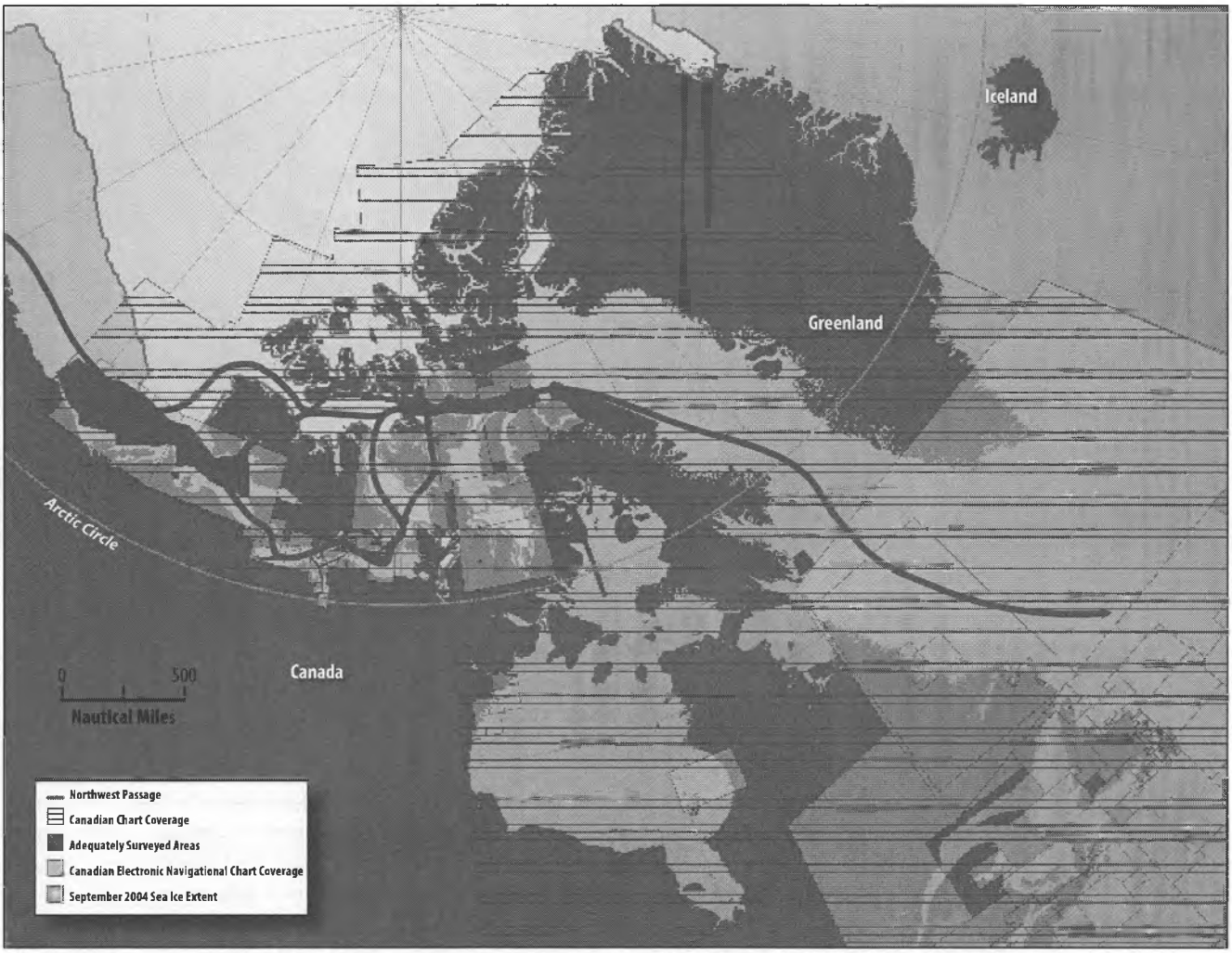
While there are published charts whose physical limits cover both the Canadian Northwest Passage and the Russian Northern Sea Route, the quality of the underlying data varies widely from modern, high resolution hydrographic surveys to no sounding information in some areas.

The quality and accuracy of navigational charts is entirely dependent on the hydrographic data used to compile them. Hydrographic surveys in the Arctic are logistically very complicated, expensive to undertake and highly dependent on weather and ice conditions. In addition, hydrographic offices normally prioritize their efforts based on a risk classification approach. Because the Arctic has traditionally seen smaller volumes of marine traffic, these risks have been perceived as low compared to other regions and progress in improving hydrographic coverage in the Arctic has been painstakingly slow.

IHO provides the current state of hydrographic surveys for member countries throughout the world. In Greenland, the limit for navigable waters has been set to 75 degrees northern latitude due to the permanent ice cover and the sparse population of its east coast. Within Canada, a high proportion of Arctic waters are inadequately surveyed or covered by frontier surveys only. A similar situation exists in the Russian Federation where ice conditions have precluded the systematic survey of the central parts of the Laptev and East Siberian seas. Only passage sounding

1933

The year the Russian Federal State Unitary "Hydrographic Enterprise" began conducting surveys.



Map 9.1 Canadian charting and survey status. *Source: AMSA*

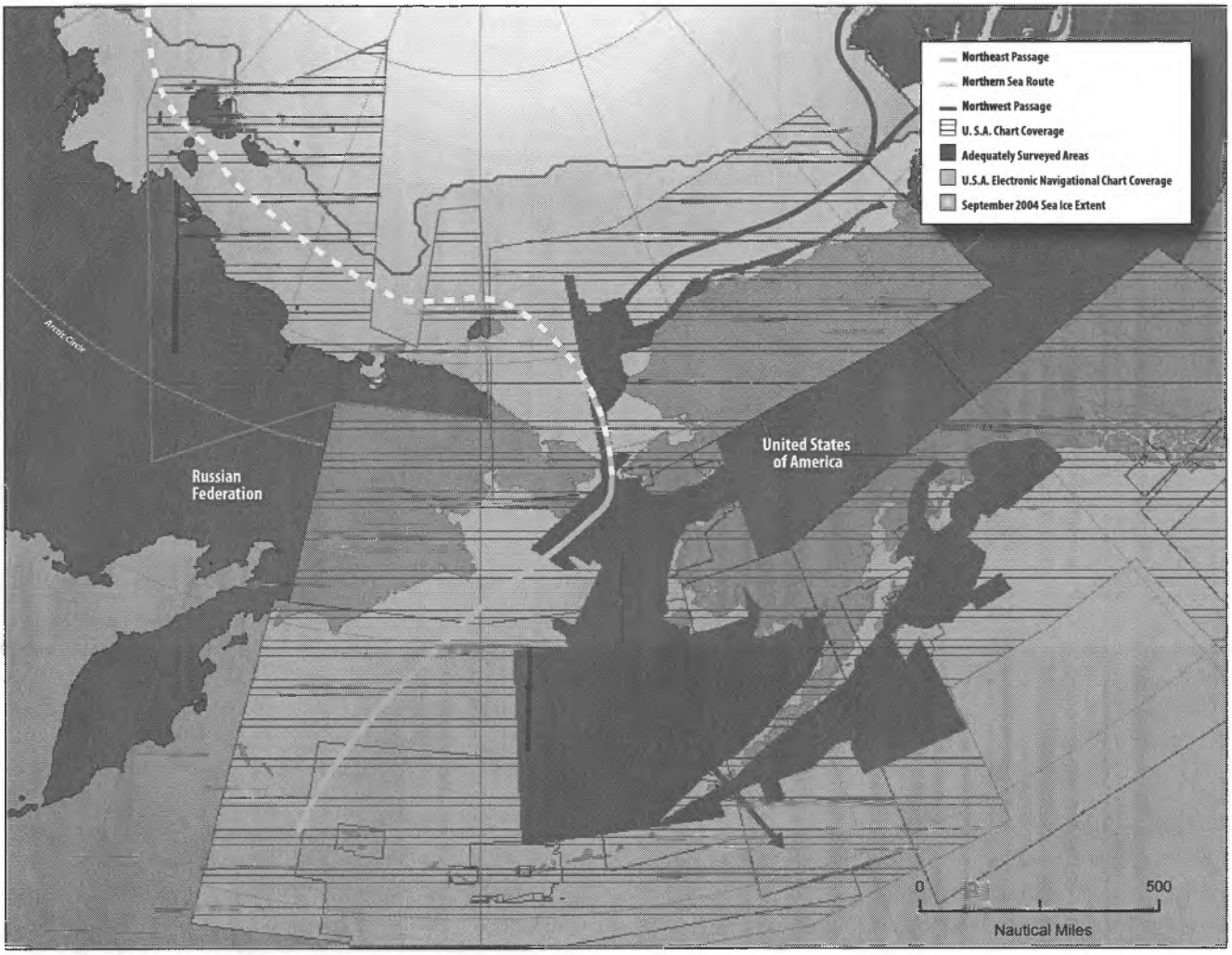
data is available for the deep water areas of the Sea of Okhotsk and the Bering Sea. The following figures illustrate the status of individual countries.

The Canadian Hydrographic Service reports that 10 percent of the Canadian Arctic has been surveyed to modern standards (Map 9.1). Coverage is often minimal and collected using rudimentary equipment and methods.

Surveys of the U.S. Arctic have been predominately along the northern coast of Alaska (Map 9.2).

The Russian Federal State Unitary "Hydrographic Enterprise" (SHD), formerly known as the Hydrographic Department, has conducted surveys since 1933. For the main areas of the Arctic shelf that cover 90 percent of the traditional navigation routes, detailed underwater topography is available (Map 9.3). Coastal surveys are completed for the Chukchi Sea, the East Siberian Sea, the Kara Sea, the navigable part of the Gulf of Ob', the shipping channel of the Yenisei River up to the port of Igarka, the shipping channel of the Khatanga and Kolyma rivers and the entrance of the Bykovsky waterway from the sea to the delta of the Lena River.

The SHD has set modern standards for Russian hydrographic surveys that recommend survey methods to ensure the detection of all



Map 9.2 U.S. charting and status of surveys in the Arctic. *Source: AMSA*

underwater obstacles on routes of intense navigation. To meet these modern standards, charts will need to be updated and, in the near future, an appreciable amount of work will have to be done. This includes detailed surveys of recommended shipping routes, harborages and anchorages for cargo operations using an instrumental area survey by special hydrographic equipment; regular measurement in areas not yet surveyed or surveyed with poor accuracy and details; and regular measurements in regions that are difficult to access because of ice conditions.

As mariners traverse the waters of nations around the world, they must be able to reliably interpret hydrographic products, independent of the country of origin. By becoming members of the International Hydrographic Organization, hydrographic offices agree to achieve uniformity in data quality and presentation standards. The emergence of digital products, most importantly electronic charts, has introduced a new aspect to the dissemination of hydrographic data. While a convergence of data sharing approaches is underway, significant inconsistencies remain. The Arctic provides an excellent opportunity to demonstrate the benefits of an open approach to data sharing in the international hydrographic community.

Sea ice is what sets the Arctic apart - what makes navigation in the Arctic especially unique and hazardous.

© German Shipowners' Association

Ice Information in the Arctic

Without sea ice, the needs for environmental information in the Arctic would be little different from the world's other oceans - wind and weather, waves, tides, currents, etc. Sea ice is what sets the Arctic apart - what makes navigation in the Arctic especially unique and hazardous.

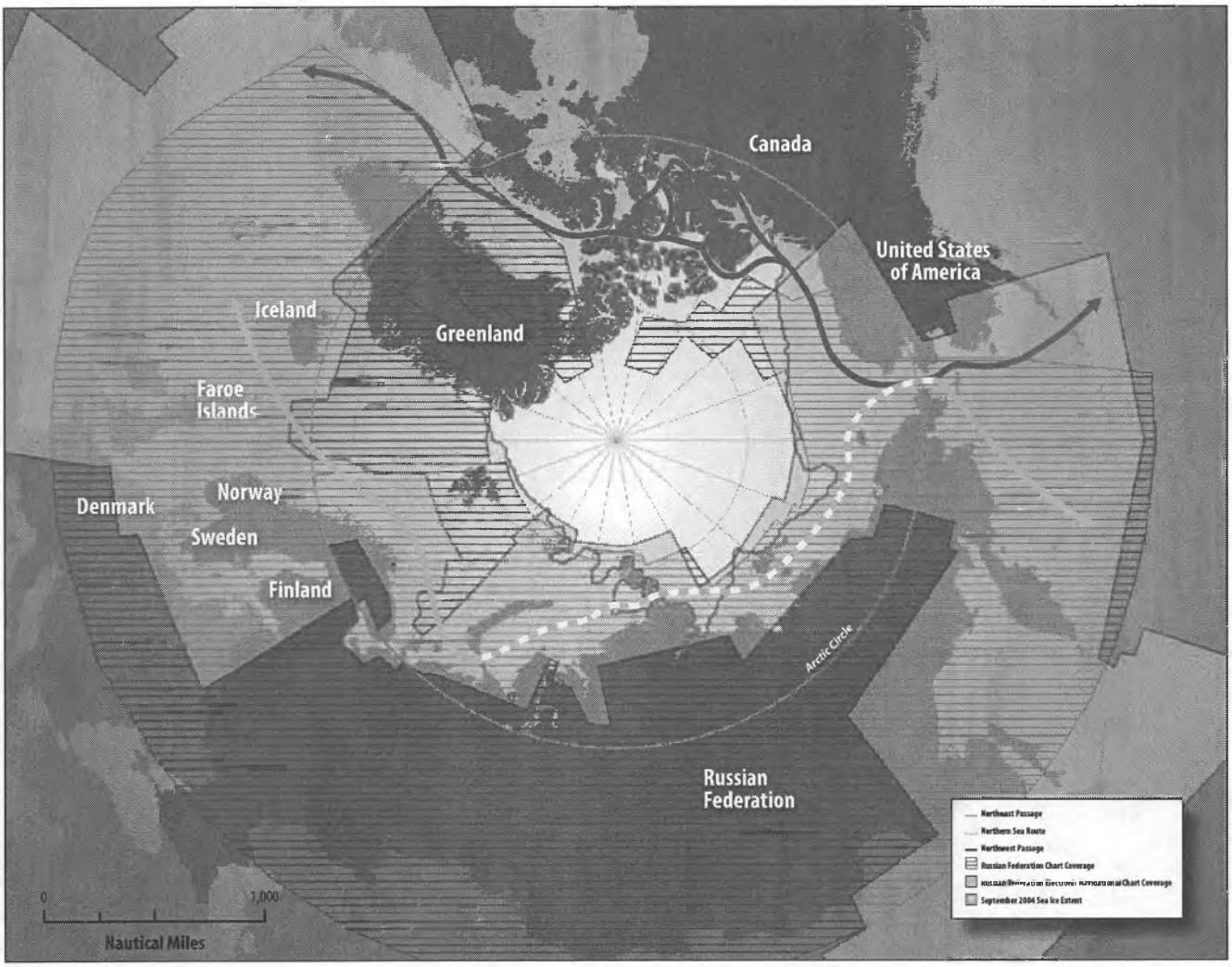
Sea ice in the Arctic has an annual cycle of freeze and melting that will not change in the future. When the sun goes down in the autumn and the extreme cold arrives, the ocean freezes. March is the month of maximum ice coverage. Through the summer months, the ice melts and retreats to a minimum extent in September.

It is generally agreed that the reduction in the thickness and extent of Arctic sea ice will continue into the future until, eventually, the Arctic will become free of sea ice in summer - much like the Baltic Sea, Sea of Okhotsk or the waters off the east coast of Canada. However, this will not eliminate the hazard that ice presents to Arctic shipping. There will still be a winter ice cover and significant inter-annual variability means that not all of the ice will melt every year, so scattered old ice floes will hide in the pack ice along with icebergs and ice island fragments. Moving ice driven by winds and currents will create a dynamic and hazardous operating environment. Variability in the onset of autumn freeze-up will present the risk of getting trapped in the Arctic over winter. Spring break-up to mark the start of summer navigation will vary and, as happens now in more southerly seas, shippers eager to start work will test the limits of their vessels in ice.

As more ships venture into the Arctic, the demand for ice information, as well as other ocean data, products and services, will continue to increase and the resources available to meet this increased demand will be stretched. The ice parameters needed in the future will not change significantly but will be required over larger geographic areas and longer periods of the year. Operators will still need to know where the ice is and isn't; where it's going to be, how closely packed it is and how thick and strong it is; generally, how difficult it will be to go around or, when necessary, go through. These parameters will be needed on a variety of space and time scales - from the hemispheric to the local, from months and weeks to daily or even hourly - to support tactical and strategic route planning for ships, scientific study and the development of policy and regulations to ensure safe marine practices.

The needs of mariners for ice information are currently met by a number of organizations, including national ice services that produce information for the Arctic that is generally freely available as a public service funded by tax-payers; academic institutions that provide ice information as part of an ongoing research program or to support field research campaigns; and commercial ice information services that provide services that are specific to individual clients with particular needs. As more ships venture into the Arctic and the demand for ice information and related services increases, there will be increasing pressure on the resources of ice information providers.

The national ice services collaborate in the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology Expert Team on Sea Ice, the body that establishes and maintains the standards for ice information internationally; and in the International Ice Charting Working Group (IICWG), an ad hoc group



Map 9.3 Russian Federation chart and ENC coverage of the Northern Sea Route. *Source: AMSA*

that coordinates ice information services internationally and advises the Expert Team on Sea Ice. As a result of this collaboration, there is an internationally accepted nomenclature for ice in the ocean, common charting and coding practices and cooperative information sharing among the ice services.

Ice information products include ice charts depicting the distribution and characteristics of the sea ice in an area; satellite images of ice-infested waters, often with interpretative text added; and text messages describing ice conditions. There is a wide range of scales for these products - from hemispheric charts that are useful for long-range planning to the navigation scale to support tactical vessel movements.

It is certain that the needs for ice information will evolve as more Arctic shipping develops. It is impossible to predict exactly how that evolution will occur because it depends on many factors - how the ice distribution itself changes, where resources are found, what markets are developed, advances in ship design and improving technology to observe, produce and disseminate ice information. The following examples are intended to provide illustrations of the particular ice information needs for some probable scenarios.

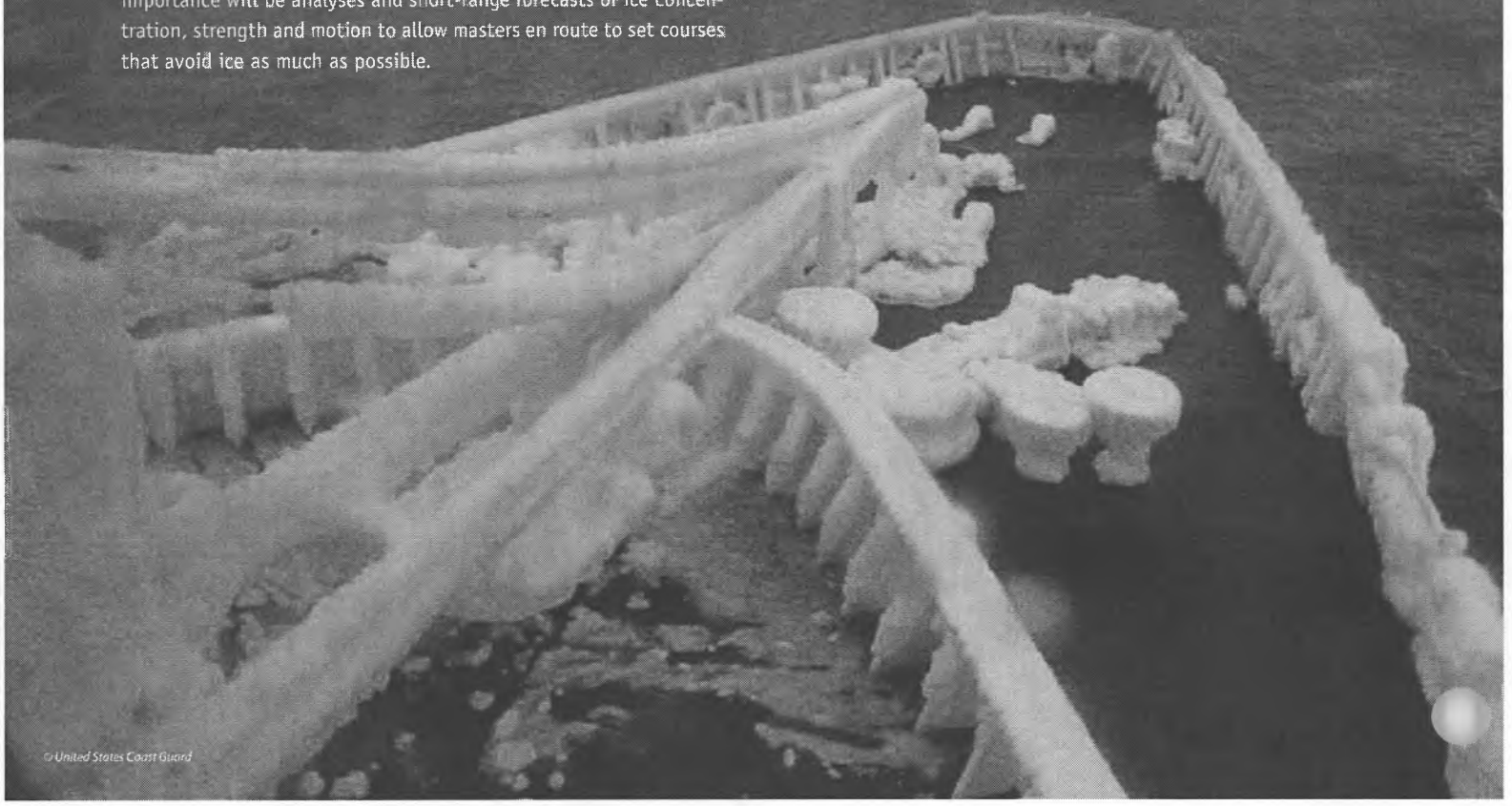
Potential shipping routes for extracting resources - principally oil, gas and minerals - will primarily be along shortest distance lines from the production sites to markets. It is likely the vessels used in this trade will be purpose-built for the trade in question and will operate year-round. They will be ice-strengthened and powered sufficiently to handle the most severe ice conditions encountered along the route. Ice information of most importance to these vessels will be that which can help them reduce time and fuel consumption en route as well as minimize the risks and delays that can be caused by difficult ice conditions around loading docks and piers.

Arctic transit shipping, using the Arctic Ocean as a short cut between Atlantic and Pacific, is not expected to become common because of the seasonal nature of the ice cover. Vessels designed to reliably pass through the winter Arctic ice cover will be greatly disadvantaged economically during the ice-free season. If transit shipping does occur in the Arctic, it will likely be limited to the summer season. These vessels will have some ice-strengthening to handle summer Arctic ice encounters but will not be able to deal with winter conditions. The most important ice information for this trade will be medium- and long-range forecasts of break-up and freeze-up to help companies decide when to head for the Arctic and when to get out in order to avoid being trapped over a winter. Close in the order of importance will be analyses and short-range forecasts of ice concentration, strength and motion to allow masters en route to set courses that avoid ice as much as possible.

Marine Weather Information for the Arctic

Modern weather information, including information for shipping, is based on numerical models. Numerical weather prediction analyses and forecasts are available for the Arctic from all of the major meteorological centers that run global models. States having the need for more detailed information for the Arctic areas have implemented high resolution models covering the Arctic region according to their needs.

In addition, Arctic coastal states provide marine weather information for their coastal waters. In most cases information for shipping is issued for large areas extending well offshore. Within the coverage of INMARSAT Global Maritime Distress Safety System transmissions, marine safety information in the form of gale and storm warnings is in place consistent with all other high sea areas in the world. However, no responsibility has yet been assigned for the high seas regions of the Arctic outside the coverage of INMARSAT, although an initiative is underway to do so by the World Meteorological Organization. Several states have offered to issue and/or prepare weather information for the Arctic. Progress in this initiative is expected and routine weather bulletins for the high Arctic areas may be in place in a few years. Prediction of the development and paths of lows giving rise to high winds is of particular concern for Arctic shipping. Accurate



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forecasts of sea ice, wave height, wind direction and speed, visibility, temperature and superstructure icing are the most important routine forecast parameters for shipping - with at least the same accuracy and timeliness requirements as on the other oceans.

Although weather forecasts for the Arctic are based on the same tools using the same techniques as in other areas of the world, the scarcity of observations in the Arctic makes the monitoring of the weather more difficult than in areas with more observations. Meteorological observations in the Arctic rely on drifting buoys placed on top of the sea ice. A new generation of buoys that will withstand multiple freeze-thaw cycles is currently under development and is urgently needed to provide surface observations in the Arctic Ocean. The ability to measure the conditions of the atmosphere and ocean from satellites is, however, developing rapidly and, with adequate surface validation, the quality of weather forecasts will approach the quality used in other areas.

The future increase in human activity in the Arctic, including Arctic marine shipping and the continued overflight of the Arctic region by commercial aircraft, will place increasing demands on the SAR infrastructure.

Wave Information for the Arctic

Because of the ubiquitous presence of sea ice, waves have not been a major navigational hazard in the Arctic. However, with less sea ice to dampen the waves, this will no longer be the case in the future. Wave information is typically packaged along with marine weather information in sea ice-free areas. New operational modeling capability will be needed to deal with a partial ice cover and its effect on wave generation and transmission. Buoys that measure the wave heights and directions are essential for model validation but none of these exist in the Arctic for operational reporting. Because of the necessity to deal with winter ice, a new generation of buoys will have to be developed.

Marine Aids to Navigation

The safe and effective use of northern waters by maritime shipping relies heavily on such safety systems as fixed and floating aids to navigation, long-range aids to navigation (shore-based electronic or satellite-based), as well as safety and navigation information broadcasts. While southern waters and well-used maritime routes are well served by established systems, northern waters are served by a patchwork of these systems. Ships navigating in the Arctic encounter unique situations. Ships usually use a combination of satellite positioning and traditional navigation techniques.

Of the eight circumpolar countries, six have coastlines. Of these, Canada, Denmark, Norway, Iceland and the Russian Federation maintain active aids to navigation (ATON) networks. More specifically: The Canadian Coast Guard maintains a number of seasonal fixed and floating aids throughout the Canadian Arctic. These are placed around the last week in June by icebreakers in Ungava Bay, Hudson Strait, Frobisher Bay and in the western Arctic by the third week in July. There is an active aids program along the Mackenzie River, serviced by two CCG shallow draft tenders. These aids are then picked up and the fixed aids deactivated as the icebreakers leave the Arctic, generally by the last week in October.

Norway maintains aids to navigation along its entire coast and at Svalbard along the coast and in fjords. Of note are a number of fixed and floating aids to navigation in Svalbard internal waters. It is expected that the requirement for aids to navigation in the Svalbard area will increase based on analyses of both the changing traffic patterns and the utilization of better risk analysis methodology.

Denmark has a permanent system of radio communication and radar beacons (RACON) along the west coast of Greenland from Uummannarsuaq/Kap Farvel to Qeqertarsuup Tunual/Diskobugten, as well as a system of coastal fixed aids, such as daymarks, from Uummannarsuaq/Kap Farvel to Upernavik.

Iceland maintains a number of fixed and floating aids to navigation in its internal waters including a Digital Global Positioning System and RACON beacons and has a permanent system of radio communication for radio monitoring of its fishing fleet.

The Russian Federation has an extensive system of fixed and floating aids to navigation mainly in the harbors of the NSR, which also includes some lighted and unlighted beacons and daymarks along the coast between ports.

The United States has no aids to navigation along the north coast of Alaska. The current U.S. short-range ATON footprint in the

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Arctic extends a short distance north of the Bering Strait where the largest zinc mine in the world (Cominco's Red Dog mine) near Kivalina receives ore carriers. North of the Aleutians along the coast of the Bering Sea, the U.S. has some floating and fixed ATON near the Pribilof Islands and Bristol Bay for tug, barge and fishing vessel traffic. In the Aleutian chain, there are several areas where navigational aids are maintained for local traffic, as well as for the trans-Pacific shipping transiting this region.

Marine Communications, Traffic Monitoring and Control

The historical standard for communicating weather, wave and ice information to ships at sea is the radio facsimile broadcast. While its use is being eclipsed world-wide by digital communications, the analogue radio broadcast remains an important source of information in the Arctic. Radio stations in the United States, Canada, the United Kingdom, Denmark, Germany and the Russian Federation broadcast analysis and forecast charts for sea ice, icebergs, sea state and weather, as well as providing vessel traffic services and general marine communications.

Norway has established a very advanced system composed of Automatic Identification System (AIS) and Maritime Communications and Traffic Services along the Arctic coast. In January 2007, a Vessel Traffic Service (VTS) for the coast of northern Norway was established in Vardø, operated by the Norwegian Coastal Administration (NCA). The service is designed to monitor and guide vessels, to promote safe and efficient navigation, and to protect the marine environment against undesired events in the Barents Sea and along the Norwegian coast. The area of operation for Vardø VTS Center is the Norwegian Economic Zone (NEZ) outside the baseline, the area around Svalbard and the area outside Tromsø and Finnmark in northern Norway. The VTS Center interacts with vessels, other government agencies, the NCA duty team that is responsible for national response and with the Norwegian SAR for search and rescue services. The administration also coordinates, on a daily basis, the tugboat preparedness in North Norway in conjunction with Regional Headquarters North-Norway (Norwegian Armed Forces) and the NCA duty team.

The United States marine communications infrastructure in Alaska is concentrated where vessels operate the most. There is excellent very high frequency (VHF) coverage throughout southeast Alaska and into portions of the Bering Sea north to St. Paul and the Bristol Bay area. North of this region there is local VHF coverage at Nome, Kotzebue and Barrow. Barrow and Kotzebue, both north of the Bering Strait, also have high frequency (HF) NOAA radios. Mariners in these areas can speak directly to a weather expert via HF radio. Outside of VHF marine coverage, the U.S. Coast Guard relies on high frequency or satellite communications. Canada operates a seasonal system, while the Russian Federation is planning to augment their existing service during the next two years with further investment up to the 2020 timeframe. The Danish Navy operates a year-round high frequency radio station on the southwest coast of Greenland and maintains the IMO mandatory ship reporting system, GREENPOS, for all ships on voyage to or from Greenland ports and places of call. Furthermore, Denmark maintains a number of stations with limited communications capabilities in the south/southeast and lower western half of Greenland. Iceland has an advanced system of AIS along its coast with 23 base stations and repeaters with total coverage of the coastline. The maritime radio system has recently been renewed in VHF, MF (medium frequency) and HF bands and two new NAVTEX stations have been established. The traffic monitoring is carried out by the Maritime Traffic Service in Reykjavik operated by the Icelandic Coast Guard.

Communications using VHF, MF and HF as well as satellite are generally sufficient for the lower Arctic areas (Hudson Bay, Foxe Basin, southern Greenland waters and waters of the Northern Sea Route); however, once the high Arctic is reached, voice and data transmission become problematic.

Most modern ships are equipped with satellite digital communications equipment - not only for safety reasons but for the management and navigation of the ship. This equipment relies on geostationary INMARSAT satellites that do not provide service northward of about 80° N latitude. Other systems, such as the IRIDIUM constellation of 66 polar orbiting satellites, provide worldwide coverage including the Arctic. IRIDIUM is capable of providing a Ship Safety and Alerting System that meets IMO requirements but its data transfer rates are very low (less than 9.6 kb/s). The feasibility of communicating ice charts and satellite images to ships in the Arctic via the IRIDIUM system has been demonstrated but communications are limited and often interrupted. Other regional systems such as the Mobile Satellite System (MSAT) offer limited voice and data transfer capability only in North America including the Canadian Arctic Archipelago.

Improvements in capacity and reductions in cost are necessary for IRIDIUM and other regional systems to become a practical, widespread solution for the Arctic not only for voice, but more importantly for data transmission. The Russian Federation has been using communication satellites in highly elliptical orbits that provide long residence time over the Arctic ("Molniya" orbits) for television and other communications needs for several decades and, in 2007, pledged to improve radio and telecommunications in the Arctic.

It should be noted that the Canadian government has initiated a "Polar Communications and Weather space mission for Canada's North," (PCW) which is planning to provide robust 24/7 two-way satellite communications capability to all of the Canadian north for rapid high rate data transmission and information products, as well as low-data rate communications capability and also near-real time meteorological information products about the north to users throughout Canada.

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Various maritime training institutions are developing, or have developed, ice navigation courses, employing full mission bridge simulators and associated software products.

Norway is in dialogue with the United Kingdom, Denmark (Greenland), Faroe Islands and Iceland with regard to establishing a regional North Atlantic AIS/VTMIS (Vessel and Traffic Monitoring and Information System). The system is planned to be in force in 2009, and will facilitate the implementation of Article 9 of the Directive 2002/59 and the establishment of the SafeSeaNet Tracking Identification Relay and Exchange System (STIRES) as presented in the STIRES study (Saab AB, PM PM 374185).

Satellites and aerial surveillance systems can improve monitoring capability and serve to improve compliance with state regulations such as those intended for pollution prevention, or traffic reporting schemes that consequently can help in protecting the environment. As shipping increases in the Arctic regions, the requirement for improved voice and data transmission coverage becomes paramount.

Personnel and Maritime Training

Considering the Arctic operational environment and the lack of infrastructure, safe navigation in the Arctic is often dependent on the skills of a limited number of seasoned northern mariners. The Arctic offers significant navigational challenges, especially to the uninitiated. For decades, safe navigation has rested in the hands of a small number of experienced officers in a few countries. Their training has mostly been on-the-job with relatively little in the way of formal ice navigation education except within the limited regular navigation curriculum. With increased shipping in the Arctic, the need for skilled mariners will increase. Earlier melt periods and later freeze-ups will allow a greater amount of multi-year ice and ice of land origin (iceberg fragments such as growlers and smaller pieces called bergy bits) into the shipping lanes of the Northern Sea Route and the Northwest Passage, as well as in Greenland waters. It should be noted that less ice does not mean less danger. Understanding of the special conditions influencing navigation in the Arctic is crucial to the maintenance of a safe shipping regime.

The IMO's *Guidelines for Ships Operating in Arctic Ice-covered Waters* and the *International Convention on Standards of Training, Certification and Watchkeeping of Seafarers* (STCW '95) call for specialized training for mariners in Arctic waters. The guidelines define an ice navigator as "any individual who, in addition to being qualified under the STCW Convention, is especially trained and otherwise qualified to direct the movement of a ship in ice-covered waters. It also states: "The Ice Navigator should have documentary evidence of having satisfactorily completed an approved training program in ice navigation. Such a training program should provide [the] knowledge, [the] understanding and proficiency required for operating a ship in Arctic ice-covered waters, including recognition of ice formation and characteristics; ice indications; ice maneuvering; use of ice forecasts, atlases and codes; hull stress caused by ice; ice escort operations; ice-breaking operations and effect of ice accretion on vessel stability." It also provides guidelines for companies operating in Arctic ice-covered waters to develop a training manual, including the development and inclusion of drills and emergency instructions, emphasizing changes to standard procedures made necessary by operations in Arctic ice-covered waters. These drills and emergency instructions would be incorporated into the routine vessel operational training.

The STCW includes mandatory training requirements for passage planning and ice navigation in ice-covered waters. This section also authorizes the use of approved training simulators to achieve the stated training requirements. The concept of an officer experienced in navigation in ice, as well as the qualifications required, forms part of various national legislation and rules among northern countries such as the Canadian *Arctic Waters Pollution Prevention Act* and its associated regulations: the *Joint Industry Coast Guard Guidelines* for the control and operation of oil tankers and bulk chemical carriers in ice control zones of Eastern Canada.

The Russian Federation has a modern Arctic maritime training regime concentrated in the following marine educational centers: the Admiral Makarov State Maritime Academy in St. Petersburg; the Admiral Nevelskoy Far East State Maritime Academy in Vladivostok; the regional center of continuing professional education at the Captain Voronin Maritime College in Arkhangelsk; the "MARSTAR" Academy in St. Petersburg; and the Primorsk Shipping Corporation training Center in Nakhodka.

These centers train prospective Arctic navigators using the "Preparation for Navigation in Ice Conditions" course developed by the Makharov Training Center. These courses are designed around three subdivisions: theoretical training, simulator training and practical training onboard a vessel. The courses follow the requirements

As more ships venture into the Arctic, the demand for ice information, as well as other ocean data, products and services, will continue to increase and the resources available to meet this increased demand will be stretched.

expressed in the IMO STCW 78/95 Requirements; the IMO's *Guidelines for Ships Operating in Arctic Ice-covered Waters* and finally those specified by the Russian *Rules of Navigation on the Seaways of the Northern Sea Route.*

The course trains officers in all aspects of operations in ice-covered waters, through theoretical and simulator-based training including: the preparation and planning for voyages in ice-covered waters; operating, navigating, maneuvering and escorting ships in Arctic ice-covered waters, including recognition of ice formation and its characteristics; features of maneuvering in ice of different density and thickness; communication between cargo vessels and icebreakers; and familiarization with emergency and search and rescue operations.

The prospective navigator must follow a practical regime composed of two phases that reinforces the theoretical and simulated aspects of the training already received, as well as knowledge passed on from more experienced operational personnel. These include practical navigation training where the student is taken onboard as a bridge officer trainee and is supervised by the navigating officers; and practical deck training where the student is taken onboard as a regular member of the ship's crew and studies features of ice operations from their point of view.

Certification of Ships' Officers and Crew

Maritime administrations around the globe are tasked with the certification process, which is linked to the maritime licensing programs for most countries. Several areas, such as vessel security officers, radar navigation and pilotage, have been fully addressed with special endorsements on individual licenses. Certification for tanker operations, vessel classification, vessel design and equipment for vessels operating in ice-covered waters has been established. Several regulations address oil spill response and environmental issues.

Various maritime training institutions are developing, or have developed, ice navigation courses, employing full mission bridge simulators and associated software products. The IMO has created a program of model training to assist institutions developing ice navigation courses with an emphasis on meeting STCW requirements. Several countries have instituted courses, including Finland and the Russian Federation, for the Baltic region, as well as Norway and Argentina. Canada has developed a model course using a simulator at the Marine Institute in St. John's, Newfoundland. While these classes begin to address the deficit in standardized ice navigation training, international harmonization is still necessary in order to provide the next generation of qualified northern navigators.

Incident Response and Capacity

As marine activity continues to expand in the Arctic, statistical trends indicate that the potential risk of vessel mishaps and marine pollution incidents also increases. The inherent navigational and environmental hazards and limited number of experienced personnel, combined with Arctic ecosystem sensitivity, heightens the need for greater incident response capacity and preparedness. It is important to learn, as soon as possible, what has been spilled, where and when in order to address it in an appropriate manner.

Protection of the Environment: Oil and Other Hazardous Spills Response

Marine incident prevention is based upon addressing four conditions that may result in pollution incidents:

- human error or failure caused by fatigue, malfeasance, unfamiliarity or other conditions either exclusively or in conjunction with each other;
- lack of operational readiness and preparedness caused by marginal or unprepared ship or crews;
- older vessel or vessel operating outside of operation parameters; and
- Arctic climate and situational unknowns caused by less predictable or rapidly changing weather, ice conditions, iceberg awareness or failure of mechanical systems unprepared for the rigors of Arctic operations.

Alone, or in combination, these conditions contribute to a myriad of scenarios for pollution and are the focus of the vast majority of preventive measures.

In addition, the variety of pollutant types and sub-types threaten the environment in different ways depending upon their chemical nature and how they behave when released. This may include circumstances such as waterway type, time of year, weather (wind, temperature) and local geography. Further adding to these circumstances are the variables associated with the potential impacts or sensitivities related to shoreline ecosystems, marine ecosystems, socio-economic systems or, in general terms, the overall exposed environments that would be lost or degraded.

Given the recognition that prevention may greatly diminish but not necessarily eliminate pollution threats, all maritime nations support preparedness and response activities. The challenge lies in the creation and sustainability of a preparedness and response regime that deals with the innumerable combinations and permutations possible.

While there are exceptions, there are few Arctic-based resources to address oil spills, especially the ability to recover trapped oil in hulls and compartments in both shallow and deep water.

Internationally, the Arctic countries are all signatories to MARPOL 73/78 (Annex I and II), COLREG Convention 72, STCW Convention 78 and Load Lines Convention 1966 and Protocol 1988, all of which fundamentally support the domestic legal frameworks for limiting vessel casualty situations. While these conventions apply internationally, the unique Arctic conditions relating to ice cover, weather fluctuation, limited basic infrastructure due to remoteness and particular biological susceptibilities increase the reliance on clear and robust prevention and preparedness regimes.

The Emergency Prevention, Preparedness and Response working group of the Arctic Council has created several products for dealing with oil spills in the Arctic. These products are available to the general public through http://eppr.arctic-council.org and include:

- an Arctic Guide referencing emergency systems and governmental contacts for all circumpolar nations that is updated annually;
- a Shoreline Cleanup and Assessment Manual (2004) for use in determining the most appropriate techniques for enhancing shoreline recovery;
- a series of Circumpolar Maps of Resources at Risk from Oil Spills in the Arctic (2002);
- a Field Guide (1998) for oil spills response referencing all manner of protection and recovery techniques; and
- an Environmental Risk Analysis (1998) of Arctic activities that indicates current potential spill sources.

Of particular note, the series of circumpolar maps, http://eppr.akvaplan.com, provides a first order overview of information for stakeholders to easily identify potential sources of spills and internationally important biological resources that could be at risk. The map catalogue includes thematic, regional and seasonal views including fish, bird, mammal, human population and protected areas.

A review of each Arctic state's response profile reveals a relatively consistent allocation of marine pollution interests from federal to local levels. In addition, there exists a number of longstanding bilateral agreements between adjacent countries that encourage cooperative efforts and transfer of best practices. For example, Norway and the Russian Federation have a bilateral oil spill response agreement for the Barents Sea that is exercised annually. There is no multilateral oil spill response agreement for the Arctic, but it may warrant an umbrella or multilateral agreement and/or a contingency planning process. Because of the diverse nature of the areas and interest, there is no particular advantage or disadvantage to any one model provided that entities share their objectives and communicate effectively.

In terms of current and future marine traffic, the Arctic is an immense, seasonally variable waterway with very little development along its shores. Despite the current disposition of resources and regimes, a more consistent country by country approach is required to address the pollution risk more effectively. Issues related to identifying risk areas, establishing timelines for response and ultimately designing a consistent response capacity remains a challenge.

Logistics - the procurement, maintenance and transportation of materials, facilities and personnel - are dependent upon existing Arctic infrastructure. This is a critical component of all Arctic operations. Sea-state and environmental exposure will place larger burdens on logistics supply lines. In the absence of shore-based infrastructure, longer range planning for refueling and replenishment are required. Distances between ports, coupled with the unpredictability of weather, may complicate access and supply, as well as removal of recovered product and waste. With public expectation of four season response capability for large or environmentally disastrous spills, the logistics infrastructure may need to be modified.

The issue of logistics is not surprisingly a significant and mostly limiting factor in facilitating an effective response. In remote areas, two distinct situations exist in relation to the provision of logistics: incidents within reasonable distances from established communities and those in more remote settings. Pre-existing infrastructure or pre-placement of response assets typically support this first scenario, while remote incident sites require the creation of infrastructure from the ground up. A mobile and relatively self-sustaining infrastructure is called for currently and likely into the foreseeable future. Selecting a site for this type of infrastructure becomes the key logistical issue facing a response and obtaining local knowledge of the areas is considered vital.

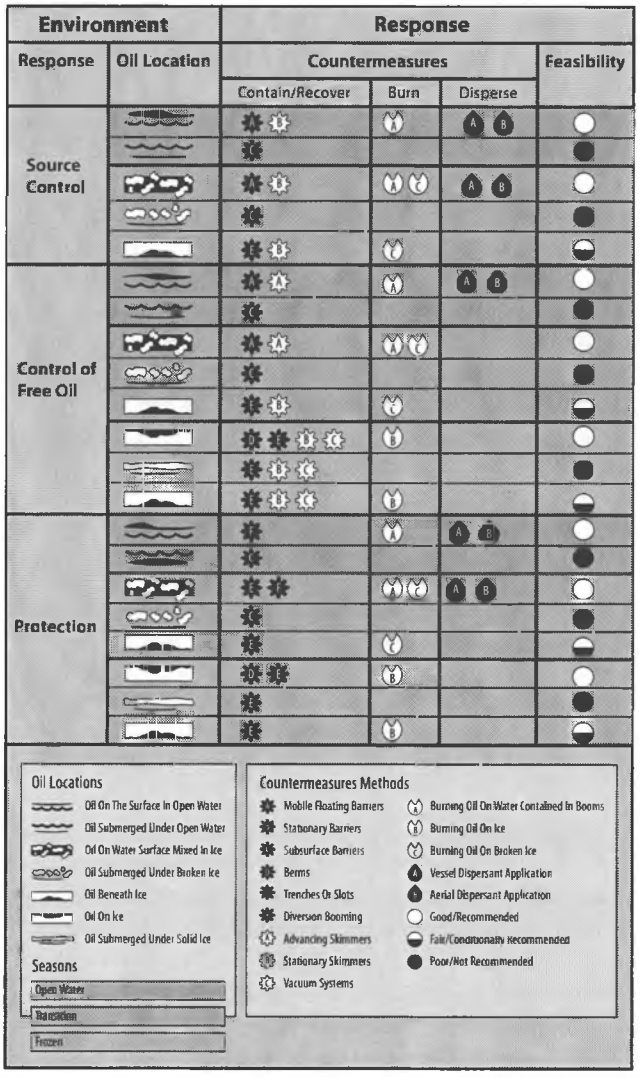

Table 9.2 Summary of typical response countermeasures in various seasons and seas. *Source: First Responder's Guide for Arctic Oil Spills, EPPR*

It is important to learn, as soon as possible, what has been spilled, where and when in order to address it in an appropriate manner.

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Oil spills in ice are more complicated to address than oil spills in open waters and there are several challenges connected with oil spill response in ice and snow and cold water. Apart from the normally long distances from existing infrastructure, the oil is less accessible in ice-covered waters. The oil can be spilled on ice or snow, in open pools between ice floes, in open channels behind vessels or even under the ice from pipelines or other sources.

There are some advantages in addressing oil spills in ice compared to open water. The weathering rate is normally much slower for an oil spill in ice as the emulsification rate is slower, resulting in an increased window of opportunity for use of most response techniques. The spreading of oil will be normally slower also, resulting in a large oil film thickness that may be favorable for oil spill response. The reduced weathering of oil in these conditions does, however, maintain the levels of its more toxic components for greater periods of time, thereby increasing the availability or risk of uptake by organisms.

Arctic Oil Spill Recovery Operations: Technology and Tactics

Effective Arctic oil spill recovery operations require advanced planning and international cooperation. All available methods must be available and considered for each situation although some methods have proven more effective in ice-covered waters. Along with planning and cooperation, training, incident communications and risk management are key elements to any oil recovery operation.

Mechanical recovery techniques combined with oil detection and tracking methods, currently dominate the in-field capabilities of most nations. However, tracking, detecting, as well as modeling oil in ice-covered waters has inherent environmental limitations. The mechanical methods are often considered the most environmentally friendly recovery methods. The concept is to create barriers via floating or alternative booms, recover the oil out of the sea with a mechanical skimmer and then do the post-treatment for the recovered oil in a controlled manner in environmentally safe conditions. However, the mechanical methods are laborious and time consuming and their efficiency is low. Further, mechanical methods often require complicated logistical support in the form of equipment and personnel transportation, which in remote or harsh conditions cannot easily be provided. Mechanical recovery in ice and snow conditions must meet challenges in terms of booming, skimming, recovery and pumping capabilities. Each of these areas has specific challenges to optimum recovery efforts.

Chemical dispersion can be utilized to promote the formation of oil droplets in order to accelerate the natural dispersion and biodegradation of spilled oil. Dispersants (surfactants) can be applied to control offshore slicks or oil that accumulates in coastal areas that have significant tidal or flushing action. In order for dispersion to be effective there needs to be limited weathering of the spilled oil, a cohesive slick, an oil within the viscosity ranges of dispersibility, an appropriate dispersant to oil ratio and turbulent mixing. Only a few research studies have been performed in the past 20 years regarding the use of dispersants on oil spills in ice-infested waters, either from an effectiveness or environmental-impact perspective, and these are of limited value in assessing the situation in realistic terms. Logistical support and effectiveness may also be a challenge when using dispersants. Limited studies such as the Joint Industry Program (JIP) on Oil in Ice, have followed the long-term fate of dispersed oil, but most impacts have been derived from laboratory studies.

In-situ burning, or ISB, is a treatment method that can be used for oil on open water, on ice and in broken ice, if adequate oil thickness can be achieved to sustain burning. This may require the use of booms or herding agents. While continued studies are needed to best determine the ISB effectiveness window of opportunity, for in-situ burning to be a viable option, planning, special equipment and training specific to ISB must be in place before the limited window of opportunity presents itself during a spill. Burnability is a function of oil type (chemical/physical factors), oil thickness on the interface and its state of weathering/degradation. While colder Arctic temperatures are a force to overcome for ISB in ice-covered waters, other natural degradation processes such as slower rates of spreading, evaporation and emulsification have supported burning.

450

The approximate number of lives saved in 2007 because of the Automated Mutual-Assistance Vessel Rescue System.

From the recovery rate point of view, in-situ burning seems to be the most effective method for clean-up of oil spills in ice and snow conditions. Furthermore, removal efficiency exceeding 90 percent can be achieved in ideal conditions (open water, fire booms and quiet conditions), but a burning rate of 60 to 70 percent can be considered as representative for burning on ice-free water. The burning rate can also be zero percent if the oil is not ignitable. ISB may be more limited due to weathering of the oil than the use of dispersants. This is significantly more effective than rates of 10 to 20 percent for mechanical recovery. Alternatively, in-situ burning will generate smoke and soot, thus moving part of the pollution from the sea to the air, and will leave a burn residue that must be recovered. Monitoring and assessment of these results is always necessary.

Oil may be removed by biological degradation. Oil-degrading bacteria naturally exist in the seas with oil, including the cold and icy waters. By adding oxygen and/or nutrients and/or bacteria a possible acceleration of this fundamentally natural process can occur. While bioremediation is an effective countermeasure for small spills with high surface areas (e.g., very thin staining or coating on shorelines), it is a relatively slow process, possibly requiring months if not years to fully accomplish and is best suited for post-spill response final treatment.

Protection of People and Property

The current search and rescue, or SAR, infrastructure in the Arctic, while varying between regions, is limited. For example, while there is a robust set of assets off the coast of Norway to respond in an emergency, there is little to no infrastructure along the coast of Greenland to respond to a passenger ship in distress. A survey of search and rescue resources among Arctic states indicates limited availability of fixed wing aircraft and helicopters in most of the region. Some survey responses included icebreakers and seasonal patrol vessels that can be used for SAR when near enough to an incident. However, in general, there are shortages of critical SAR response assets, such as long-distance, heavy-lift capacity helicopters. The usefulness of these assets is often limited by weather and other operating conditions. Emergency response efforts are further hampered in many regions by an insufficient shoreside infrastructure needed to provide basic logistics and support functions for SAR missions. The location and availability of SAR assets are often problematic given the vast distances and frequent harsh operating conditions typical in this region. In some instances, such as in connection with oil and gas activities, private industry addresses these gaps and shortfalls by providing its own supplemental SAR capacity

as part of its ongoing Arctic operations, but this remains the exception rather than the rule.

Arctic states have attempted to maximize the effectiveness of existing SAR resources by entering into bilateral and sub-regional SAR agreements with neighboring nations that have improved coordination of SAR responses in specific areas of the Arctic. For example, the Russian Federation, Canada and the United States have a search and rescue agreement. Norway and the Russian Federation have a bilateral search and rescue agreement for the Barents Sea that is exercised annually. There are also informal search and rescue arrangements with local governmental and private entities. There is no multilateral search and rescue agreement covering the entire Arctic region.

The future increase in human activity in the Arctic, including Arctic marine shipping and the continued overflight of the Arctic region by commercial aircraft, will place increasing demands on the SAR infrastructure. Many of the infrastructure deficiencies discussed in this report, such as the insufficient number of accurate charts or the need for better real-time information concerning the operational environment and communications difficulties, will also impact search and rescue efforts.

The need to strengthen search and rescue capabilities was specifically recognized by the representatives from the Russian Federation, Canada, the U.S., Denmark and Norway who met in Ilulissat, Greenland, in May 2008. "The increased use of Arctic waters for tourism, shipping, research and resource development also increases the risk of accidents and, therefore, the need to further strengthen search and rescue capabilities and capacity around the Arctic Ocean to ensure an appropriate response from states to any accident," states the Ilulissat Declaration. "Cooperation, including on the sharing of information, is a prerequisite for addressing these challenges. We will work to promote safety of life at sea in the Arctic Ocean, including through bilateral and multilateral arrangements between or among relevant states."

Passenger Vessel Safety in the Arctic

The most significant emerging challenge to the existing search and rescue infrastructure arises from the increase in marine tourism and passenger vessels operating in Arctic waters. As large passenger vessels continue to operate more frequently and farther north in the Arctic, the prospect of having to conduct mass rescue operations with limited SAR resources increases. Recent growth in Arctic marine tourism is outpacing infrastructure investment, development and support throughout the region. There are several potential problems associated with responding to an incident aboard a cruise ship. The potential number of people that would have to be rescued from a cruise ship far exceeds the capacity of most SAR response vessels and aircraft available in the Arctic. Cruise ships have a minimal capacity for self-rescue. Compliance with IMO guidelines for passenger

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Emergency response is particularly challenging in the Arctic for a variety of reasons, including the remoteness and great distances that are often involved in responding; the impacts of cold, ice and a harsh operating environment on response personnel and equipment; and the lack of shoreside infrastructure and communications to support and sustain a response of any significant magnitude.

vessels operating in remote areas is voluntary and, as a result, the planning and capability for self-rescue varies. Passengers are likely to be ill-prepared for the weather, which decreases their likelihood of survival if they are not rescued quickly. There are also a host of logistical challenges associated with the lack of shoreside infrastructure in most of the Arctic needed to accommodate and care for those that are rescued, including the lack of sufficient food, lodging and medical facilities. In many cases, the only available platform with capacity to feed and house rescued passengers would be another cruise ship.

A number of potential actions are available to address the challenges presented by emergency response to passenger vessel incidents in Arctic waters. First, ships intending to conduct passenger vessel transits in the Arctic would greatly improve the prospects for a successful rescue and survival of passengers and crew if they coordinated their transits with other passenger ships in the vicinity. In two incidents in the Antarctic, passengers and crew from stricken vessels were successfully transferred to other nearby passenger vessels. One of the stricken passenger vessels, the *M/V Explorer,* sank shortly after the transfer. Second, provisions in the *Enhanced Contingency Planning Guidance for Passenger Ships Operating in Areas Remote from SAR Facilities* (IMO 2006) provide valuable guidance for passenger vessels operating in remote areas such as the Arctic. The voluntary guidelines provide detailed information on emergency drills and inspections, and contain additional requirements for lifeboats, liferafts and survival kits that would allow passengers and crew to better survive the harsh Arctic environment until SAR response arrived on scene. The value of these guidelines is dependent in large part on the degree to which they are adopted and implemented. Third, search and rescue operations could be improved and limited resources used to best advantage by sharing information, lessons learned and best

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practices arising from incidents that have already occurred in polar regions, including the two latest Antarctic incidents.

The advantages of mutual assistance between vessels operating in the Arctic, although particularly significant for passenger vessels, extend to all vessels. Voluntary systems have been established that allow search and rescue authorities to identify and request assistance from other vessels in the vicinity of a vessel in distress. The Automated Mutual-Assistance Vessel Rescue System (AMVER) is one such established system that can be accessed by Arctic SAR authorities to identify a possible source for assistance in any distress case in the Arctic region. There are more than 17,000 vessels enrolled in the AMVER network, representing 155 countries. On any given day, more than 3,500 vessels are available to divert and assist in a distress situation at sea. Approximately 450 lives were saved in 2007 because of AMVER. Participation is voluntary unless mandated by a vessel's flag state, shipping company or other authority.

€4.4B

The amount of money invested since 2004 to improve Murmansk's deepwater port facilities to include new oil, coal and container terminals as well as expanded rail lines.

Participating vessels provide regularly updated information on their SAR capabilities and intended track to rescue coordination centers. AMVER information is released only to recognized SAR agencies for safety-of-life-at-sea purposes, and provides rescue coordination centers with data on vessels in the vicinity of a SAR case that may be available to divert and assist.

Another example is the Russian Vessel Monitoring System, referred to as *VMS Victoria*. The system is intended for near real-time automated monitoring of vessels positions provided vessels are fitted with the ship satellite communication systems: INMARSAT-C or INMARSAT-D+, and for delivering the collected position reports data via Internet to remote users. *VMS Victoria* caters to the shipowners, operators and organizations responsible for control and surveillance of maritime vessels, as well as for search and rescue at sea. There are more than 1,200 vessels enrolled in the system, among them more than 600 foreign flag-state vessels. *VMS Victoria* operates constantly and allows its users: to track the movements of their fleets by receiving regular automated position reports from the vessels; to request an immediate position report from any vessel on demand if required; and to send short text messages and FleetNet broadcasts to a vessel/vessels. *VMS Victoria* processes messages in real time and then transmits them to INMARSAT. It is anticipated that the establishment of the LRIT-system will be an important system to identify ships in the vicinity of a distressed vessel, thereby requesting them to provide assistance.

Promoting the use of mutual vessel assistance systems such as AMVER or *VMS Victoria* would serve to supplement the extremely limited search and rescue resources and improve SAR capacity in the Arctic.

Although Arctic states often have existing agreements in place to coordinate SAR operations with neighboring nations, there are several advantages to creating a multilateral Arctic SAR agreement that would cover the entire northern region for both aeronautical and maritime SAR. A multilateral SAR agreement for the entire Arctic region would facilitate the most effective use of limited SAR resources throughout the Arctic and would ensure that available Arctic SAR facilities closest to a vessel or aircraft in distress are identified and respond first, regardless of nationality, in order to reduce response time and potentially save the most lives. A region-wide agreement would also improve SAR response by serving as the framework within which to conduct joint exercises and training; share information, lessons learned and best practices; and identify and improve mechanisms for mutual cooperation, coordination and support in search and rescue and emergency response.

The creation of a more comprehensive multilateral SAR agreement would build on existing proposals for an aeronautical Arctic SAR Memorandum of Agreement to include both aeronautical and maritime SAR, as encouraged by the *International Convention on Maritime Search and Rescue*, 1979, as amended; the *Convention on International Civil Aviation*, 1944 (Annex 12), as amended; and the *International Aeronautical and Maritime Search and Rescue Manual* (IAMSAR Manual). The proposed Arctic Region SAR agreement would identify aeronautical and maritime SAR region lines of delimitation; as affirmed in both conventions, such delimitation of SAR regions is not related to and would not prejudice the delimitation of any boundary between nations.

A multilateral SAR agreement would serve as the centerpiece of cooperation and coordination in support of Arctic emergency response operations while providing an important example of a mutually beneficial regional approach among Arctic nations to address important shared issues of concern.

Since Arctic and Antarctic emergency responses are similar in many ways, Arctic and Antarctic nations engaged in polar SAR could benefit from consultation and cooperation on issues of mutual concern and applicability. The five nations responsible for SAR in the Southern Ocean (New Zealand, Australia, Argentina, Chile and South Africa) currently meet to address many of the same challenges that face the eight Arctic Council nations concerning distance, harsh environment and limited SAR resources. In August 2008, New Zealand, Australia, Argentina, Chile, South Africa, United States, France, United Kingdom and the Council of Managers of National Antarctic Programs (COMNAP), met in Valparaiso, Chile, to discuss improving Antarctic SAR coordination and cooperation. One means of enhancing cooperation would be through mutual efforts of the Arctic Council and Antarctic Treaty Consultative Meetings. Future proposals and recommendations on polar SAR could be coordinated between both international fora to ensure continuity and standardization where appropriate.

Gaps in Preparedness and Response Operations

Remote surveillance and detection technologies (i.e., satellite communications, GPS availability, weather stations) are critical for establishing situational awareness for both preventive and response issues. This overall capability is limited in the Arctic due to a lack of coverage and the availability of real-time weather information.

Lightering in emergency situations and salvage typically represent two distinct marine activities that may be used in whole or in part to prevent and/or recover pollutants, and are considered in many cases synonymous with mechanical response capacities.

While all Arctic states individually support the overall strategic goal of limiting negative environmental impact and establishing

sustainable development, the potential for increased shipping has led to increased concern for threats, risk and evaluation of potential consequences worldwide. This leads to a high expectation by public and environmental groups for adoption of stringent preventive measures, as well as thorough mitigation and restoration measures in the event of an incident. This has also contributed to an increasing gap in maintaining realistic response expectations. To address this pressure many recent workshops and panel discussions have indicated a need for more harmonious pan-Arctic shipping rules. Cooperation at this level requires nations to develop common goals and objectives based upon mutually acceptable and scientific criteria. Ultimately the communication of these objectives is vital in maintaining realistic expectations.

While there are exceptions, there are few Arctic-based resources to address oil spills, especially the ability to recover trapped oil in hulls and compartments in both shallow and deep water. A multilateral oil spill contingency plan or an oil spill agreement may be options to address this issue.

Ports

In temperate maritime areas, deepwater ports and the services they provide are typically relatively close to global maritime shipping and often taken for granted. The situation in the Arctic is quite different. Deepwater ports, places of refuge, marine salvage, adequate port reception facilities for ship-generated waste and towing services are rarely available. The availability of port infrastructure and support directly influences the level of risk associated with transiting a particular waterway and corresponds to the levels of marine insurance rates.

Ports and Intermodal Transport Links

There are few deepwater ports in U.S. or Russian waters near the Bering Strait. The closest U.S. harbor with deep water is Dutch Harbor in the southern Bering Sea. On the Russian Federation side, the nearest deepwater port is Provideniya. Other Russian ports near the Bering Strait that are closed to foreign ships are Egvekinot, Anadyr and Beringovsky.

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Arctic Marine Incidents Workshop

A key AMSA workshop, Opening the Arctic Seas: Envisioning Disasters and Framing Solutions, was held in March 2008 at the Coastal Response Research Center of the University of New Hampshire. The center, a partnership between the U.S. National Oceanic and Atmospheric Administration and UNH, develops new approaches to spill response and restoration through research and synthesis of information.

In cooperation with the U.S. Coast Guard and U.S. Arctic Research Commission, the center hosted the workshop to identify key strategies, action items and resource needs for preparedness and response to potential Arctic marine incidents. The 50 workshop participants represented a spectrum of constituencies and expertise including government agencies, the marine industry, Arctic indigenous groups, academia and non-governmental organizations. Experts from the U.S., Denmark, Canada, Russian Federation, Norway and Finland and one non-Arctic state, South Africa, participated.

The workshop focused on the qualitative risk factors for five plausible Arctic marine incidents developed by the organizing committee and bear some similarities with incidents that have already occurred in polar waters. The incidents were designed to explore: spill response; search and rescue; firefighting and salvage; communications; governance and jurisdiction; and legal issues. The five incidents were:

- **Cruise ship grounding in the west coast of Greenland**
  Mid-September grounding in a fjord of a cruise ship with 1,400 passengers. Progressive flooding makes the ship unstable and all passengers and crew must abandon ship.

- **Bulk carrier trapped in ice in the central Arctic Ocean**
  September/late season crossing of the Arctic Ocean en route to the Bering Strait and the Pacific Ocean. Ice damages the ships' rudder and propeller. The ship's non-ice strengthened hull makes wintering impossible. Rescue operations are challenging due to the remote location and changing sea ice cover.

- **Fire and collision in offshore operations in the Beaufort Sea**
  In late winter, a drill ship, two oil spill response vessels and one ice management icebreaker are conducting exploratory drilling operations in 50 meters of water 20 nautical miles offshore within the disputed U.S.-Canada border area in the Beaufort Sea. An engine room fire on the icebreaker causes it to lose control and collide with the drill ship, rupturing a ballast tank. The drill ship empties 700 barrels of Arctic grade diesel fuel to maintain stability; 300 barrels of diesel fuel are also spilled because of the fire on the ice management ship. Crew members on both vessels suffer injuries.

- **Oil tanker and fishing vessel collision in the Barents Sea**
  The collision occurs in near-zero visibility within the disputed Russia-Norway border in the Barents Sea. The tanker releases 25,000 barrels of crude oil in the water and must be towed to a place of refuge to avoid potentially spilling its remaining cargo. The fishing vessel sinks making salvage impractical.

- **Tug and barge grounding on St. Lawrence Island in the Bering Sea** In May in broken ice conditions, a tug loses power while towing a barge laden with mining explosives and other containerized cargo for several Arctic communities. Pushed by a storm surge, the tug and barge are grounded in an area that was a critical habitat for threatened and endangered species and a haul-out location for Pacific walrus. The tug and barge are separated by several miles, the tug ruptures a fuel tank, containers are in the water and some wash onshore.

Workshop participants were divided into five groups each working on a single, plausible incident. Four questions were addressed by each group: If this incident happened today in the Arctic, how would we respond? How would we prefer to respond? What are the gaps and needs that exist today that prevent us from responding in the preferred manner? What do we need to do to address those needs and fill the gaps?

The exercise yielded the following themes:

(A) Ports and Waterways Management

- Designate potential places of refuge in the Arctic and develop guidelines for their use; an international effort should also rank them by seasonal environmental conditions.
- Establish policies and systems to control ship movements such as route planning; use of Automatic Identification Systems on all Arctic ships; vessel tracking systems and designation as Particularly Sensitive Sea Areas from IMO.

(B) Vessels and Crew Safety

- Institute mandatory safety regulations for Arctic operations; the current IMO Guidelines for Ships Operating in Arctic Ice-Covered Waters address specific construction, fire safety, lifesaving, navigational, operational and crew training issues, but they are voluntary; mandatory training for ice navigation and emergency response in polar environments is necessary; a non-binding regulatory framework seems inconsistent with the hazards of Arctic navigation and the potential for environmental damage in the Arctic Ocean.

(C) Response Agreements and Plans

- Existing search and rescue and pollution contingency plans do not provide enough detailed information to facilitate an effective response; there is a need for Arctic-wide agreements for SAR and pollution response; agreements and response plans should

designate which nations respond in specific areas and clarify operations in disputed regions; agreements and response plans should also ensure foreign responders can participate in operations unimpeded by customs and immigration issues; Arctic states could establish an integrated response management center to manage the execution of agreements and facilitate the decision-making process.

(D) Strategies to Improve Prevention and Preparedness

- Conduct comprehensive environmental risk assessments and impact assessments to assist in decision-making, route planning, emergency response, etc.
- Increase emergency response assets, equipment and supplies in the Arctic, placing emphasis on regions of active development; self-sustaining, forward-operating response bases should be established.
- Improve knowledge for Arctic incident response through training and engagement of the local community; responders and the maritime industry. Arctic indigenous people should be trained in response and local communities must participate in response operations.

(E) Strategies to Improve Response

- Consider alternative countermeasures for oil spill cleanup; mechanical measures in ice-covered waters may be impractical and alternative response options should be considered (dispersants, chemical herders, sinking agents, in-situ burning, etc.).
- Expand communications capabilities throughout the Arctic; expanded shore based (VHF and HF) and satellite systems are required.
- Improve logistical support capabilities for responders; support for response personnel in remote Arctic regions must be brought to the region of operations.

(F) Strategies to Foster Community Involvement

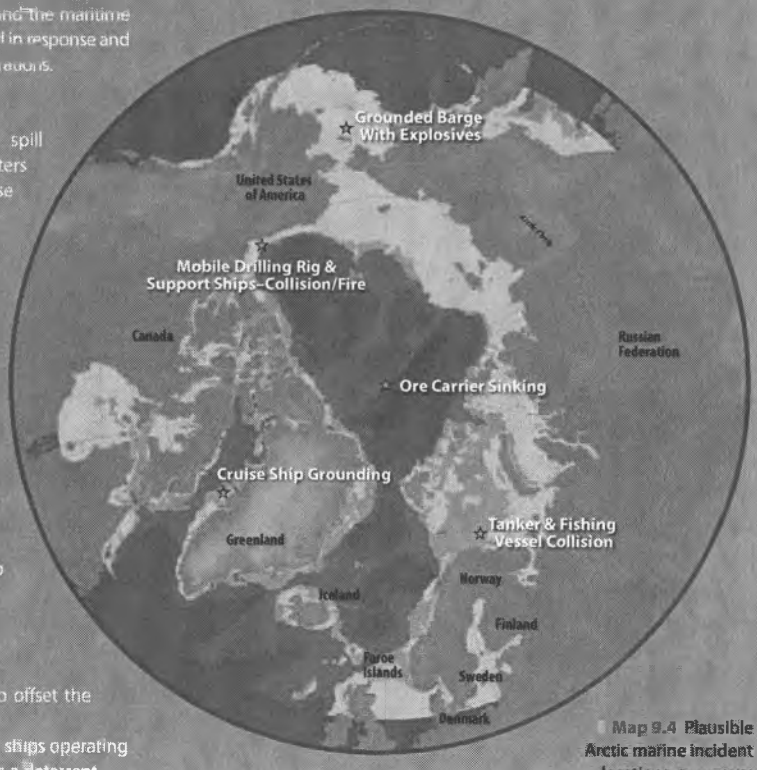
- Involve indigenous peoples and local communities in planning, response, recovery and restoration decisions and operations.
- Conduct outreach to local communities and keep all stakeholders well informed.

(G) Strategies to Ensure Availability of Funds for Response

- Establish an international Arctic response fund to offset the costs of SAR and pollution response.
- Increase penalties and insurance requirements for ships operating in the Arctic to ensure response funding and act as a deterrent.

The workshop identified three key areas of data and research needs: (1) the updating of weather data due to a lack of overall information, and investment to update navigational charts for Arctic regional seas, ports and waterways; (2) studies on the behavior of oil in cold water and technologies for spill response (including the detection of oil under ice as well as cleanup measures for oil in ice); and (3) improving the baseline information for Arctic resources (biological/ecological resources and areas important for human use and cultural significance) that could be affected by potential marine incidents.

Two themes resonated throughout the workshop: The Arctic states need to foster and enhance their cooperation to improve joint contingency plans and multinational agreements, as well as to agree to develop mandatory safety regulations for Arctic marine operations. The proper management of risk using appropriate policies and strategies, supported by scientific research, can lead to reduced risk for loss of life and environmental damage.



Map 9.4 Plausible Arctic marine incident locations. *Source: AMSA*

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This situation differs with the region between the Atlantic and Arctic oceans, where there are many Norwegian, Icelandic and Russian deepwater ports. There are a number of deepwater ports along the west coast of Greenland. In the Arctic, there are essentially no deepwater ports along the North Slope of Alaska or throughout the Canadian Archipelago, except for that of Tuktoyaktuk, which, while having a relatively deepwater port, suffers from a shallow approach channel and a high degree of in-fill silting, situated as it is in the delta of the Mackenzie River. Mention should also be made of the limited port facilities at Resolute Bay, in the middle of the archipelago, which acts as a center of transportation, communications and administration for the high Arctic but which can only handle ships of 5m draft alongside a sunken barge used as a dock. Ships of deeper draft must anchor in an open roadstead.

In Hudson Bay, the Port of Churchill is Canada's only northern deepwater seaport with well sheltered, along-side berthing facilities. It provides access, via rail, to the interior of Canada and North America in general. The growing Port of Churchill offers four berths for the loading and unloading of grain, general cargo and tanker vessels. The Port can efficiently load Panamax size vessels. The link between Murmansk and Churchill has become known as the "Arctic Bridge" since it requires sea and rail systems to complete the transport of goods to North American destinations. The use of the Port of Churchill eliminates time-consuming navigation, additional handling and high-cost transportation through the Great Lakes and St. Lawrence Seaway. The current shipping season runs from mid-July to the beginning of November. The use of icebreakers could significantly lengthen the shipping season. Another significant port in the Eastern Canadian Arctic is Iqaluit, which requires that ships anchor and use barges to land their cargo and features some of the highest tides on the planet as well as one of the largest tidal ranges in existence.

The Canadian government has recently proposed an upgrade to the rail link to Churchill, as well as the development of a deepwater port at the old mining town of Nanisivik in Nunavut on Baffin Island, to be used primarily by the Department of National Defence. It is unclear what facilities this port will have since it is not situated near a major population center, major shipping route or railroad. In addition to the proposed port at Nanisivik, future planned development on Baffin Island also includes the iron-ore mine at Mary River under construction by Baffinland Iron Mines Corporation that will include a railroad to the planned port at Steensby Inlet.

In contrast, the northern coast of the Russian Federation has several deepwater ports that have been supported by the Northern Sea Route Authority and fleet of icebreakers for several decades. Murmansk is well known for being the largest deepwater port north of the Arctic Circle that is ice-free throughout the year. Murmansk also provides intermodal access to northern European and Asian

industrial centers. In recent years, Russian Arctic ports in the Barents Sea, including Murmansk, have expanded significantly as offshore oil and ore production have increased in the region. Since 2004, more than €4.4 billion have been invested in improving Murmansk's deepwater port facilities to include new oil, coal and container terminals as well as expanded rail lines. Murmansk port capacities are projected to increase to an annual 28.5 million tonnes by 2010 and 52 million tonnes by 2020. Other Russian Arctic ports along the Northern Sea Route include Pevek, Tiksi, Igarka, Dudinka, Dikson, Vitino, Arkhangelsk and Novy. These ports are well-established and supported by the Russian icebreaker fleet, although many require long river transits to access.

Unique to the region is the Port of Varandey on the Pechora Sea coast. As oil production expands in the Russian Arctic, LUKOIL, in cooperation with ConocoPhillips, has developed Varandey into a deepwater oil export terminal. The Varandey facility consists of an onshore tank farm with a total rated capacity of 325,000 cubic meters (2,000,000 barrels); and an innovative fixed ice-resistant oil terminal 14 miles offshore, with a height of more than 160 feet. The terminal includes living quarters and a mooring cargo handling system with a jib and a helicopter platform; two underwater pipelines, connecting the onshore tank battery and the offshore oil terminal; and an oil metering station, auxiliary tanks, pumping station and power supply facilities. Sovkomflot has one new 70,000 DWT ice-strengthened oil tanker in operation and two being built in South Korean shipyards, to shuttle oil to Murmansk, as well as other locations in Europe and North America.

There are likely to be significant practical difficulties to be encountered in finding and supporting suitable places of refuge for ships in need of assistance in the Arctic and in providing such ships with adequate support.

© Canadian Coast Guard

Places of Refuge

The Ilulissat Declaration outlined the need to cooperate to improve search and rescue and disaster response capability in the Arctic as marine activity increases. Central to this objective is the need for deepwater places of refuge and marine salvage/support capability.

According to IMO's *Guidelines on Places of Refuge for Ships in Need of Assistance*, a place of refuge means a location where a ship in need of assistance can take action to enable it to stabilize its condition and reduce the hazards to navigation, and to protect human life and the environment. A ship in need of assistance means a ship in a situation, apart from one requiring rescue of persons on board, which could give rise to the loss of the vessel or an environmental or navigational hazard.

With an increase in international Arctic shipping, it is likely that ships in need of assistance may need to request refuge in sheltered waters of the Arctic states. There are likely to be significant practical difficulties to be encountered in finding and supporting suitable places of refuge for ships in need of assistance in the Arctic and in providing such ships with adequate support. In the Arctic, harsh environmental conditions and increasing marine traffic densities make this course of action even more critical. Potential place of refuge guidelines detail the process by which port authorities decide where to allow a damaged ship to berth. In an attempt to balance shipping interests with the protection of natural and cultural resources, selection of such places should incorporate input from potentially affected governments, communities, the shipping industry and other stakeholders. Authorities should also rank places based on seasonal environmental conditions.

The European Union Places of Refuge Framework provides a model for the development of potential place of refuge guidelines by Arctic nations. Western Norway has an established system for places

of refuge based on IMO guidelines and the EU framework, including predefined places if applicable. The system will be expanded to include the entire Norwegian coast, including Svalbard, by late 2009 or early 2010. The places of refuge are evaluated based on the EU Safety at Sea project.

Other Infrastructure Components

Arctic marine infrastructure includes components not required or taken for granted in temperate waters. Polar icebreakers and marine salvage capability are risk mitigators from the perspective of marine insurance companies. If a vessel navigating in the Arctic has readily available polar icebreaker and/or marine salvage support, the risk to the vessel and corresponding financial risk to owners and insurers is substantially reduced.

Icebreakers

Government and private icebreakers are a key resource in the development of the Arctic. Generally, icebreakers are able to carry out the following roles: maintenance of shipping tracks in ice-covered waters, close escort of shipping in ice, provision of ice information, sovereignty support/representation, search and rescue, environmental response, command platform for emergency response, medical evacuation in remote areas, harbor breakout, electrical power supply, science platform, constabulary function (maritime security), transporting cargo (northern re-supply and logistic support) and fisheries conservation and protection.

There are some 50 icebreakers in the world fleet. The Russian fleet is by far the largest and most powerful, counting icebreakers powered by nuclear power plants, with five of 75,000 shaft horsepower (shp). The Russian Federation recently announced the allocation of some 15 billion rubles to build another 75,000 shp icebreaker. The next largest

The world's icebreaker fleets are aging and will require significant investment during the coming years to maintain their effectiveness and capability.

fleet of Arctic-class icebreakers is that of the Canadian Coast Guard. The Canadian Government recently announced an investment of $C720 million to provide an Arctic-class replacement for the *CCGS Louis S. St-Laurent*. Most other countries that operate icebreakers own one or two, other countries such as Denmark and Norway have small fleets of ice-strengthened vessels generally intended for fisheries patrol and interdiction. The world's icebreaker fleets are aging and will require significant investment during the coming years to maintain their effectiveness and capability. For instance, Canadian icebreakers are on the average 30-plus years old, while those of the U.S. are 30 years old, with the exception of the *USCGC Healy*, which was built in 2000. Of note is the recently issued report, *Polar Icebreakers in a Changing World*, which is a needs analysis of U.S. icebreaking requirements in the coming years. In addition, it is also known that a number of other countries are either building or planning construction of new icebreakers primarily intended for science research, namely the European Union and South Korea.

Icebreaker construction is very specialized and very expensive. Steel is thicker and stronger than that required for normal cargo ship construction. In addition, there are other necessary specific features, such as horizontal and vertical construction members that are deeper and stronger, reinforced icebelts and redundant features. These details are specified in a number of national regulations governing construction of ice-class ships, namely those of the Russian Federation, Canada, Finland and Sweden; as well as classification societies such as the American Bureau of Shipping, Det Norske Veritas, Germanischer Lloyd and Lloyd's Register. Recently, the International Association of Classification Societies approved their *Polar Class* construction standard as one of a number of "Unified Requirements." Classification societies have one year to enter the new requirement in their respective rules. Classification societies have the new requirements in their respective rules, and some are expected to keep their existing rules.

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Marine Salvage Support

In the Arctic Ocean, with the exception of Norway, Iceland and ports along the Northern Sea Route, there are few places of refuge or government/commercial salvage response to support commercial shipping. Generally, there are limited ship repair and/or salvage infrastructure and pollution countermeasures capabilities based around the Arctic basin. This lack of an Arctic salvage capability is a concern to the marine insurance industry.

There is inadequate port, salvage, towing and other necessary marine infrastructure support for the growing amount of commercial traffic transiting the Great Circle Route through the Aleutian Islands. This was highlighted by the 2004 *M/V Selendang Ayu* engine failure and subsequent grounding with a spill of more than 1 million liters of fuel oil along the northern side of Unalaska Island (See page 88). This incident could have been prevented if large tugs and adequate salvage support were nearby; instead, the nearest tugs capable of handling this type of emergency were in Seattle, Washington. After the 738 ft *M/V Selendang Ayu's* engine broke down in gale-force Bering Sea winter weather, several efforts to tow it by small tugs based out of Dutch Harbor failed.

Baltic Sea Case Study

Introduction

As the Arctic Ocean becomes seasonally ice-covered, coupled with the likelihood of increased marine shipping activity, an evaluation of the Baltic Sea marine shipping regime could be considered as a model for ship operations, information systems, incident response and harmonization of regulations.

The countries of the Baltic Sea Area work to protect the marine environment of the Baltic Sea from all sources of pollution through intergovernmental cooperation under the Convention on the Protection of the Marine Environment of the Baltic Sea Area and its governing body, the Baltic Marine Environment Protection Commission (HELCOM). All detailed information of the HELCOM activities is placed on website www.helcom.fi.

The Baltic Sea area is a sensitive marine ecosystem that needs comprehensive nature conservation and protection measures. The Baltic Sea states within the framework of HELCOM designated 89 areas as Baltic Sea Protected Areas (BSPAs) on the basis of their significance for marine nature conservation and protection of habitat and species. Work is still ongoing to designate other offshore areas as BSPAs. In order to harmonize the approaches and implementation process for marine protected areas (MPAs) in the Northeast

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Atlantic and the Baltic Sea, HELCOM and the OSPAR Commission, the governing body of the Convention for the Protection of the Marine Environment of the North-East Atlantic, have developed a detailed work program on marine protected areas closely linked to the European Union network for the protection of European fauna and flora, the so-called NATURA 2000 network.

The Baltic Sea States are dependent upon safe, secure and sustainable sea transports. The maritime traffic in the Baltic Sea area is dense and has increased notably since the beginning of the 1990s. The annual turnover for oil and oil products in the Baltic Sea is calculated to be approximately 160 million tonnes. On top of that, 500 million tonnes of other goods are annually transported by ships within the Baltic Sea area. Therefore an extensive regime of protective measures consisting of both international and national regulations is in place inside and adjacent to this semi-enclosed sea; examples of relevant measures are compulsory reporting and traffic surveillance, routing systems, compulsory pilotage and the designation of the area as a Special Area under Annexes I and V; and as a SOx Emission Control Area under Annex VI of the MARPOL 73/78 Convention.

Navigation Systems and Ship Operations

The Baltic Sea has some of the densest maritime traffic in the world. More than 2,000 ships are en route in the Baltic on an average day, not including ferries, smaller fishing boats or pleasure craft. Among those 2,000 ships, some 200 are oil tankers with a cargo up to 150,000 tonnes.

Several ferry lines connect the states in the Baltic proper. Some of the world's biggest ferries are transporting goods and people

between Sweden and Finland and there are several other ferry lines; i.e., between Sweden and Germany, Denmark and Germany, and between Denmark and Sweden. Most of the year intensive fishing for herring, cod and salmon takes place, sometimes in close vicinity to the major shipping lanes. Incidents are not rare considering that up to 2,000 fishing boats could be at sea on an average day. In summer, large numbers of cruise ships from all over the world enter the Baltic Sea area to visit the many coastal cities of cultural interest, such as Helsinki, St. Petersburg, Tallinn, Riga, Gdansk, Rostock, Lübeck, Copenhagen, Visby and Stockholm. Also numerous pleasure craft are sailing between the more than 500 ports or between different archipelago areas in the Baltic Sea. Oil and gas activities are for the time being few, but are expected to grow in the southern section of the area.

Compulsory Reporting and Traffic Surveillance

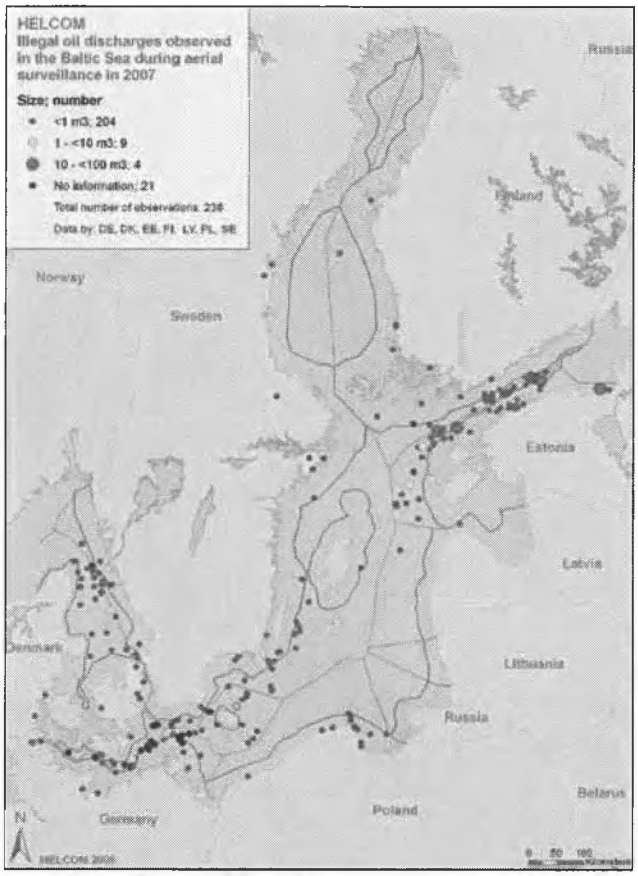
When ships enter the Baltic Sea they have to go through the Kattegat and the Great Belt or the Sound. There is intense traffic in the northern part of the area, where an extensive part of the traffic goes to and from Denmark as well as to and from the Baltic Sea. Large vessels follow the traffic lane Route T.

It is recommended that all ships of 20,000 gross tonnage and above navigating Route T should participate in the radio reporting service SHIPPOS together with all ships with a draft of 11 meters and more; loaded oil-, gas- and chemical tankers of 1,600 gross tonnage and above; and all ships carrying radioactive cargoes.

The system provides beneficial information to ships about other ship movements in the area. IMO has adopted a mandatory ship reporting system in the Great Belt Traffic Area. Ships with a gross tonnage equal to or exceeding 50 and all ships with a draft of 15 meters or more are required to submit a ship report to the VTS Centre.

Mandatory ship reporting systems have been established nationally by the Baltic Sea states in approaches to oil terminals and other ports. Article 4 of the EU directive 2002/59/EC of June 27, 2002, establishing a community vessel traffic monitoring and information system, states the operator, agent or master of a ship bound to a port of a member state shall report information to the port authority at least 24 hours in advance or in certain cases earlier. The information includes ship identification, port of destination, estimated time of arrival, etc.

A new mandatory reporting system has been introduced in the Gulf of Finland using the Gulf of Finland Mandatory Reporting System, GOFREP. In accordance with the IMO resolution, Finland, Estonia and the Russian Federation require that all vessels exceeding



Map 9.5 Location of oil spills observed in the Baltic Sea area in 2007. *Source: HELCOM*

300 gross tonnage are required to participate in the GOFREP system when sailing in the international waters in the Gulf of Finland. This reporting system will allow automatic reporting with AIS and automatic response from the GOFREP.

IMO resolution MSC.138(76) recommends masters use new and improved navigation equipment including Electronic Chart Display and Information System (ECDIS) onboard ships navigating Route T with a draft of 11 meters or more; oil tankers navigating the Sound with a draft of seven meters or more; chemical tankers; gas carriers; and ships carrying a shipment of irradiated nuclear fuel, plutonium and high level radioactive wastes (INF cargoes) irrespective of size. ECDIS supports plotting and automatically monitoring ships' positions throughout their voyage. The risk of collisions and groundings will be reduced by superimposing AIS and radar information on the electronic chart display.

Research Opportunities

- Research to advance the convergence of critical navigational information including hydrography (ENCs), weather, ice conditions and other data into integrated shipboard navigation systems.
- Research into technologies for hydrographic data collection, especially for adaptation to the Arctic environment. This should include the use of unmanned, underwater (under-ice) vehicles, multibeam technology, through-the-ice data collection, and airborne systems for the collection of nearshore depths and for shoreline identification.
- Research on satellite remote sensing and surface validation to develop means of monitoring ice thickness across the Arctic Ocean.
- Simulated conditions or field testing of oil spills and other pollutants to determine behavior including fate and effects. This should include improvements in remote surveillance and detection technologies; improved oil-in-ice modeling capabilities and long-term fate and effects of lingering oil.
- Focus on further development and improvement of ice service products and services on ice thickness, iceberg detection, forecasting of ice drift and drift of icebergs.
- Research on behavior of oil in cold, ice infested areas including establishing forecasting models to compute the drift of oil in such waters.
- Further development of satellite based oil detection algorithms for ice-covered areas.
- Research on effective response techniques and technology for oil spill recovery on ice, broken ice and cold water.

Routing Systems

A transit route (Route T) through the Kattegat, the Great Belt and the Western Baltic has been established for deep draft ships. Routing systems have been established for ships navigating the Sound. A deepwater route (DW) from Bornholm, south of the Hoburgen bank and up to the border with the Estonian Economic Zone fulfilling the IHO S44 standard for hydrographic surveying has been established. With a clearance of 10 nautical miles to the banks, this will allow a ship with, for example, an engine failure, ample time for speed reduction to be able to drop anchor.

Fifteen traffic separation schemes are established and adopted by IMO in eight parts of the Baltic Sea Area. Two schemes are established in Samsø Belt/Great Belt, two in the Sound, one off Kiel lighthouse, one south of Gedser, one south of Öland Island, one south of Gotland Island, two in the entrance to the Gulf of Finland and five in the Gulf of Finland.

Pilotage

Pilotage services are established locally by the port states and are normally compulsory for ships over certain sizes.

Due to the *Copenhagen Treaty 1857*, ships sailing to or from the North Sea to the Baltic Sea are not required to use pilots. The IMO recommends that when navigating the entrances to the Baltic Sea, local pilotage services should be used by ships as identified in Resolution MSC.138 (76). Certified pilots for the entrances to the Baltic Sea are available in Denmark and, for ships passing through the Sound, in Sweden. Certified Baltic Sea deep-sea pilots are available in all Baltic Sea States.

Weather and Wave Information Systems

Weather and wave monitoring and information systems have been established by the Baltic Sea States in the Baltic Sea area. Weather and wave information is available for seafarers at all times.

Ice Information Systems

Baltic Icebreaking Management (BIM) is an organization with members from all the Baltic Sea states: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, the Russian Federation and Sweden. The overall objective of BIM is to ensure a well functioning, year-round maritime transport system in the Baltic Sea through the enhancement of strategic and operational cooperation between the Baltic Sea countries in the area of winter navigation assistance.

The Internet site, www.Baltice.org, is a single access point to reliable and up-to-date information related to winter navigation in the Baltic Sea area.

Protection of People and Property: Incident Response and Overall Coordination

Search and rescue at sea means saving and protecting lives of persons in distress in the sea area. This includes many different duties like assisting vessels and boats in distress at sea, preventing disasters, searching for missing people and performing medical transport in the archipelago and sea area. The basis for carrying out these duties is enacted in international treaties and decrees. All authorities operating in the Baltic Sea area carry out SAR at sea. Also participating are merchant shipping and voluntary organizations. For example, in Finland, the Border Guard is responsible for SAR service at sea and the Maritime Rescue Coordination Centre and maritime rescue sub-centers lead SAR operations. When the persons or environment are no longer in danger, commercial companies carry out the salvage of vessels and cargo.

Protection of the Environment: Oil and Other Hazardous Spills Response

The cooperation in combating spillages of oil and other harmful substances in the Baltic Sea area is based on the Helsinki Convention and HELCOM Recommendations on combating matters, adopted by the Helsinki Commission.

In accordance with the Helsinki Convention the Contracting Parties shall maintain the ability to respond to spillages of oil and other harmful substances into the sea threatening the marine environment of the Baltic Sea area. This ability shall include adequate equipment, ships and manpower prepared for operations in coastal waters as well as on the high seas.

According to the Helsinki Convention, the Contracting Parties shall agree bilaterally or multilaterally on those regions of the Baltic Sea Area in which they should conduct aerial surveillance and take action for combating or salvage activities whenever a significant spillage of oil or other harmful substance or any incident causing or likely to cause pollution within the Baltic Sea area has occurred or is likely to occur.

In cases where a Contracting Party is not able to cope with a spillage by the sole use of its personnel and equipment, the Contracting Party in question can request combating assistance from other Contracting Parties, starting with those who seem likely also to be affected by the spillage.

Monitoring / Enforcing Compliance with Marine Regulation

Port State Control

Port State Control systems have been established by the Baltic Sea States in all Baltic Sea ports in accordance with the Paris Memorandum of Understanding.

Aerial Surveillance

By international law, any release of oily wastes or oily water from ships is prohibited in the Baltic Sea, where oil pollution can affect sensitive ecosystems for long periods. But ships persist in making illegal discharges, despite improvements in port reception facilities and a harbor fee system, which means there is no financial gain to be had from polluting the sea. Every year national surveillance aircraft detect several hundred illegal oil discharges in the Baltic Sea. The actual number of illegal discharges is probably much higher than this. In fact, during most years more oil is released on purpose around the Baltic Sea than is spilled accidentally.

Internationally Coordinated Surveillance Flights

The HELCOM states endeavor to fly, at a minimum, twice per week over regular traffic zones including approaches to major sea ports, as well as in regions with regular offshore activities; and once per week over the regions with sporadic traffic and fishing activities. Twice a year, several Baltic Sea states jointly organize surveillance flights (24 to 36 hours): one covering the southern part of the Baltic Sea and another flight over waters further north.

Arctic Maritime Training

Maritime training in ice conditions is available by private companies in the Baltic Sea area.

The content of the courses includes ice characteristics and ice classifications, ice charts, ice classes, winterization, ship operations in ice, independent navigation in ice, icebreaker operations and ice navigation in convoy. Training of ship maneuvering in ice is done in a full-mission simulator.

Findings

1] Considering the Arctic operational environment and the lack of infrastructure, safe navigation in the Arctic is often dependent on the skills of a limited number of seasoned northern mariners. The demand for skilled mariners is increasing, the number of experienced Arctic mariners is decreasing and there are no universal or mandatory formal education, training and certification requirements in place for ice navigators or crew to prepare them for Arctic marine operations.

2] Based on the information provided, significant portions of the primary Arctic shipping routes do not have adequate hydrographic data, and therefore charts, to support safe navigation. This appears most critical in the Canadian Archipelago and the Beaufort Sea and possibly other areas in the Arctic; at the same time the Russian Federation has broadly identified a requirement for updated hydrography in its Arctic waters. In addition, expansion of the current routes is required to allow alternative courses when hazardous ice conditions are encountered, for entry to points of refuge when necessary, and to support access to natural resources.

3] Electronic Chart Display and Information Systems (ECDIS), especially when coupled with Digital Global Positioning System, improves navigational safety by providing precise, real-time positioning along with holistic display of navigation and environmental information critical for safe navigation in the Arctic. ECDIS may also reduce the requirements and costs associated with deploying and maintaining traditional aids to navigation systems. This creates a high expectation that hydrographic offices will have electronic charts ready for use in the primary navigation routes in the Arctic by 2012. However, the use of ECDIS is wholly dependent on the availability of accurate navigational charts, which rely on comprehensive hydrographic surveys and data.

4] Arctic Maritime Traffic Awareness - There are few systems to monitor and control the movement of ships in ice-covered Arctic waters as an effective way to reduce the risk of incidents, particularly in areas deemed sensitive for environmental or cultural reasons.

5] There are serious limitations to radio and satellite communications for voice or data transmission in the Arctic because there is not complete satellite coverage of the region.

6] There is no binding requirement to implement the recently developed and adopted International Association of Classification Societies (IACS) Unified Requirements concerning *Polar Class* and the December 2002 IMO *Guidelines for Ships Operating in Arctic Ice-covered Waters;* consequently polar vessel construction standards are unevenly applied.

7] For safe operations, ships navigating in the Arctic need the same suite of meteorological and oceanographic data, products and services as in the other oceans plus a comprehensive suite of data, products and services related to sea ice and icebergs. As the shipping season becomes extended, significant increases in resources will be needed to expand the information services accordingly.

8] Emergency response capacity for saving lives and pollution mitigation is highly dependent upon a nation's ability to project human and physical resources over vast geographic distances in various seasonal and climatic circumstances. The current lack of infrastructure in all but a limited number of areas, coupled with the vastness and harsh environment, makes carrying out a response significantly more difficult in the Arctic. Without further investment and development in infrastructure, only a targeted fraction of the potential risk scenarios can be addressed.

9] The operational network of meteorological and oceanographic observations in the Arctic, essential for accurate weather and wave forecasting for safe navigation, is extremely sparse.

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The Arctic Council's Arctic Marine Shipping Assessment was a four-year, multinational-led project, under the direction of the Protection of the Arctic Marine Environment (PAME) working group, that included more than 185 experts in maritime and related fields; 13 major workshops in Canada, Finland, Iceland, the Russian Federation and the United States; and 14 town hall meetings in selected Arctic communities, supported by the Permanent Participants of the Arctic Council. Funding for the *AMSA 2009 Report* was a public-private partnership effort.

AMSA Lead Country Representatives

Canada: V.M. Santos-Pedro; Finland: K. Juurmaa; United States: L. Brigham, Chair

Section Lead Authors

Introduction: L. Brigham; Arctic Marine Geography, Climate and Sea Ice: L. Brigham & R. McCalla; History of Arctic Marine Transport: E. Cunningham, L. Brigham & W. Barr; Governance of Arctic Shipping: D. VanderZwaag, A. Chircop & V.M. Santos-Pedro; Current Marine Use and the AMSA Database : R. MacDonald & S. Harder; Scenarios, Futures and Regional Futures to 2020: L. Brigham, B. Ellis & J. Snyder; Human Dimensions: H. Huntington & E. Cunningham; Environmental Considerations and Impacts: H. Skjoldal & M. Gold; Arctic Marine Infrastructure: M. Williams, T. Wojhan & J. Falkingham.

AMSA 2009 Report Co-editors

B. Ellis, L. Brigham

Contributors

S. Anderson, K. Baiborodova, K. Bailey-McCarthy, H. Ballestero, E. Balo, A. Bambulyak, D. Bancroft, W. Barr, P. Bergmann, O. Bjerkemo, W. Blanchard, S. Borgerson, P. Bourbonnais, S. Brand, R. Bridges, L. Brigham, V. Broje, R. Browne, R. Brubaker, B. Brunstad, R. Button, J. Calvesbert, M. Cerne, A. Chircop, S. Chursanov, P. Clemente-Colón, D. Cobb, K. Cole, J. Corbett, R. Corell, T. Crowe, E. Cunningham, J. Cunningham, A. Degteryov, D. Dickins, C. Dokis, M. Druckenmiller, N. Durham, D. Edwards, H. Eicken, B. Ellis, V. Ershov, T. Ertmann, C. Fabienke, J. Falkingham, J. Farrell, A. Fish, E. Franckx, I. Frolov, L. Furgione, V. Galahov, I. Gapeshko, I. Germogenova, V. Gofman, M. Goguen, M. Gold, D. Goodman, D. Gordon, A. Gorshkovskiy, A.Granberg, W. Gray, M. Grigoriev, C. Grinberg, S. Gudmundsdottir, C. Hall, L. Hamilton, S. Harder, O. Hauge, R. Headland, N. Hemsath, J. Hodgson, B. Hollebone, J. Holst-Andersen, L. Hosseus, R. Huebert, H. Huntington, H. Hustad, B. Ionov, U. Ivankov, D. Jackson, C. Johnson, C.C. Johnson, K. Juurmaa, J. Kamarainen, A. Kholodov, H. Kindred, V. Kingeekuk-Metcalf, N. Kinner, D. Kirby, N. Kornilov, V. Korshunov, M. Krol, D. Laible, K. Lampela, T. Laughlin, J. Lawson, R. Levenson, S. Lilley, L. Littlejohn, J. LoSciuto, L. Low, R. MacDonald, K. MacInnis, B. MacKenzie, Z. Magdol, D. Main, V. Makarov, A. Makinen, K. Mandsager, G. Martuk, G. Matishov, R. McCalla, M. McCammon, M. McConnell, A. McDonald, T. McDorman, R. Meehan, A. Merten, M. Meza, V. Mikhailichenko, S. Mills, S. Montoya, S. Moore, S. Morgan, R. Morris, M. Moynihan, T. Mustonen, T. Newbury, K. Newman, D. Nicholson, M. Niini, R. Noblin, A. Nosacyov, B. O'Connell, J. Ouellet, J. Overland, J. Parsons, R. Parsons, R. Pawlowski, V. Peresypkin, V. Plaksiy, Y. Potapova, T. Puthucherril, P. Rabinow, C. L. Ragner, M. Ranen, R. Rayner, C. Reimer, G. Retter, S. Rice, A. Robertson, G. Robertson, S. Rolston, J. Sabine, E. Saebo, V.M. Santos-Pedro, P. Saunders, A. Scholik-Schlomer, P. Schwartz, J. Schwarz, K. Schwehr, A. Seninov, S. Sen'shin, A. Sevost'yanov, W. Sheard, G. Sheffield, G. Silber, H. Skjoldal, E. Smith, N. Snow, J. Snyder, I. Soady, B. Southall, K. Spears, B. Spencer, T. Stubbs, V. Suvorov, T. Tanninen, D. Temple, A. Tezikov, D. Thurston, G. Tolbert, P. Travaglini, L. Trigatti, L. Tsoy, A. Tucci, O. Turin, D. Upcraft, A. Ushakov, A. Uusiaho, D. VanderZwaag, G. Viggósson, D. Vongraven, J. Walton, M. Wang, J. Weatherly, D. Wells, D. Westerholm, M. Williams, J. Whitney, C. Wiley, B. Wilson, J. Winebrake, M. Winterbottom, T. Wojhan, C. Wright, C. Wu, I. Yagubov, V. Zolotaryov

AMSA Workshops

July 2006 - Calgary, Canada: ICETECH06 and Stakeholder Workshop
March 2007 - Akureyri, Iceland: Arctic Navigation Conference
April 2007 - San Francisco, United States: GBN Scenarios Workshop I
July 2007 - Helsinki, Finland: GBN Scenarios Workshop II
October 2007 - Ottawa, Canada: Marine Infrastructure Workshop
February 2008 - St. Petersburg, Russian Federation: NSR Partnership Workshop
March 2008 - University of New Hampshire, United States: Arctic Marine Incidents Workshop
March 2008 - Ottawa, Canada: Arctic Indigenous Use Workshop
April 2008 - San Francisco, United States: Environmental Impacts Workshop
July 2008 - Calgary, Canada: ICETECH08 and Stakeholder Workshop
September 2008 - London, United Kingdom: Marine Insurers Workshop
September 2008 - Seattle, United States: AMSA Environmental Impacts Workshop
October 2008 - Cornwall, Canada: AMSA Integration Workshop

AMSA Town Hall Meetings

April 2006 - Iqaluit, Nunavut, Canada
July 2006 - ICC General Assembly, Barrow, Alaska, United States
August 2006 - Tuktoyaktuk, Northwest Territories, Canada
March 2007 - Akureyri, Iceland
March 2007 - Reykjavik, Iceland
September 2007 - Unjárga/Nesseby, Porsanger, Norway
September 2007 - Billávuotna /Billefjord, Porsanger, Norway
June 2008 - Iqaluit, Nunavut, Canada
June 2008 - Pond Inlet, Nunavut, Canada
June 2008 - Resolute Bay, Nunavut, Canada
June 2008 - Cambridge Bay, Nunavut, Canada
June 2008 - Inuvik, Northwest Territories, Canada
June 2008 - Yellowknife, Northwest Territories, Canada
August 2008 - Nome, Alaska, United States

AMSA Financial Contributors

Government of Canada (Fisheries and Oceans Canada, Foreign Affairs and International Trade Canada, Indian and Northern Affairs Canada, Transport Canada)
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Susie Harder

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TerraGraphica, Anchorage, Alaska, U.S.A.
Eric Cline, Creative Director
Amy Turilli, Designer

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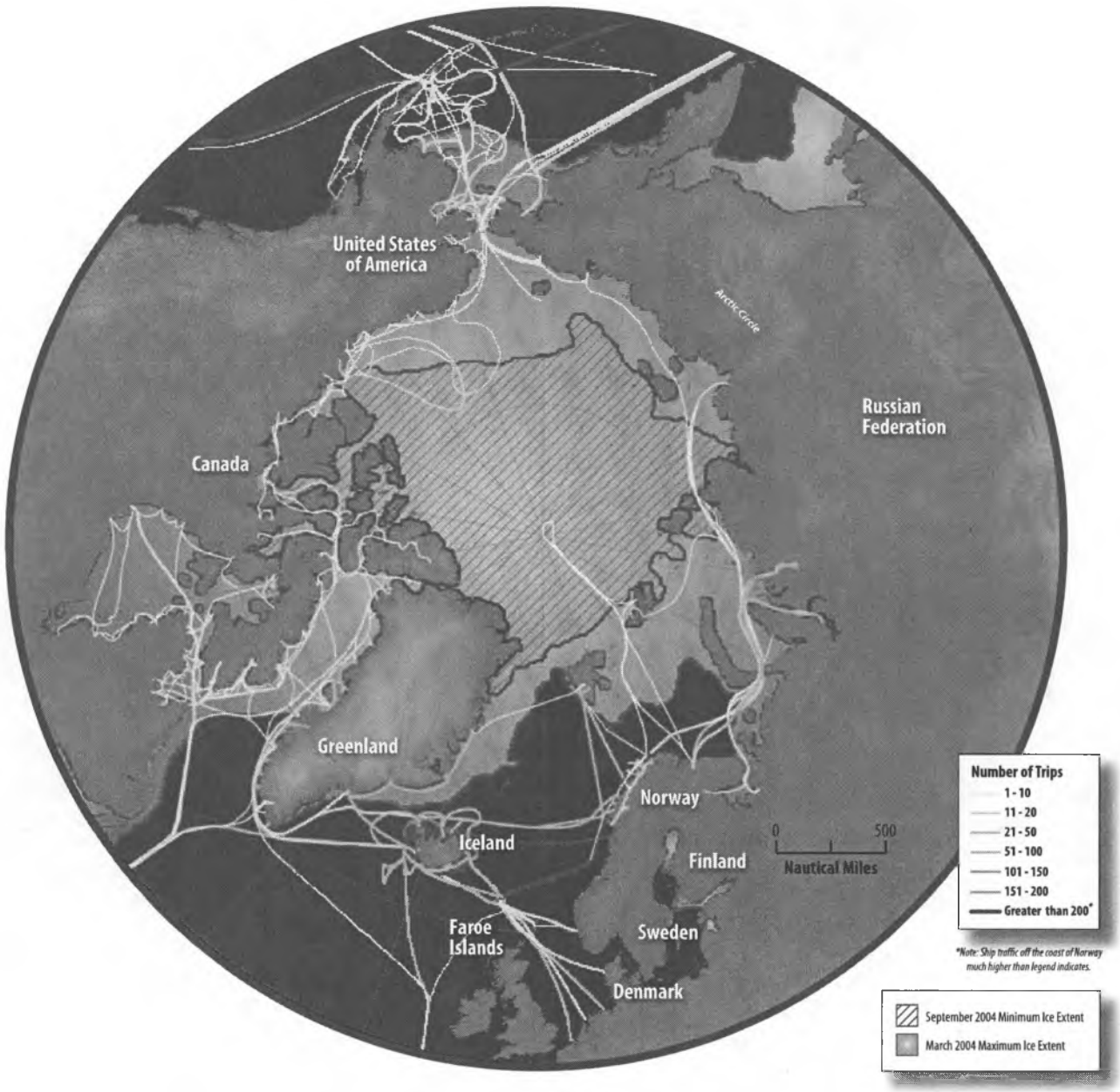
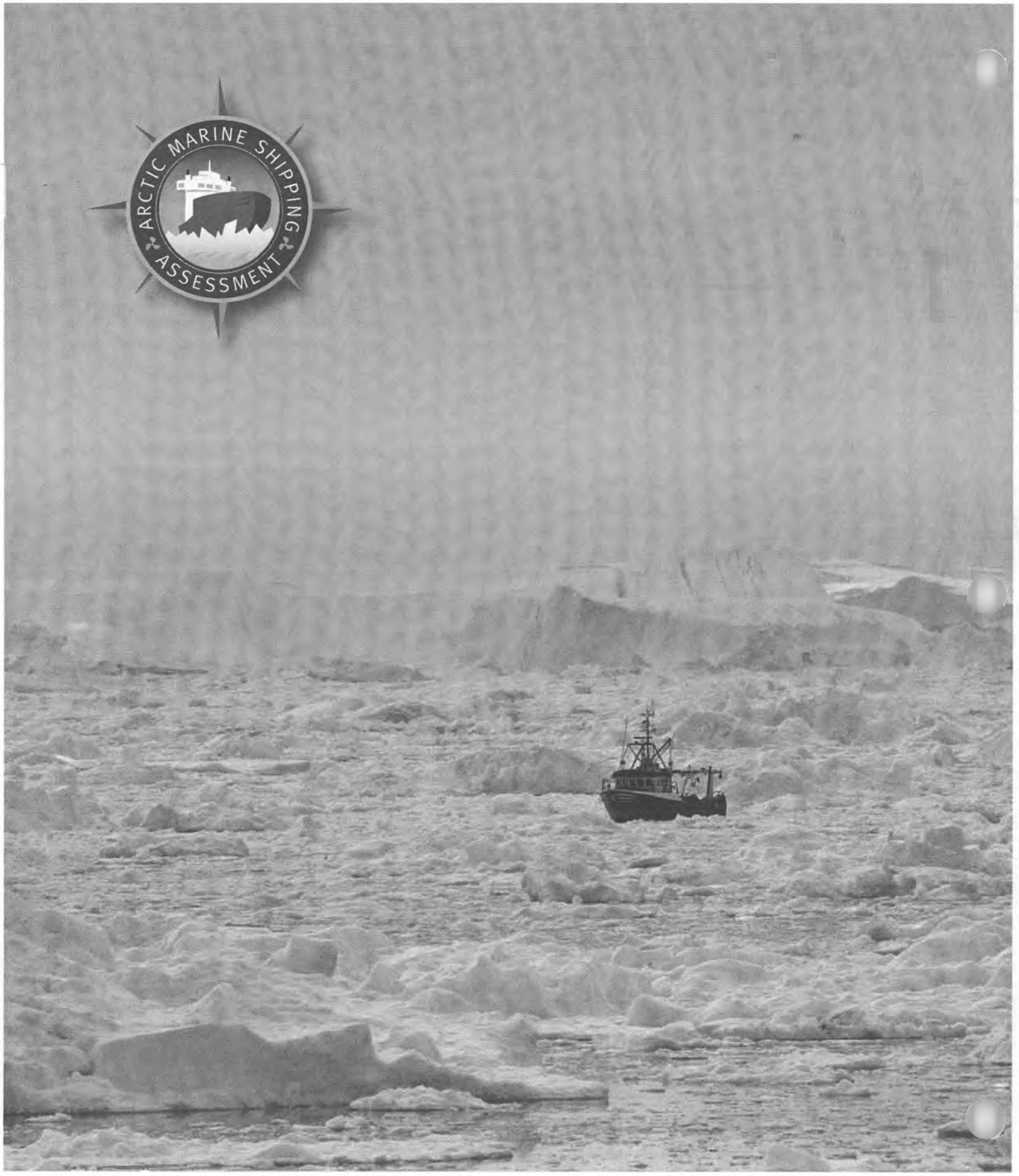


Shipping traffic in the Arctic for the AMSA survey year 2004. *Source: AMSA*


ARCTIC MARINE SHIPPING
ASSESSMENT

UAF NEWS RELEASE
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Report details next steps in arctic shipping policies

FOR IMMEDIATE RELEASE: Sept. 15, 2010
CONTACT: Marmian Grimes, UAF information officer, 907-474-7902, marmian.grimes@alaska.edu

Fairbanks, Alaska—As the climate warms and global commerce grows, the prospect of an arctic shipping route becomes more tangible. A new report released by the University of Alaska Fairbanks offers international policymakers guidance for navigating the political and practical ramifications of shipping in the Arctic.

The report, "Considering a Roadmap Forward: The Arctic Marine Shipping Assessment," is the result of a workshop hosted by UAF in October 2009 as part of the University of the Arctic's Institute for Applied Circumpolar Policy. The workshop drew nearly 70 experts from Canada, China, Denmark, Japan, Norway, the United Kingdom and the United States to examine the 17 recommendations outlined in the Arctic Council's 2009 Arctic Marine Shipping Assessment.

"The workshop report takes the key AMSA recommendations and provides to the arctic community a list of action items to consider as we collectively navigate a future of change," said Mike Sfraga, head of the UA Geography Program and UAF vice chancellor for students.

Sfraga co-chairs the Institute for Applied Circumpolar Policy with Kenneth Yalowitz of Dartmouth College. Yalowitz is director of the Dickey Center for International Understanding at Dartmouth.

"The future of shipping in the Arctic is one of the most important issues resulting from climate change in the North," Yalowitz said.

The three-day October 2009 workshop focused on three themes: enhancing arctic marine safety, protecting arctic people and the environment, and building the arctic marine infrastructure. The 24-page report offers dozens of proposed actions, many of which will require public or private funding. Among the highest-priority policy issues are:

- A mandatory International Maritime Organization Polar Code.
- Full tracking and monitoring of arctic commercial ships.
- An arctic search and rescue agreement (underway).
- Surveys of indigenous marine use.
- A circumpolar response capacity agreement among the arctic states.
- Implementation of an arctic observing network to support science and marine operations.

"The working groups identified a roadmap, actions and a set of key issues for each of AMSA's recommendations," said UAF geography professor Lawson Brigham, who led the original AMSA effort for the Arctic Council.

Sfraga presented the report at an Institute for Applied Circumpolar Policy workshop in Rovaniemi, Finland, last week. UAF Chancellor Brian Rogers is sharing the report with members of the University of the Arctic, Arctic Council and Arctic Parliamentarians in Brussels this week. It is available online at http://www.snap.uaf.edu/downloads/arctic-marine-shipping-assessment. The workshop report will also be widely distributed to the global maritime and arctic communities.

- 30 -

ADDITIONAL CONTACTS: Mike Sfraga at 907-474-7317 or msfraga@alaska.edu. Lawson Brigham, UAF geography professor, at 907-474-7494 or lwb48@aol.com.

ON THE WEB:
The Arctic Marine Shipping Assessment, http://pame.is/amsa
University of the Arctic's Institute for Applied Circumpolar Policy, http://iacp.dartmouth.edu/

NOTE TO EDITORS: A copy of the report is also available online at www.uafnews.com

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Considering a Roadmap Forward: The Arctic Marine Shipping Assessment

WORKSHOP REPORT

University of Alaska Fairbanks
October 22-24, 2009

University of the Arctic ~ Institute for Applied Circumpolar Policy

Editors: Lawson W. Brigham and Michael P. Sfraga

University of Alaska Geography Program
School of Natural Resources & Agricultural Sciences

UNIVERSITY OF ALASKA FAIRBANKS

Greetings from the University of Alaska Fairbanks - America's Arctic University. I am pleased that UAF is a founding member, along with our partner Dartmouth College, of the University of the Arctic Institute for Applied Circumpolar Policy. The Institute was established to explore, inform, and shape policy issues that impact residents of the North. It is with this background that I share with you the findings of the Institute's 2nd workshop held at the University of Alaska Fairbanks entitled "Considering a Roadmap Forward: The Arctic Marine Shipping Assessment."

As Chancellor of the University of Alaska Fairbanks and member of the University of the Arctic's Board of Governors, I believe universities throughout the North have a responsibility to study and consider issues that impact the people of the North. The Arctic Council's Arctic Marine Shipping Assessment (AMSA), published in April of 2009, is a path-breaking report that will have far-reaching impacts on Northern communities well into the future. This report's long-term importance is the reason the Fairbanks workshop considered the implications and challenges of the AMSA and its related recommendations.

It takes many partners to conduct a successful program. In addition to the participants, I want to highlight Victor Santos-Pedro, David Jackson, Margaret Williams, and Bob Pawlowski, who tirelessly led the program's three working groups. I would like to thank Holland America Lines and the United States Arctic Research Commission for their generous support of the workshop.

I am confident that "Considering a Roadmap Forward: The Arctic Marine Shipping Assessment" will further inform stakeholders, policy makers, industry, and the people of the North as they consider the challenges in our unique, dynamic, fragile, and powerful Arctic of the future.

Brian Rogers, Chancellor
University of Alaska Fairbanks
Member, University of the Arctic
Board of Governors

Cover photo: The icebreaking carrier MV *Arctic* in the Canadian Arctic where the ship has operated safely and effectively since 1975. © Fednav Ltd

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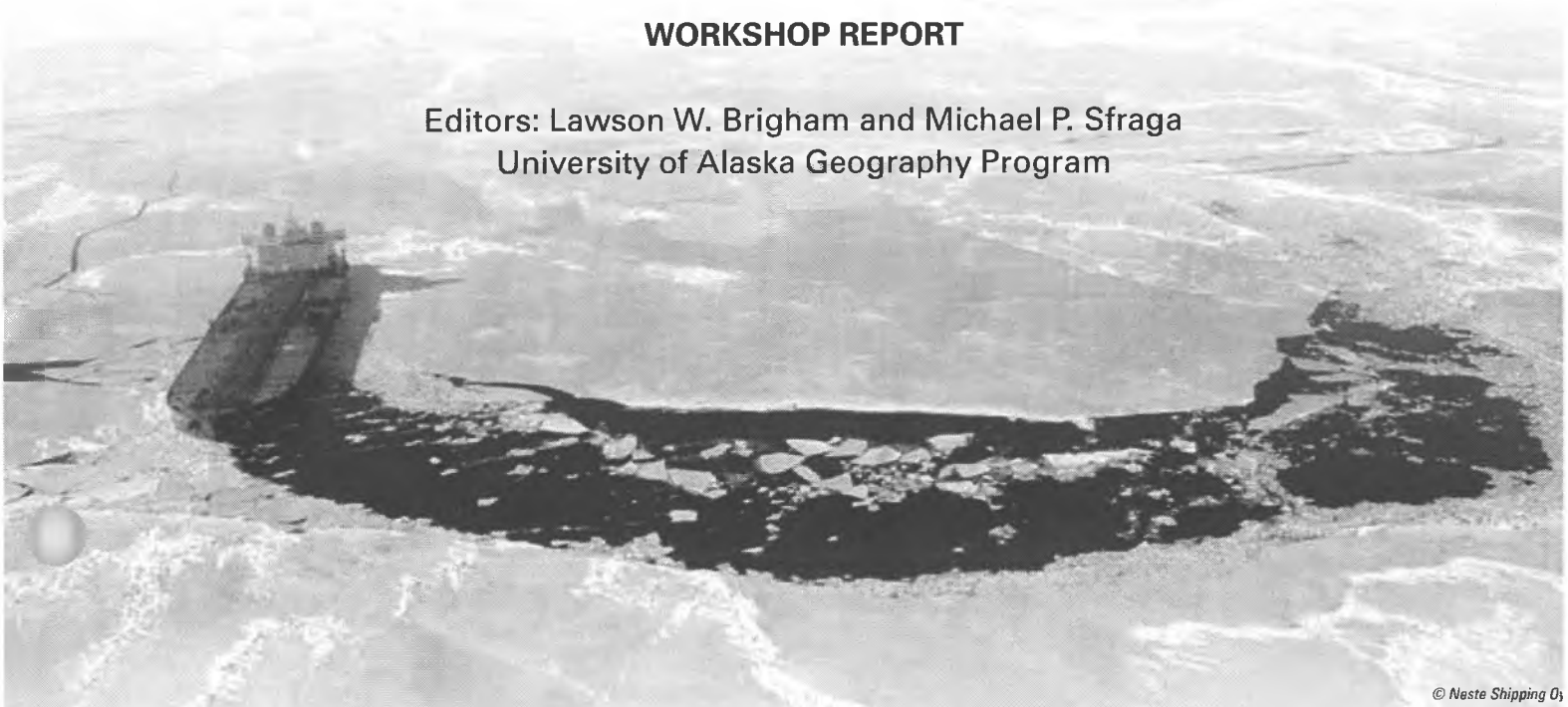
Considering a Roadmap Forward: The Arctic Marine Shipping Assessment

University of Alaska Fairbanks ~ October 22-24, 2009
University of the Arctic Institute for Applied Circumpolar Policy

WORKSHOP REPORT

Editors: Lawson W. Brigham and Michael P. Sfraga
University of Alaska Geography Program



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Introduction and Workshop Objectives

This is a report of an Arctic policy workshop hosted by the University of Alaska Fairbanks on 22-24 October 2009. It forms an important contribution to the University of the Arctic's Institute for Applied Circumpolar Policy (IACP), a collaboration between Dartmouth College, the University of Alaska Fairbanks (UAF), and the University of the Arctic (UArctic). ICAP is co-directed by Dr. Michael Sfraga, University of Alaska Fairbanks and Former U.S. Ambassador Kenneth Yalowitz, Dartmouth College. IACP is the first formal institute sanctioned by UArctic member institutions and its mission is to promote discussion and analysis of critical issues facing the circumpolar region and its people. IACP has also been established to provide educational opportunities and policy-oriented advice as northern peoples face the challenges resulting from rapid climate change and other drivers of change in the Arctic such as natural resource development and globalization.

IACP has initially focused its efforts on a series of conferences and workshops that will hopefully improve public and private understanding of the policy implications resulting from circumpolar change, especially climate change and the human dimension. These gatherings bring together representatives of governments, non-governmental organizations, Arctic indigenous peoples, industry, and research organizations to discuss, identify, and prioritize issues and policy-related research. The outcomes of these meetings will help develop the agendas for governments to address pressing policy issues in the Arctic. The first IACP venue was held at Dartmouth College 1-3 December 2008 with a focus on climate change and Arctic security issues; a report, *The Arctic Climate Change and Security Policy Conference - Final Report and Findings*, was released in June 2009 at the Carnegie Endowment for International Peace in Washington, DC. The second IACP venue is the subject of this workshop report regarding the Arctic Council's Arctic Marine Shipping Assessment (AMSA). A third venue will be organized at the Arctic Centre in Rovaniemi, Finland in September 2010 focusing on climate change and human security in the Arctic.

The topic for this workshop report, the Arctic Council's Arctic Marine Shipping Assessment (AMSA), came about because of the April 2009 release of the *AMSA 2009 Report*. AMSA has clear policy implications for the Arctic and the global maritime industry, and UArctic and UAF recognized the relevance of these issues to the mission of IACP. Nearly seventy experts from Canada, China, Denmark, Japan, Norway, the United Kingdom and the United States participated; participants included representatives from the Arctic states, non-governmental organizations, indigenous groups, marine companies, maritime organizations, and academic institutions.

The objectives of the Fairbanks workshop were to explore the implications of the AMSA recommendations using three working groups of experts, and discuss the challenges ahead for implementation of the outcomes of AMSA. The working groups identified a roadmap and actions, and a set of key issues for each of AMSA's recommendations. Further discussions focused on funding and financial issues, and the key policy issues that are of the highest priority in addressing Arctic marine safety and marine environmental protection. The workshop agenda, included as Appendix 2, also indicates nine workshop presentations that highlighted significant policy issues being faced today by the Arctic states and indigenous communities throughout the North. It is anticipated that the results of this workshop will be used by the Arctic Council and its working groups, the Permanent Participants on the Council, the maritime industry, and many other stakeholders to assist in shaping future use of the Arctic Ocean.

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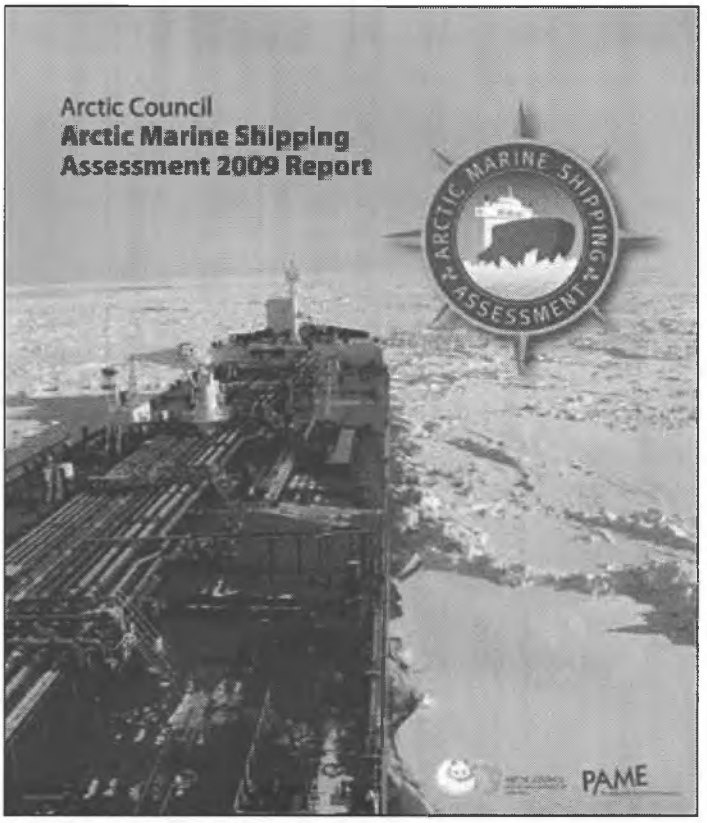
Background ~ The Arctic Marine Shipping Assessment

On 29 April 2009 at the Arctic Council Ministerial meeting in Tromso, Norway, the Arctic Ministers approved a key study for the future of the region, the Arctic Marine Shipping Assessment (AMSA). AMSA is the culmination of work by nearly 200 experts under the Council's working group Protection of the Arctic Marine Environment (PAME). AMSA was led by Canada, Finland and the United States during 2005-2009 and is a follow-on effort to the Council's Arctic Climate Impact Assessment and the Arctic Marine Strategic Plan, both released in 2004 and each indicating increases in Arctic marine operations. AMSA is an assessment of current and future Arctic marine activity with a focus on Arctic marine safety and marine environmental protection. These themes are consistent with the Arctic Council's key mandates of environmental protection and sustainable development. Overall, the *AMSA 2009 Report* is a message by the Arctic states to the world with a framework to address the many, complex challenges of protecting Arctic people and the environment in an era of expanding use of the Arctic Ocean.



AMSA can be viewed in three ways:

- A **baseline assessment** of Arctic marine activity early in the 21st century using the 2004 AMSA database as an historic snapshot of marine use;
- A **strategic guide** for a host of Arctic and non-Arctic actors and stakeholders;
- A **policy document of the Arctic Council**, since the *AMSA 2009 Report* was negotiated and consensus for its approval was reached by the eight Arctic states within the Council.

The *AMSA 2009 Report* is a key Arctic Council policy document that contains some elements of scientific research, especially those topics related to environmental impacts. However, AMSA is much broader than science and includes such topics as geography, law of the sea, scenarios of the future, marine infrastructure, globalization of the Arctic, indigenous community viewpoints, natural resource development, and other practical issues of Arctic marine navigation; 96 findings are presented in the assessment. The *AMSA 2009 Report* and *AMSA Background Research Documents* (research papers not approved or negotiated by the Arctic Council) can be found on the PAME web site (www.pame.is).

The key outcomes of AMSA are 17 recommendations agreed to by the Arctic states in the *AMSA 2009 Report* under three, inter-related themes: Enhancing Arctic Marine Safety, Protecting Arctic People and the Environment, and Building the Arctic Marine Infrastructure. The full AMSA recommendations are included in Appendix I of this report. These 17 recommendations were the focus of the Fairbanks workshop expert discussions and resulted in a roadmap ahead and key issues for each, and identification of funding challenges and policy issues that require attention. As with AMSA itself, the workshop experts recognized that implementation of the AMSA recommendations would require extensive international cooperation and public-private partnerships.

Guidance to the Workshop Working Groups

AMSA Workshop Working Groups:

I. Enhancing Arctic Marine Safety
II. Protecting Arctic People and the Environment
III. Building the Arctic Marine Infrastructure

- ✓ Please read recommendations specific to your AMSA theme.
- ✓ Please address the five tasks listed below.
- ✓ Provide bulleted answers – followed by a brief narrative that summarizes the overall "roadmap" response to each recommendation.

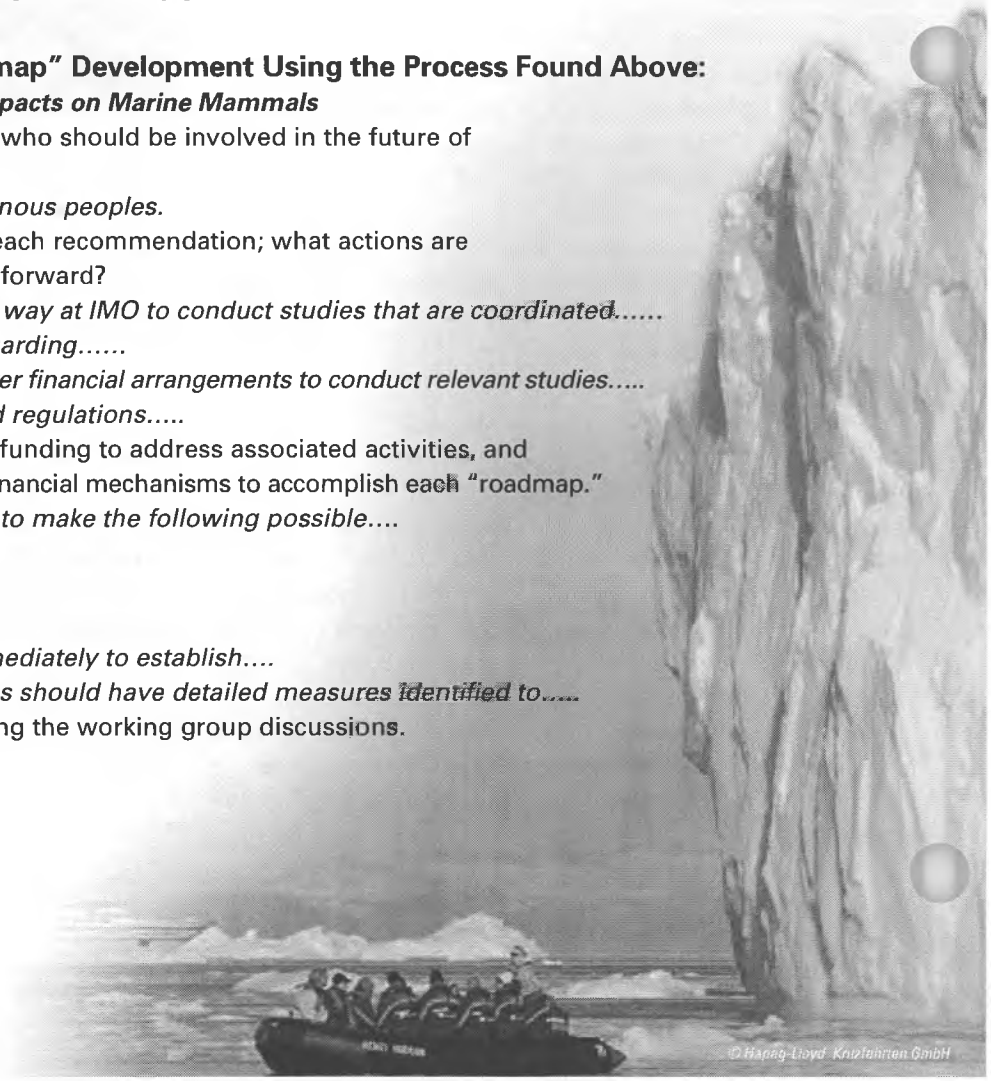
Tasks:

1) Identify primary stakeholders and actors who should be involved in the future of this recommendation.
2) Develop "roadmap" or "roadmaps" for each recommendation; what actions are required to move each recommendation forward?
3) For each "roadmap" identify sources of funding to address associated activities, and recommend any possible new or special financial mechanisms to accomplish each "roadmap."
4) Establish a timeline for each "roadmap."
   a. Less than 2 years
   b. Beyond 2 years
5) Identify other key issues discovered during the working group discussions.

Example Recommendation and "Roadmap" Development Using the Process Found Above:

AMSA Recommendation II G: Addressing Impacts on Marine Mammals

1) Identify primary stakeholders and actors who should be involved in the future of this recommendation.
   - *IWC, IMO, Maritime agencies, Indigenous peoples.*
2) Develop "roadmap" or "roadmaps" for each recommendation; what actions are required to move each recommendation forward?
   - *Arctic nations should act in a unified way at IMO to conduct studies that are coordinated.....*
   - *Consult with Arctic Communities regarding.....*
   - *Arctic Council, SDWG, etc. should foster financial arrangements to conduct relevant studies.....*
   - *Establish international standards and regulations.....*
3) For each "roadmap," identify sources of funding to address associated activities, and recommend any possible new or special financial mechanisms to accomplish each "roadmap."
   - *Establish new financial mechanisms to make the following possible....*
4) Establish a timeline for each "roadmap."
   a) Less than 2 years
   b) Beyond 2 years
      - *Technical groups must begin immediately to establish....*
      - *In two year's time, working groups should have detailed measures identified to.....*
5) Identify other key issues discovered during the working group discussions.



Identifying the Stakeholders and Actors

Experts in the three Workshop Working Groups (Enhancing Arctic Marine Safety, Protecting Arctic People and the Environment, and, Building the Arctic Marine Infrastructure) identified a host of stakeholders and actors who are believed to have some involvement and influence in AMSA and in the future of Arctic marine activity. As might be expected, there were significant overlap among the working group listings, and discussions on who might be relevant stakeholders and actors. The primary decision-makers and 'players' in this review are considered to be the eight Arctic sovereign states, the flag states, and the indigenous groups who make up the six Permanent Participants of the Arctic Council. The below should be considered examples of the key stakeholders & actors, however, not an exhaustive list.

~ **Sovereign States** (Regulatory and response agencies; regional authorities; national hydrographic services; national ice services; national pollution funds); Flag States; ~ **Indigenous Groups** (including domestic tribal groups and Arctic Council Permanent Participants)

~ **International Governmental Organizations:** International Maritime Organization; International Hydrographic Organization; International Maritime Satellite Organization; World Meteorological Organization; International Whaling Commission; International Association of Marine Aids to Navigation and Lighthouse Authorities; International Oil Pollution Compensation Funds; International Telecommunication Union; International Oceanographic Commission; International Ice Charting Working Group; The World Bank

~ **Maritime Industry:** Shipping companies; Offshore drilling companies; Ship classification companies; International Association of Classification Societies (IACS); Intertanko, Bimco; Cruise Lines International Association; Oil Companies International Marine Forum; Offshore Marine Services Association; International Oil and Gas Products; SIGTTO; International Association of Drilling Contractors; International Association of Arctic Expedition Cruise Operators; Passenger Vessel Association; International Association of Antarctic Tour Operators; Fishing industry; marine pilots; Oil spill response organizations; International Tanker Owners Pollution Federation; Local marine suppliers and engineering/technical support firms

~ **Marine Insurers:** Marine insurance companies; International Union of Marine Insurance; American Institute of Marine Underwriters

~ **Private/Independent:** NGOs; Non-profit foundations; academic & training institutions; research organizations (public and private)

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Results of the Working Group Discussions on the AMSA Recommendations:

Roadmap and Actions & Key Issues for

I ~ Enhancing Arctic Marine Safety

II~ Protecting Arctic People and the Environment

III ~ Building the Arctic Marine Infrastructure

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I. Enhancing Arctic Marine Safety

I.A. Linking with International Organizations

ROADMAP AND ACTIONS	KEY ISSUES

• PAME to bring together experts on shipping from the Arctic states to identify common interests and develop unified positions and approaches.
• Identify an Arctic state lead country to facilitate an IMO meeting of experts on Arctic safety issues.
• For a consistent approach on Arctic shipping issues, the Arctic states should coordinate:
  ○ Input from all actors and stakeholders in each state including regional interests.
  ○ Input from different government agencies who attend various international organizations (for example IMO, ILO and WMO).
  ○ Input from stakeholders and government departments who attend a particular organization (such as IMO).
	• Taking into consideration the opinions and ideas of other interested stakeholders before approaching international organizations (such as IMO), the Arctic states may have a potential agreed position.
	• Knowing who is and is not represented at the international organizations.
	• Early, proactive actions will improve communications on all Arctic shipping issues

I.B. IMO Measures for Arctic Shipping

ROADMAP AND ACTIONS	KEY ISSUES
• Guidelines have been updated to become the IMO 'Guidelines for ships operating in polar waters.' • Arctic Council to send a letter to Arctic marine interests as a whole to promote the December 2009 IMO Assembly resolution applying guidelines to polar waters. • Arctic states to promote the application of the polar guidelines with industry and others as appropriate, to national and international interests. • IMO Maritime Safety Committee (MSC) has tasked the Design and Equipment Subcommittee to develop a mandatory polar code in 3 sessions (Feb 2010, Autumn 2010, and Spring 2011). • Adoption will be by tacit or implied amendment to SOLAS and MARPOL Conventions. • Having agreed the polar code is to become mandatory, the Arctic states encourage other interested states/ parties to participate, engage and support adoption and implementation of the polar code. • Influential for communication and consensus building for the mandatory polar code are the Consultative Parties of the Antarctic Treaty.	• These Guidelines now apply to Arctic and Antarctic waters whether ice-covered or not. • Polar code will have a mandatory Part A and recommendations in Part B. • Construction requirements (hull and machinery) will be in both the polar code and International Association of Classification Societies (IACS) rules. • Ice navigator competence requirements must be clearly defined in STCW Convention; requirements to have an ice navigator aboard will be in the polar code. • Need for a model ice navigation course and to establish acceptance criteria for simulations as partial training fulfillment. • Need for theoretical training, including the incorporation of contemporary local knowledge, together with practical experience in ice. • Lack of Arctic marine infrastructure needs to be considered for independent operations. • Endorsement of certificates to include bridge and engineering personnel; desirable for operators to be familiar with ship conditions when operating in remote and ice-covered waters.

I.C. Uniformity of Arctic Shipping Governance

ROADMAP AND ACTIONS	KEY ISSUES
• PAME to conduct a survey/inventory of national or regional regulations, standards and guidelines with the aim of harmonizing safety and pollution prevention measures in keeping with UNCLOS. • Required surveys and inventories from the AMSA research agenda include: 1. Comparative study of how Arctic states address liability and compensation, especially for bunker fuel spills and hazardous/noxious substance incidents. 2. Survey of existing and potential fee systems for icebreaking and other Arctic services, such as navigational aids, charting, SAR, and ice information services, provided by the Arctic states. 3. Survey of ballast water practices and invasive species threats from Arctic shipping and a comparison of Arctic state approaches to ballast water exchanges and treatments. 4. Review of how bilateral and regional cooperation in addressing Arctic marine operations might be enhanced using other international approaches and experiences. • Draft language for a potential international agreement or designation (PSSA) in keeping with UNCLOS on safety and pollution prevention measures in regions of the central Arctic Ocean beyond coastal state jurisdiction for consideration by IMO.	• Key examples of Arctic state regulations for possible integration in the harmonization of measures: ○ *Canada:* Reporting scheme; guidelines for cruise ship operation; ballast guidelines for tankers and barges; equivalent standards for construction of Arctic class ships; Arctic shipping/waters pollution prevention regulations; oil transfer guidelines. ○ *Russia:* Guidelines for operation on the Northern Sea Route; Arctic port regulations. ○ *United States:* Marine Mammal Protection Act; cruise ship discharge regulations in Alaska. ○ *Greenland:* mandatory reporting scheme; regulations for the safety of navigation. ○ *Norway and Russia:* Results of Barents 2020. ○ WWF-Gap Analysis study. ○ Industry and NGO surveys and standards.

I.D. Strengthening Passenger Ship Safety in Arctic Waters

ROADMAP AND ACTIONS	KEY ISSUES
• Include in an Arctic Council letter (for distribution of polar guidelines to operators), the IMO enhanced contingency guidance for cruise ships in polar waters. • Request cruise ship associations (CLIA and AECO) to develop harmonized best practices for operating in remote and ice-covered conditions (for example, mother ship and tenders). • Invite cruise ship associations to make presentations to PAME and Arctic expert meetings at IMO. • Organize an international workshop/conference on cruise ship safety in Arctic waters with cruise operators and regulators.	• Need to encourage the formation of cruise ship organizations that cover all Arctic waters, such as IAATO in Antarctic waters. • Urge passenger ship operations in polar waters to be carried out in tandem with sufficient capacity for mutual rescue. • Passenger ship operators to document and mitigate risks and hazards associated with potential grounding in poorly charted waters.

I.E. Arctic Search and Rescue (SAR) Instrument

ROADMAP AND ACTIONS	KEY ISSUES
• U.S. currently chairing an Arctic Council task force to draft a multinational Arctic SAR agreement; to be completed by 2011 for signature by the Arctic Ministers; first meeting December 2009. • Coordinate the use of existing resources and deploy them in the most effective manner that will cover any response gaps. • Arctic Council to urge all Arctic states, and EPPR, to participate in the process for a SAR agreement.	• Requirement for a comprehensive review of current, national SAR (maritime and aviation) capabilities for the Arctic. • Evaluation of the adequacy of cooperative SAR agreements and arrangements for addressing increasing commercial use of the Arctic Ocean and Arctic airspace.

II. Protecting Arctic People and the Environment

II.A. Survey of Arctic Indigenous Marine Use

ROADMAP AND ACTIONS	KEY ISSUES
• Feasibility and design of a survey should be regional and national, not one unified circumpolar effort. • Development of a survey must have early communications and develop trust with indigenous communities. • Surveys to be based on scientific methods with verifiable data; data needs to be accessible in a synthesized format for review. • Survey characteristics: relate risk to communities, resource and traditional ways; build on existing information/past surveys; structured for acceptability; administered with trust and believability; sustainable for future use and comparison; cover general areas and patterns rather than specific tracks. • Surveys must recognize changes: increased access for shipping; boundary changes with climate change; marine values associated with resource access; differences in stakeholder perspectives of the circumpolar region; importance of today's decisions and the future.	• Must identify who to communicate with including organizations, community leaders, and spokespersons. • Must determine what information is important for operations, development, and regulatory regimes. • Survey must insure: scientific methodology; verifiability; accuracy; and usability for the intended purpose. • Survey data must be formatted and mapped for accessibility by many. • More synthesized information will have greater value in decision-making; level of resolution of data also key for users.

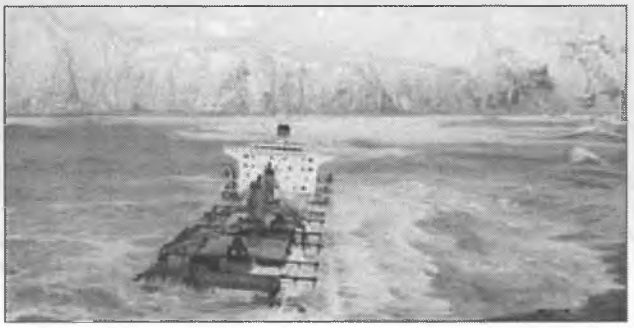
II.B. Engagement with Arctic Communities

ROADMAP AND ACTIONS	KEY ISSUES
• Community engagement long before regional/local development or ship arrivals. • Communication of near-term Arctic marine operations, such as cruise ships, allows preparedness for community opportunities to show cultural pride and traditional lifestyle, to provide arts and crafts, and for local job development. • Early communication of marine operations can enhance coordination of traditional uses of ice-covered waterways with ship uses/tracks. • Future planning for Arctic ports and ship support requires community involvement with socio-economic aspects and an understanding of traditional uses of the waterways and local coastal areas. • Recognition that future Arctic port site selection (and limited funds for infrastructure) will create competition between communities; evaluation of gains and losses within communities and needs for investment. • Future development will require mandated environmental assessment processes involving: community engagement, national standards, international coordination, and transparency of findings. • New Arctic marine developments will require risk assessments involving community engagement and reporting of results.	• Need to keep Arctic communities engaged; Permanent participants at the Arctic Council can monitor progress and mechanisms for engagement. • Determination of the level of public process mandated for each region. • Stressing the importance of ongoing dialogue and government consultation with a goal of enhanced community engagement. • Fostering conflict avoidance and communicating the importance of building trust among the actors. © Ross MacDonald

II.C. Areas of Heightened Ecological and Cultural Significance, and II.D. Specially Designated Arctic Marine Areas

ROADMAP AND ACTIONS	KEY ISSUES
• **For Archaeological and Cultural Sites:** o Develop site management plans with: location identification; community engagement; identification of stresses on the site (tourism, offshore operations, and climate change); rules for numbers of visitors, type of access, and type of facilities allowed; guidelines for waste management offshore. o Develop site response plans to: offshore anchoring, discharges from ships, cargo loss, oil spills and hazmat spills. o Site response plans would be nested in larger, regional response plans. • **For Migratory Route Protection and Preservation:** o Measures include: regulating ship speeds; establishing areas to be avoided; ship routing; establishing financial responsibility for liability and compensation. o Monitoring and designating reporting areas are key elements to evaluating mitigation effectiveness.	• Local site management should not conflict with MARPOL or UNCLOS navigation rights. • Consideration of climate change impacts and the resulting movement of cultural and ecological sites. • Should management regimes be mobile as well as protected sites with changing climate? • How to pay for response activities; the need for an international regime (civil liability). • Movement of marine species with changing Arctic climate. • Sorting out the relationship between changing access for shipping and the impacts of climate change on migratory routes. • Range of objectives, from allowing no shipping to creating a balance between shipping and environmental protection measures. • Multiple strategies available to minimize marine use impacts; options available to communities to be pro-active rather than reactive to future Arctic marine uses.

II.E. Protection from Invasive Species

ROADMAP AND ACTIONS	KEY ISSUES
• Ratification of IMO Ballast Water Convention (for the global oceans) not enough and there is a need for tighter, Arctic-specific measures/requirements. • Beyond ballast water there are hull fouling and cargo riders as potential sources of invasive species. • Requirement for an Arctic prevention plan, perhaps a Hazard Analysis and Critical Control Points (HACCP) evaluation program (Australia has developed invasive species transfer avoidance measures for a range of marine activities). • Require further Arctic shipping scenarios and projections to frame the risks of invasive species. • Need more baseline surveys, especially in the areas of concentrated marine activity. • Require expanded monitoring, protocols for comparability, and the involvement of local residents with traditional knowledge who will be first to see changes. • As part of a response capacity there is a need for agreed upon emergency treatment options. • Shipwreck response and rapid response (eradication) capacities in shallow waters and on land (rats).	• Rapid ratification of the IMO Ballast Water Convention required, especially by the 8 Arctic states. • IMO movement on creating measures for the Arctic under the Ballast Water Convention and the other agreements. • Potential incentives for shipbuilders and ship operators to improve prevention effectiveness. • Application of same regulations for international shipping to Arctic coastwise trade. • Require research/testing and personnel expertise ~ capacity building in the Arctic. 

II.F. Oil Spill Prevention

ROADMAP AND ACTIONS	KEY ISSUES
• Most significant strategy remains keeping oil contained ashore and within ships - the prevention of Arctic oil spills. • Initiate a comparative evaluation of Arctic state schemes including: strength of prevention regime; liability standard; damage compensation; preparedness laws; fuel transfer standards; compliance; enforcement of regulations. • Enhanced cooperation and dialogue on unified standards of prevention and levels of tolerance/enforcement. • Initiate an effectiveness evaluation of training, systems, technology and environmental knowledge. • Conduct response gap analysis with a view to required research and capacity-building. • Explore the possibility of marine areas or zones where there is restricted traffic for tankers & LNG ships. • Development of a potential liability incentive fund for prevention.	• Development of trust among the many stakeholders on prevention issues. • Establishing strategic communication among the states and conducting oil spill tests and experiments with international consensus. • Required funding of basic research for systems improvements.

II.G. Addressing Impacts on Marine Mammals

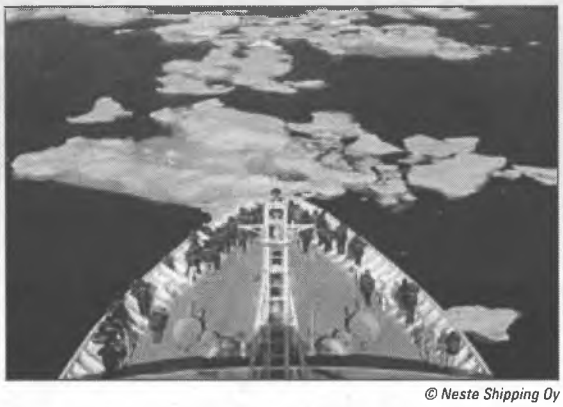
ROADMAP AND ACTIONS	KEY ISSUES
• Research on improving baseline information on migratory routes required: added challenge are route changes and distinguishing between climate change impacts and increased marine activities. • Industry representatives must be involved in discussions for mitigation measures from the earliest development. • Preferred strategy is to separate ship traffic and marine mammals in space and time; where separation is not feasible, restrictions on ship speeds can help reduce mammal strikes. • Completion of an AIS receiver network in the Arctic is high priority; linkages between AIS and marine mammal awareness need to be developed. • Spatial distance is key for other disturbances: mating, migration, resting, calving, feeding and haul out areas; seasonal deflection from normal migratory routes can impact food security, subsistence lifestyles and the social structure of communities. • Develop lighting measures to reduce light disturbance to birds. • Research on noise from marine operations: deflection causes; masking (mammal communications); potential physiological damage. • Develop 'sound budgets' to review the cumulative effects of various marine operations.	• Cultural-subsistence awareness training should be developed for regional operators. • Restrictions and measures impacting navigation should be linked to the evolution of special marine areas and mapping efforts to plot changing marine ecosystems. • Vessel routing and speed restrictions are effective measures to mitigate impacts on marine mammals. • Many Arctic regions are not currently regulated; potential mechanisms and use of possible technologies are pathways forward.

II.H. Reducing Air Emissions

ROADMAP AND ACTIONS	KEY ISSUES
• Development at IMO of uniform standards. • Recognition that the global marine industry and IMO are developing regulations and uncertainty surrounds future standards. • Air quality agencies of the Arctic states should address this issue at a meeting with marine operators; potential for future negotiated acceptable levels of emissions for the Arctic. • Assessment of black carbon impacts in the Arctic important. • Arctic-specific standards may be requested in the the future at IMO.	• New control technologies may be available to mitigate ship emissions in the Arctic. • Different, more stringent emissions standards may be required for the Arctic Ocean and entire Arctic region. • Monitoring and tracking of future emissions will be essential for enforcement.

III. Building the Arctic Marine Infrastructure

III.A. Addressing the Infrastructure Deficit

ROADMAP AND ACTIONS	KEY ISSUES
• Institute an 'infrastructure deficit awareness program.' • Industry notification of communities at all stages. • Port and shore side development plans in all Arctic states. • Coordinate and identify public and private/industry funding. • Survey existing ports and port needs. • Develop national Arctic port strategies. • Explore 'tiered-port' (primary & secondary) approach. • Match government and industry priorities enhancing cooperation. • International conference of Arctic, Northern and Gateway ports and infrastructure. • Review linkages between large ports, small ports, and river infrastructure. • Launch an Arctic aids-to-navigation requirements review. • Prioritization of areas for hydrographic resurvey. • Review and assess Arctic long-range electronic navigation requirements. • Continue harmonization of national ice services and products. • Continued research on Arctic sea ice thickness and improved remote sensing tools for thickness. • Explore concept of 'virtual' ice center for the Arctic Ocean. • Improved sea ice type and iceberg detection (satellite and radar).	• Prioritizing hydrographic surveys. • Industry funding identification for public-private partnerships. • Development of new schemes for cost recovery of all marine infrastructure. • Icebreaker fleet renewal (public and private/ industry fleets). • Survey and enumeration of Arctic places of refuge. • Holistic Arctic port planning – closer Arctic state cooperation and coordination.  © Neste Shipping Oy

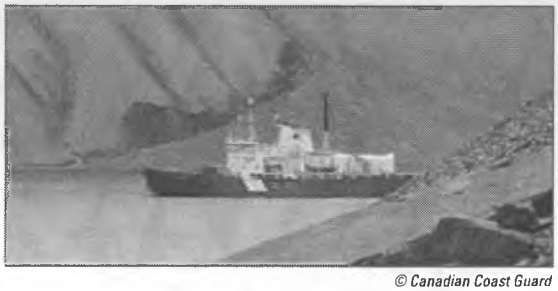
III.B. Arctic Marine Traffic Systems

ROADMAP AND ACTIONS	KEY ISSUES
• Mandatory Automatic Identification System (AIS) carriage. • Mandatory commercial traffic reporting. • Assessment of potential vessel traffic separation schemes in selected Arctic waterways. • Assessment of Arctic state ability to enforce mandatory reporting. • Potential harmonization of mandatory reporting systems (for example, between the Northern Sea Route, Canadian Arctic and Bering Strait regions). • Comprehensive examination of crossing maritime borders: examining the practical issues (ease of crossing, logistical support, SAR, emergency response, communications). • Develop consolidated coast pilot & sailing directions for the Arctic Ocean (one-stop shopping and available electronically in multiple languages).	• Identification of potential marine protected areas; timing key for infrastructure and navigation systems development. • Status of endangered species legislation that could impact traffic schemes. • Sharing traffic information with regional governments and local communities. © Fednav, Ltd.

III.C. Circumpolar Environmental Response Capacity

ROADMAP AND ACTIONS	KEY ISSUES
• Primary goal of all Arctic rules and regulations: spill prevention. • Enhanced R&D for: recovery of oil in ice; trajectory modeling; remote sensing detection. • Harmonization of minimum standards for oil spill legislation. • Extend best practices and R&D to all Arctic states. • Comprehensive analyses of projected marine areas of high risk. • Enhanced analyses and reviews of appropriate response strategies based on geography. • Continued close cooperation among the Arctic states in: R&D, spill response exercises, and exchange of information and best practices. • Encourage regional, bilateral response agreements (for example, Canada/Denmark, US/Russia). • Assessment and augmentation of emergency and rapid transportation capability for oil spill response equipment. • Initiate Arctic discussions regarding hazardous material and chemical spills in the Arctic.	• Responses to incidents involving naval vessels in the Arctic Ocean. • Need for an Arctic oil spill liability trust fund; potential joint Arctic state-industry collaboration. • Role of Arctic communities in emergency response capability. • Increased frequency of Arctic emergency response joint exercises. • Potential for an Arctic state agreement on circumpolar, environmental response capabilities and capacities; could be an Arctic Council initiative following Arctic SAR agreement.

III.D. Investing in Hydrographic, Meteorological and Oceanographic Data

ROADMAP AND ACTIONS	KEY ISSUES
• Improved quality of regional and circumpolar weather forecasting. • Improved and refined met-ocean-ice forecasts and modeling techniques. • Improved training for Arctic forecasters (link met training to sea ice training; increased field training). • Improved access throughout the Arctic Ocean (including EEZs) for real-time met-ocean-ice data. • PAME/Arctic Council to approach the World Meteorological Organization (WMO) to expand Arctic states' participation in WMO activities. • WMO conference for met-ocean-ice cooperation in the Arctic. • Arctic Council and Arctic states to coordinate increased cooperation for observations. • Increased reporting of local weather observations by all ships in the Arctic Ocean (a function of the ice navigator). • Enhanced iceberg monitoring in the Arctic Ocean. • New observing systems with free and open access to environmental satellite information.	• Requirements for adequate polar communication to handle new, large information flow. • Cost recovery of data and information (user fees possible). • Status and future of observing networks resulting from IPY cooperation. • Cost and access to SAR data for ice information. • Improving transfer of met-ocean-ice information to indigenous populations and communities for hunting and fishing.  *© Canadian Coast Guard*

Funding Issues

Key issues not addressed in AMSA are the broad financial and funding concerns linked to each of the AMSA recommendations. The Fairbanks workshop experts identified several significant areas that require near-term funding and also reviewed issues related to the need for liability and compensation mechanisms in the Arctic.

Indigenous Marine Use Surveys ~ A key requirement in most regions of the Arctic, and one of the AMSA recommendations, is the need for surveys of indigenous marine use. Up-to-date baseline data on regional and local patterns of indigenous use of Arctic waters is necessary to assess the impacts from increasing Arctic marine operations. Significant discussions were held on this topic in Fairbanks due to the complexities and sensitivities of conducting such human use surveys. There was general agreement that the surveys could not be conducted in one unified circumpolar effort (although the baseline data could be merged later to construct a unified 'picture'). Public appropriations from national and regional governments are key since these surveys relate to subsistence living, marine safety, environmental protection and multiple use management of Arctic marine waterways. Broad scale surveys are nominally the responsibility of governments, national and regional. However, private sources of funding, such as from NGOs and nonprofit foundations, could also be important at the local, community level for detailed studies and surveys. Grants or surveys from industry sources (for example, natural resource developments related to mining) could be used to support surveys in preparation of new marine transportation systems and navigation in local waterways.

Marine Infrastructure Elements ~ The lack of adequate marine infrastructure in most of the Arctic (except for the Norwegian coast and northwest Russia) to support current and future levels of Arctic marine activity is a key finding of AMSA. Large public and private investments will be necessary to provide an adequate safety net for marine operations and environmental protection. Public and private funding for satellite communications and environmental monitoring are urgently required to fill existing Arctic gaps in coverage. Enhancing environmental response capacity may require public-industry funding of equipment to be cached in remote Arctic locations. A mandatory ship tracking and monitoring system will require public appropriations and the potential for pooling funding among the Arctic states. Public funding of enhanced Arctic weather and sea ice information may also mandate cost recovery schemes. Hyrographic surveys and charting are urgent requirements and these activities need significant national investments; cost recovery through industry user fees may be necessary, for example, in remote Arctic regions of seasonal marine traffic. The World Bank and other international financial institutions should be considered for Arctic port facilities and overall marine infrastructure. Coordinated investments for such elements as ports and aids to navigation should be discussed by the Arctic states.

Liability and Compensation Challenges ~ Robust, effective oil spill liability trust funds are required in the Arctic; funds can come from public-private partnerships and they could be based on regional or bi-lateral agreements. Two national models are Canada's Ship-source Oil Pollution Fund and the U.S. Oil Pollution Act of 1990. A conference on liability-compensation issues for Arctic marine incidents should be organized by the Arctic states and industry interests.

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Summary ~ Key Policy Issues Ahead

During the course of the workshop discussions revealed a number of high priority issues as critical outcomes of AMSA. The Co-editors of this report have developed a list of key policy issues from the discussions in Fairbanks that require attention in the near-term to enhance Arctic marine safety and marine environmental protection. Throughout the workshop the highest priority issue consistently noted was the urgent need for a mandatory Polar Code developed by the International Maritime Organization. Implementation of mandatory rules for polar ship construction, design, equipment, operations and ice navigator competency was considered by the workshop participants as the crucial first step for protecting Arctic people and the environment in an era of increased marine operations in the Arctic Ocean.

The following lists are provided as summaries of Arctic policy issues derived from the expert discussions of the AMSA Workshop:

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I. <u>Highest Priority</u> Arctic Policy Issues Related to AMSA:

- A mandatory Polar Code developed by the IMO.
- Full tracking and monitoring of Arctic commercial ships (mandatory AIS).
- An Arctic SAR agreement ~ an ongoing Arctic Council SAR Task Force is to produce a binding agreement by spring 2011.
- Surveys of indigenous marine use so that multiple use strategies in Arctic waterways can be developed.
- A circumpolar response capacity agreement ~ an agreement among the Arctic states (and possibly non-Arctic states) for pooling resources and enhancing regional capacity.
- Implementation of an Arctic Observing Network among the 8 Arctic states and non-Arctic states ~ a network to support scientific research and marine operations.

II. <u>High Priority</u> Arctic Policy issues Related to AMSA:

- A critical Arctic marine infrastructure requirement ~ increased hydrography and surveying of Arctic waters for enhanced navigation charts.
- Oil spill research on prevention best practices and responses to oil released in Arctic ice-covered waters.
- Enhanced research, including mitigation measures, on the impacts on marine mammals, and other migratory fauna, of increased Arctic marine operations.
- Identification of specific ballast water/invasive species issues and prevention strategies related to Arctic marine operations.
- A comprehensive study to identify potential Arctic marine areas, including the central Arctic Ocean, for possible designation as IMO Particularly Sensitive Sea Areas (PSSAs).
- Marine industry development of harmonized best practices for all cruise ships operating in Arctic waters, including operational strategies for mutual rescue.
- Studies on the application of ecosystems-based management to Arctic coastal regions.
- A comparative study of Arctic state liability and compensation strategies for marine incidents with a view to developing future uniform measures.
- Fully developed IMO ice navigator competency requirements included in the STCW; mandatory requirement for onboard ice navigator as part of the Polar Code.
- Enhanced marine communications systems in the Arctic, including full coverage satellite communications in the central Arctic Ocean.

APPENDIX 1:
The Arctic Marine Shipping Assessment Recommendations

The focus of the AMSA is marine safety and marine environmental protection, which is consistent with the Arctic Council's mandates of environmental protection and sustainable development. Based on the findings of the AMSA, recommendations were developed to provide a guide for future action by the Arctic Council, Arctic states and many others. The AMSA recommendations are presented under three broad, inter-related themes that are fundamental to understanding the AMSA: Enhancing Arctic Marine Safety, Protecting Arctic People and the Environment, and Building Arctic Marine Infrastructure. It is recognized that implementation of these recommendations could come from the Arctic states, industry and/or public-private partnerships.

I. ENHANCING ARCTIC MARINE SAFETY

A. Linking with International Organizations: That the Arctic states decide to, on a case by case basis, identify areas of common interest and develop unified positions and approaches with respect to international organizations such as: the International Maritime Organization (IMO), the International Hydrographic Organization (IHO), the World Meteorological Organization (WMO) and the International Maritime Satellite Organization (IMSO) to advance the safety of Arctic marine shipping; and encourage meetings, as appropriate, of member state national maritime safety organizations to coordinate, harmonize and enhance the implementation of the Arctic maritime regulatory framework.

B. IMO Measures for Arctic Shipping: That the Arctic states, in recognition of the unique environmental and navigational conditions in the Arctic, decide to cooperatively support efforts at the International Maritime Organization to strengthen, harmonize and regularly update international standards for vessels operating in the Arctic. These efforts include:

---Support the updating and the mandatory application of relevant parts of the *Guidelines for Ships Operating in Arctic Ice-covered Waters* (Arctic Guidelines); and,

---Drawing from IMO instruments, in particular the Arctic Guidelines, augment global IMO ship safety and pollution prevention conventions with specific mandatory requirements or other provisions for ship construction, design, equipment, crewing, training and operations, aimed at safety and protection of the Arctic environment.

C. Uniformity of Arctic Shipping Governance: That the Arctic states should explore the possible harmonization of Arctic marine shipping regulatory regimes within their own jurisdiction and uniform Arctic safety and environmental protection regulatory regimes, consistent with UNCLOS, that could provide a basis for protection measures in regions of the central Arctic Ocean beyond coastal state jurisdiction for consideration by the IMO.

D. Strengthening Passenger Ship Safety in Arctic Waters: That the Arctic states should support the application of the IMO's *Enhanced Contingency Planning Guidance for Passenger Ships Operating in Areas Remote from SAR Facilities*, given the extreme challenges associated with rescue operations in the remote and cold Arctic region; and strongly encourage cruise ship operators to develop, implement and share their own best practices for operating in such conditions, including consideration of measures such as timing voyages so that other ships are within rescue distance in case of emergency.

E. Arctic Search and Rescue (SAR) Instrument: That the Arctic states decide to support developing and implementing a comprehensive, multi-national Arctic Search and Rescue (SAR) instrument, including aeronautical and maritime SAR, among the eight Arctic nations and, if appropriate, with other interested parties in recognition of the remoteness and limited resources in the region.

II. PROTECTING ARCTIC PEOPLE AND THE ENVIRONMENT

A. Survey of Arctic Indigenous Marine Use: That the Arctic states should consider conducting surveys on Arctic marine use by indigenous communities where gaps are identified to collect information for establishing up-to-date baseline data to assess the impacts from Arctic shipping activities.

B. Engagement with Arctic Communities: That the Arctic states decide to determine if effective communication mechanisms exist to ensure engagement of their Arctic coastal communities and, where there are none, to develop their own mechanisms to engage and coordinate with the shipping industry, relevant economic activities and Arctic communities (in particular during the planning phase of a new marine activity) to increase benefits and help reduce the impacts from shipping.

C. Areas of Heightened Ecological and Cultural Significance: That the Arctic states should identify areas of heightened ecological and cultural significance in light of changing climate conditions and increasing multiple marine use and, where appropriate, should encourage implementation of measures to protect these areas from the impacts of Arctic marine shipping, in coordination with all stakeholders and consistent with international law.

D. Specially Designated Arctic Marine Areas: That the Arctic states should, taking into account the special characteristics of the Arctic marine environment, explore the need for internationally designated areas for the purpose of environmental protection in regions of the Arctic Ocean. This could be done through the use of appropriate tools, such as "Special Areas" or Particularly Sensitive Sea Areas (PSSA) designation through the IMO and consistent with the existing international legal framework in the Arctic.

E. Protection from Invasive Species: That the Arctic states should consider ratification of the IMO International Convention for the Control and Management of Ships Ballast Water and Sediments, as soon as practical. Arctic states should also assess the risk of introducing invasive species through ballast water and other means so that adequate prevention measures can be implemented in waters under their jurisdiction.

F. Oil Spill Prevention: That the Arctic states decide to enhance the mutual cooperation in the field of oil spill prevention and, in collaboration with industry, support research and technology transfer to prevent release of oil into Arctic waters, since prevention of oil spills is the highest priority in the Arctic for environmental protection.

G. Addressing Impacts on Marine Mammals: That the Arctic states decide to engage with relevant international organizations to further assess the effects on marine mammals due to ship noise, disturbance and strikes in Arctic waters; and consider, where needed, to work with the IMO in developing and implementing mitigation strategies.

H. Reducing Air Emissions: That the Arctic states decide to support the development of improved practices and innovative technologies for ships in port and at sea to help reduce current and future emissions of greenhouse gases (GHGs), Nitrogen Oxides (NOx), Sulfur Oxides (SOx) and Particulate Matter (PM), taking into account the relevant IMO regulations.

III. BUILDING THE ARCTIC MARINE INFRASTRUCTURE

A. Addressing the Infrastructure Deficit: That the Arctic states should recognize that improvements in Arctic marine infrastructure are needed to enhance safety and environmental protection in support of sustainable development. Examples of infrastructure where critical improvements are needed include: ice navigation training; navigational charts; communications systems; port services, including reception facilities for ship-generated waste; accurate and timely ice information (ice centers); places of refuge; and icebreakers to assist in response.

B. Arctic Marine Traffic System: That the Arctic states should support continued development of a comprehensive Arctic marine traffic awareness system to improve monitoring and tracking of marine activity, to enhance data sharing in near real-time, and to augment vessel management service in order to reduce the risk of incidents, facilitate response and provide awareness of potential user conflict. The Arctic states should encourage shipping companies to cooperate in the improvement and development of national monitoring systems.

C. Circumpolar Environmental Response Capacity: That the Arctic states decide to continue to develop circumpolar environmental pollution response capabilities that are critical to protecting the unique Arctic ecosystem. This can be accomplished, for example, through circumpolar cooperation and agreement(s), as well as regional bilateral capacity agreements.

D. Investing in Hydrographic, Meteorological and Oceanographic Data: That the Arctic states should significantly improve, where appropriate, the level of and access to data and information in support of safe navigation and voyage planning in Arctic waters. This would entail increased efforts for: hydrographic surveys to bring Arctic navigation charts up to a level acceptable to support current and future safe navigation; and systems to support real-time acquisition, analysis and transfer of meteorological, oceanographic, sea ice and iceberg information.

APPENDIX 2: Workshop Agenda & Presentations

THURSDAY, OCTOBER 22, 2009

9:00 am **Welcome**
- Mike Sfraga, Director, UA Geography Program, Associate Dean, School of Natural Resources and Agricultural Sciences
- Brian Rogers, Chancellor, University of Alaska Fairbanks
- Mead Treadwell, Chairman, United States Arctic Research Commission
- Denise Michels, Inuit Circumpolar Council Representative, Mayor of Nome
- Lars Kullerud, President, University of the Arctic
- Ross Virginia, Director, Institute of Arctic Studies, Dartmouth College

9:45 am **Opening Presentations**
- *Economic Development, Community Sustainability, and Future Arctic Marine Use,* Denise Michels, Mayor of Nome, Vice President Kawerak Native Corporation, ICC Representative
- *Arctic Climate Modeling,* Scott Rupp and John Walsh, University of Alaska Fairbanks
- *Research Challenges in the Arctic Ocean – The Marine Mammal Protection Act and Geophysical Research,* Bernard Coakley, University of Alaska Fairbanks
- *Outcomes of the Arctic Marine Shipping Assessment,* Lawson Brigham, University of Alaska Fairbanks and Chair, AMSA

12:00 pm **Lunch**
- *The International Maritime Organization's Arctic Initiatives,* Victor Santos-Pedro, Transport Canada

1:30 pm **Charge to the Working Groups:** Mike Sfraga, Lawson Brigham, Ben Ellis
Outline Major Issues/Questions; Introduce Working Group Leads

2-5:00 pm **Working Groups and Leads in Session,** I. Enhancing Arctic Marine Safety , II. Protecting Arctic People and the Environment, and III. Building the Arctic Marine Infrastructure

6:30 pm **Welcome Dinner and Presentation**
- North by 2020: Hajo Eicken, Professor of Geophysics and Amy Lovecraft, Associate Professor of Political Science, University of Alaska Fairbanks

FRIDAY, OCTOBER 23, 2009

9:00 am **Working Group Leads Report to Participants and Discussion:** Lawson Brigham

10:00 am **Working Groups Reconvene**

12:00 pm **Lunch**
- *Governance Issues in the Arctic Ocean* – Betsy Baker, Vermont Law School and Dartmouth College
- *Regulating Arctic Ships and Operations* - Des Upcraft, Lloyd's Register, UK

1:30-5 pm **Working Groups Reconvene**

6:30 pm **Chancellor's Reception** – Sponsored by Holland America Lines
University of Alaska Museum of the North, Entertainment: Pavva Inupiaq Dancers
***Buses Depart Princess Lodge at 6:00 pm** ***Buses Depart Museum at 8:30 pm**

SATURDAY, OCTOBER 24, 2009

9:00 am **Working Groups Reconvene:** Mike Sfraga, Lawson Brigham

12:00 pm **Lunch**
- *Monitoring Ships in the Alaskan Arctic* – John Adams, Marine Exchange of Alaska

1:00 pm **Working Group Reports:** Group Leads, 30 minutes per group

3:00 pm **Synthesis Activity**

3:30 pm **Program Reflection, Next Steps**
- Draft document prepared
- Schedule for Report Writing, Participant Distribution, Editing, etc.
- Timing and plans for Report Distribution, etc.

APPENDIX 3: Workshop Participants

Michael Baffrey	U.S. Department of Interior, Alaska
Betsy Baker	Vermont Law School and Dartmouth College
Lawson Brigham	University of Alaska Fairbanks and AMSA Chair / Workshop Co-Leader & Report Co-Editor
Pablo Clemente-Colon	U.S. National Ice Center
Bernard Coakley	University of Alaska Fairbanks
Craig Dorman	University of Alaska
Hajo Eicken	University of Alaska Fairbanks
Ben Ellis	Ben Ellis & Company / Workshop Co-Leader
Pierre-Andres Forest	University of the Arctic
Victoria Gofman	Aleut International Association
Larry Hartig	Commissioner, Alaska State Department of Environmental Conservation
William Hill	Crowley Marine Services, Anchorage
Rob Huebert	University of Calgary
Layla Hughes	WWF-Alaska
Henry Huntington	PEW Environment Group
Michael Inman	U.S. Coast Guard Seventeenth District, Juneau
David Jackson	Canadian Coast Guard / Leader, Workshop Working Group III
Jay Jerome	U.S. Coast Guard Sector, Anchorage
John Kaighin	Shell Exploration & Production Company, Anchorage
John Kelley	University of Alaska Fairbanks
Katie Kennedy	University of Alaska Fairbanks
Hiromitsu Kitagawa	Ocean Policy Research Foundation, Tokyo, Japan
Pia Kohler	University of Alaska Fairbanks
Lars Kullerud	President, University of the Arctic
Denny Lassuy	U.S. North Slope Science Initiative, Anchorage
Thomas Laughlin	International Union for Conservation of Nature, Washington, DC
Carol Lewis	University of Alaska Fairbanks
Patrick Lewis	WWF Arctic, Oslo, Norway
Amy Lovecraft	University of Alaska Fairbanks
Ken MacInnis	Marine and Environmental Law Institute, Dalhousie University, Halifax, Canada
Molly McCammon	Alaska Ocean Observing System, Anchorage
Earl McDowell	U.S. Navy
Elizabeth McLanahan	U.S. National Oceanic & Atmospheric Administration, Washington, DC
Denise Michels	Mayor of Nome, Alaska
Sharry Miller	Alaska State Department of Environmental Conservation
Sherry Modrow	University of Alaska Fairbanks
William Morani Jr.	Holland America Lines, Seattle
Tom Moyer	Office of U.S. Senator Mark Begich of Alaska
Patricia Opheen	U.S. Army Corps of Engineers, Alaska
Bob Pawlowski	Denali Commission, Anchorage / Co-Leader, Workshop Working Group II
Jackie Poston	Alaska State Department of Environmental Conservation
Brian Rogers	Chancellor, University of Alaska Fairbanks
Tracy Rogers	University of Alaska Fairbanks
Cheryl Rosa	U.S. Arctic Research Commission
Scott Rupp	University of Alaska Fairbanks
Warren Sanamo Jr.	Edison Chouest Offshore, Galliano, Louisiana
Victor Santos-Pedro	Transport Canada, Ottawa and AMSA Co-lead / Leader, Workshop Working Group I
Mike Sfraga	University of Alaska Fairbanks / Workshop Co-Leader & Report Co-Editor
Virgil "Buck" Sharpton	University of Alaska Fairbanks
Per Sønderstrup	Danish Maritime Authority, Copenhagen, Denmark
Wanda Tangermann	University of Alaska Fairbanks
Nancy Tarnai	University of Alaska Fairbanks
Michael Terminel	Edison Chouest Offshore, Anchorage
Dennis Thurston	U.S. Minerals Management Service, Alaska Region
Mead Treadwell	Chairman, U.S. Arctic Research Commission
Carl Uchytil	U.S. Coast Guard Seventeenth District, Juneau, Alaska
Des Upcraft	Lloyd's Register, London, United Kingdom
Ross Virginia	Dartmouth College
John Walsh	University of Alaska Fairbanks
Hanling Wang	Chinese Academy of Social Sciences, Beijing
John Whitney	U.S. National Oceanic & Atmospheric Administration, Anchorage
Denis Wiesenburg	University of Alaska Fairbanks
Margaret Williams	WWF-Alaska / Co-Leader, Workshop Working Group II
Shiji Xu	Chinese Arctic and Antarctic Administration, Beijing

Acronyms

AECO ~ Association of Arctic Expedition Cruise Operators
AIS ~ Automated Identification System
AMSA ~ Arctic Marine Shipping Assessment
CLIA ~ Cruise Lines International Association
EEZ ~ Exclusive Economic Zone
EPPR ~ Emergency Prevention, Preparedness and Response
HACCP ~ Hazard Analysis and Critical Control Points
IAATO ~ International Association of Antarctica Tour Operators
IACP ~ Institute for Applied Circumpolar Policy
IACS ~ International Association of Classification Societies
ILO ~ International labor Organization
IMO ~ International Maritime Organization
IPY ~ International Polar Year (2007-08)
IWC ~ International Whaling Commission
LNG ~ Liquefied Natural Gas
MARPOL ~ International Convention for the Prevention of Pollution from Ships
NGO ~ Non-governmental Organization
PAME ~ Protection of the Arctic Marine Environment
PSSA ~ Particularly Sensitive Sea Area
R&D ~ Research and Development
SAR ~ Search and Rescue
SDWG ~ Sustainable Development Working Group
SOLAS ~ International Convention for the Safety of Life at Sea
STCW ~ International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
UAF ~ University of Alaska Fairbanks
UArctic ~ University of the Arctic
UNCLOS ~ United Nations Convention on the Law of the Sea
WMO ~ World Meteorological Organization

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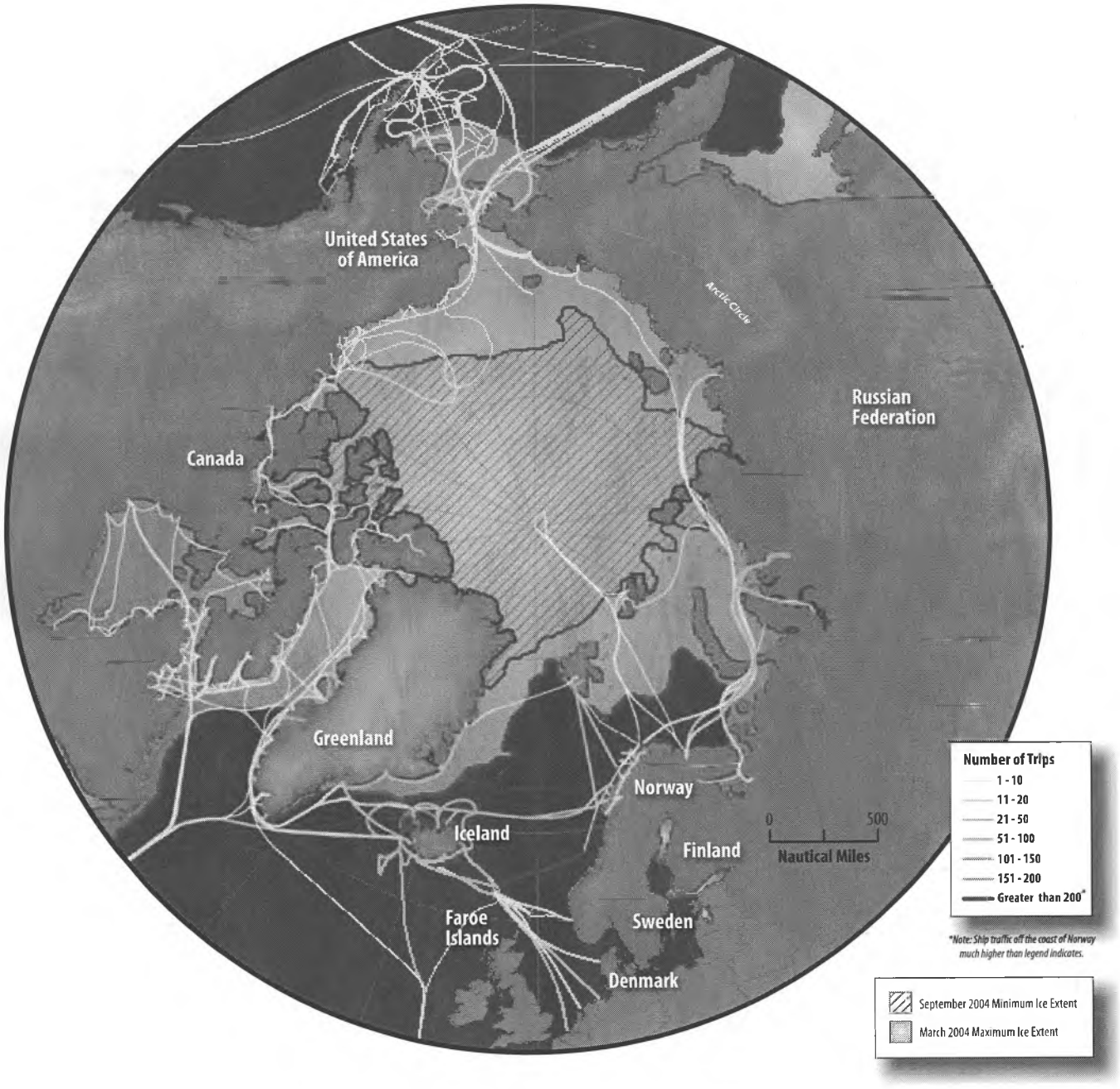
Shipping traffic in the Arctic for the AMSA survey year 2004. *Source: AMSA*



UA Geography Program
University of Alaska Fairbanks
P.O. Box 755840
Fairbanks, AK 99775-5840 USA
Ph: 1-907-474-7494
www.geographyua.org

Word Emphasis Within the Outcomes (Roadmaps and Key Issues) of Workshop Discussions for the Arctic Marine Shipping Assessment Recommendations.

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The United Nations Convention on the Law of the Sea lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole.

The Convention was opened for signature on 10 December 1982 in Montego Bay, Jamaica. This marked the culmination of more than 14 years of work involving participation by more than 150 countries representing all regions of the world, all legal and political systems and the spectrum of socio/economic development. At the time of its adoption, the Convention embodied in one instrument traditional rules for the uses of the oceans and at the same time introduced new legal concepts and regimes and addressed new concerns. The Convention also provided the framework for further development of specific areas of the law of the sea.

The Convention entered into force in accordance with its article 308 on 16 November 1994, 12 months after the date of deposit of the sixtieth instrument of ratification or accession. Today, it is the globally recognized regime dealing with all matters relating to the law of the sea.

The Convention (full text) comprises 320 articles and nine annexes, governing all aspects of ocean space, such as delimitation, environmental control, marine scientific research, economic and commercial activities, transfer of technology and the settlement of disputes relating to ocean matters.

Some of the key features of the Convention are the following:

* Coastal States exercise sovereignty over their territorial sea which they have the right to establish its breadth up to a limit not to exceed 12 nautical miles; foreign vessels are allowed "innocent passage" through those waters;
* Ships and aircraft of all countries are allowed "transit passage" through straits used for international navigation; States bordering the straits can regulate navigational and other aspects of passage;
* Archipelagic States, made up of a group or groups of closely related islands and interconnecting waters, have sovereignty over a sea area enclosed by straight lines drawn between the outermost points of the islands; the waters between the islands are declared archipelagic waters where States may establish sea lanes and air routes in which all other States enjoy the right of archipelagic passage through such designated sea lanes;
* Coastal States have sovereign rights in a 200-nautical mile exclusive economic zone (EEZ) with respect to natural resources and certain economic activities, and exercise jurisdiction over marine science research and environmental protection;
* All other States have freedom of navigation and overflight in the EEZ, as well as freedom to lay submarine cables and pipelines;
* Land-locked and geographically disadvantaged States have the right to participate on an equitable basis in exploitation of an appropriate part of the surplus of the living resources

of the EEZ's of coastal States of the same region or sub-region; highly migratory species of fish and marine mammals are accorded special protection;
* Coastal States have sovereign rights over the continental shelf (the national area of the seabed) for exploring and exploiting it; the shelf can extend at least 200 nautical miles from the shore, and more under specified circumstances;
* Coastal States share with the international community part of the revenue derived from exploiting resources from any part of their shelf beyond 200 miles;
* The Commission on the Limits of the Continental Shelf shall make recommendations to States on the shelf's outer boundaries when it extends beyond 200 miles;
* All States enjoy the traditional freedoms of navigation, overflight, scientific research and fishing on the high seas; they are obliged to adopt, or cooperate with other States in adopting, measures to manage and conserve living resources;
* The limits of the territorial sea, the exclusive economic zone and continental shelf of islands are determined in accordance with rules applicable to land territory, but rocks which could not sustain human habitation or economic life of their own would have no economic zone or continental shelf;
* States bordering enclosed or semi-enclosed seas are expected to cooperate in managing living resources, environmental and research policies and activities;
* Land-locked States have the right of access to and from the sea and enjoy freedom of transit through the territory of transit States;
* States are bound to prevent and control marine pollution and are liable for damage caused by violation of their international obligations to combat such pollution;
* All marine scientific research in the EEZ and on the continental shelf is subject to the consent of the coastal State, but in most cases they are obliged to grant consent to other States when the research is to be conducted for peaceful purposes and fulfils specified criteria;
* States are bound to promote the development and transfer of marine technology "on fair and reasonable terms and conditions", with proper regard for all legitimate interests;
* States Parties are obliged to settle by peaceful means their disputes concerning the interpretation or application of the Convention;
* Disputes can be submitted to the International Tribunal for the Law of the Sea established under the Convention, to the International Court of Justice, or to arbitration. Conciliation is also available and, in certain circumstances, submission to it would be compulsory. The Tribunal has exclusive jurisdiction over deep seabed mining disputes.

Oceans and Law of the Sea

Division for Ocean Affairs and the Law of the Sea

The United Nations Convention on the Law of the Sea
(A historical perspective)

- A historical perspective
- Third United Nations Conference on the Law of the Sea
- Key provisions of the Convention
- The United Nations and the Convention
- The future
- Links to the texts of the 1958 Geneva Conventions on the Law of the Sea

Convention on the Territorial Sea and the Contiguous Zone, 1958

Convention on the High Seas, 1958

Convention on Fishing and Conservation of the Living Resources of the High Seas, 1958

Convention on the Continental Shelf, 1958

Optional Protocol of Signature concerning the Compulsory Settlement of Disputes, 1958

A Historical Perspective

The oceans had long been subject to the freedom of-the-seas doctrine - a principle put forth in the seventeenth century essentially limiting national rights and jurisdiction over the oceans to a narrow belt of sea surrounding a nation's coastline. The remainder of the seas was proclaimed to be free to all and belonging to nc While this situation prevailed into the twentieth century, by mid-century there was an impetus to extend national claims over offshore resources. There was growi concern over the toll taken on coastal fish stocks by long-distance fishing fleets and over the threat of pollution and wastes from transport ships and oil tankers ca noxious cargoes that plied sea routes across the globe. The hazard of pollution was ever present, threatening coastal resorts and all forms of ocean life. The navies maritime powers were competing to maintain a presence across the globe on the surface waters and even under the sea.

A tangle of claims, spreading pollution, competing demands for lucrative fish stocks in coastal waters and adjacent seas, growing tension between coastal nation rights to these resources and those of distant-water fishermen, the prospects of a rich harvest of resources on the sea floor, the increased presence of maritime pow and the pressures of long-distance navigation and a seemingly outdated, if not inherently conflicting, freedom-of-the-seas doctrine - all these were threatening to transform the oceans into another arena for conflict and instability.

In 1945, President Harry S Truman, responding in part to pressure from domestic oil interests, unilaterally extended United States jurisdiction over all natural resources on that nation's continental shelf - oil, gas, minerals, etc. This was the first major challenge to the freedom-of-the-seas doctrine. Other nations soon follo suit.

In October 1946, Argentina claimed its shelf and the epicontinental sea above it. Chile and Peru in 1947, and Ecuador in 1950, asserted sovereign rights over a 2 mile zone, hoping thereby to limit the access of distant-water fishing fleets and to control the depletion of fish stocks in their adjacent seas.

Soon after the Second World War, Egypt, Ethiopia, Saudi Arabia, Libya, Venezuela and some Eastern European countries laid claim to a 12-mile territorial se clearly departing from the traditional three-mile limit.

Later, the archipelagic nation of Indonesia asserted the right to dominion over the water that separated its 13,000 islands. The Philippines did likewise. In 1970, Canada asserted the right to regulate navigation in an area extending for 100 miles from its shores in order to protect Arctic water against pollution.

From oil to tin, diamonds to gravel, metals to fish, the resources of the sea are enormous. The reality of their exploitation grows day by day as technology opens ways to tap those resources.

In the late 1960s, oil exploration was moving further and further from land, deeper and deeper into the bedrock of continental margins. From a modest beginni 1947 in the Gulf of Mexico, offshore oil production, still less than a million tons in 1954, had grown to close to 400 million tons. Oil drilling equipment was already as far as 4,000 metres below the ocean surface.

The oceans were being exploited as never before. Activities unknown barely two decades earlier were in full swing around the world. Tin had been mined in the shallow waters off Thailand and Indonesia. South Africa was about to tap the Namibian coast for diamonds. Potato-shaped nodules, found almost a century earlie lying on the seabed some five kilometres below, were attracting increased interest because of their metal content.

And then there was fishing. Large fishing vessels were roaming the oceans far from their native shores, capable of staying away from port for months at a time. Fish stocks began to show signs of depletion as fleet after fleet swept distant coastlines. Nations were flooding the richest fishing waters with their fishing fleets virtually unrestrained: coastal States setting limits and fishing States contesting them. The so-called "Cod War" between Iceland and the United Kingdom had brought about the spectacle of British Navy ships dispatched to rescue a fishing vessel seized by Iceland for violating its fishing rules.

Offshore oil was the centre of attraction in the North Sea. Britain, Denmark and Germany were in conflict as to how to carve up the continental shelf, with its rich oil resources.

It was late 1967 and the tranquillity of the sea was slowly being disrupted by technological breakthroughs, accelerating and multiplying uses, and a super-Power rivalry that stood poised to enter man's last preserve - the seabed.

It was a time that held both dangers and promises, risks and hopes. The dangers were numerous: nuclear submarines charting deep waters never before explored; designs for antiballistic missile systems to be placed on the seabed; supertankers ferrying oil from the Middle East to European and other ports, passing through congested straits and leaving behind a trail of oil spills; and rising tensions between nations over conflicting claims to ocean space and resources.

The oceans were generating a multitude of claims, counterclaims and sovereignty disputes.

The hope was for a more stable order, promoting greater use and better management of ocean resources and generating harmony and goodwill among States that would no longer have to eye each other suspiciously over conflicting claims.

Third United Nations Conference on the Law of the Sea

On 1 November 1967, Malta's Ambassador to the United Nations, Arvid Pardo, asked the nations of the world to look around them and open their eyes to a looming conflict that could devastate the oceans, the lifeline of man's very survival. In a speech to the United Nations General Assembly, he spoke of the super-Power rivalry that was spreading to the oceans, of the pollution that was poisoning the seas, of the conflicting legal claims and their implications for a stable order and of the rich potential that lay on the seabed.

Pardo ended with a call for "an effective international regime over the seabed and the ocean floor beyond a clearly defined national jurisdiction". "It is the only alternative by which we can hope to avoid the escalating tension that will be inevitable if the present situation is allowed to continue", he said.

Ambassador Tommy Koh, President, UN Convention on the Law of the Sea. *(UN Photo)*

Pardo's urging came at a time when many recognized the need for updating the freedom-of-the-seas doctrine to take into account the technological changes that had altered man's relationship to the oceans. It set in motion a process that spanned 15 years and saw the creation of the United Nations Seabed Committee, the signing of a treaty banning nuclear weapons on the seabed, the adoption of the declaration by the General Assembly that all resources of the seabed beyond the limits of national jurisdiction are the common heritage of mankind and the convening of the Stockholm Conference on the Human Environment. What started as an exercise to regulate the seabed turned into a global diplomatic effort to regulate and write rules for all ocean areas, all uses of the seas and all of its resources? These were some of the factors that led to the convening of the Third United Nations Conference on the Law of the Sea, to write a comprehensive treaty for the oceans.

The Conference was convened in New York in 1973. It ended nine years later with the adoption in 1982 of a constitution for the seas - the United Nations Convention on the Law of the Sea. During those nine years, shuttling back and forth between New York and Geneva, representatives of more than 160 sovereign States sat down and discussed the issues, bargained and traded national rights and obligations in the course of the marathon negotiations that produced the Convention.

United Nations Convention on the Law of the Sea - key provisions

- Setting Limits
- Navigation
- Exclusive Economic Zone
- Continental Shelf
- Deep Seabed Mining

- The Exploitation Regime
- Technological Prospects
- The Question of Universal Participation in the Convention
- Pioneer Investors
- Protection of the Marine Environment
- Marine Scientific Research
- Settlement of Disputes

The Convention

Navigational rights, territorial sea limits, economic jurisdiction, legal status of resources on the seabed beyond the limits of national jurisdiction, passage of ships through narrow straits, conservation and management of living marine resources, protection of the marine environment, a marine research regime and, a more unique feature, a binding procedure for settlement of disputes between States - these are among the important features of the treaty. In short, the Convention is an unprecedented attempt by the international community to regulate all aspects of the resources of the sea and uses of the ocean, and thus bring a stable order to mankind's very source of life.

"Possibly the most significant legal instrument of this century" is how the United Nations Secretary-General described the treaty after its signing. The Convention was adopted as a "Package deal", to be accepted as a whole in all its parts without reservation on any aspect. The signature of the Convention by Governments carries the undertaking not to take any action that might defeat its objects and purposes. Ratification of, or accession to, the Convention expresses the consent of a State to be bound by its provisions. The Convention came into force on 16 November 1994, one year after Guyana became the 60th State to adhere to it.

Across the globe, Governments have taken steps to bring their extended areas of adjacent ocean within their jurisdiction. They are taking steps to exercise their rights over neighbouring seas, to assess the resources of their waters and on the floor of the continental shelf. The practice of States has in nearly all respects been carried out in a manner consistent with the Convention, particularly after its entry into force and its rapid acceptance by the international community as the basis for all actions dealing with the oceans and the law of the sea.

The definition of the territorial sea has brought relief from conflicting claims. Navigation through the territorial sea and narrow straits is now based on legal principles. Coastal States are already reaping the benefits of provisions giving them extensive economic rights over a 200-mile wide zone along their shores. The right of landlocked countries of access to and from the sea is now stipulated unequivocally. The right to conduct marine scientific research is now based on accepted principles and cannot be unreasonably denied. Already established and functioning are the International Seabed Authority, which organize and control activities in the deep seabed beyond national jurisdiction with a view to administering its resources; as well as the International Tribunal for the Law of the Sea, which has competence to settle ocean related disputes arising from the application or interpretation of the Convention.

Wider understanding of the Convention will bring yet wider application. Stability promises order and harmonious development. However, Part XI, which deals with mining of minerals lying on the deep ocean floor outside of nationally regulated ocean areas, in what is commonly known as the international seabed area, had raised many concerns especially from industrialized States. The Secretary-General, in an attempt to achieve universal participation in the Convention, initiated a series of informal consultations among States in order to resolve those areas of concern. The consultations successfully achieved, in July 1998, an Agreement Related to the Implementation of Part XI of the Convention. The Agreement, which is part of the Convention, is now deemed to have paved the way for all States to become parties to the Convention.

Setting Limits

The dispute over who controls the oceans probably dates back to the days when the Egyptians first plied the Mediterranean in papyrus rafts. Over the years and centuries, countries large and small, possessing vast ocean-going fleets or small fishing flotillas, husbanding rich fishing grounds close to shore or eyeing distant harvests, have all vied for the right to call long stretches of oceans and seas their own.

Conflicting claims, even extravagant ones, over the oceans were not new. In 1494, two years after Christopher Columbus' first expedition to America, Pope Alexander VI met with representatives of two of the great maritime Powers of the day - Spain and Portugal - and neatly divided the Atlantic Ocean between them. A Papal Bull gave Spain everything west of the line the Pope drew down the Atlantic and Portugal everything east of it. On that basis, the Pacific and the Gulf of Mexico were acknowledged as Spain's, while Portugal was given the South Atlantic and the Indian Ocean.

Before the Convention on the Law of the Sea could address the exploitation of the riches underneath the high seas, navigation rights, economic jurisdiction, or any other pressing matter, it had to face one major and primary issue - the setting of limits. Everything else would depend on clearly defining the line separating national and international waters. Though the right of a coastal State to complete control over a belt of water along its shoreline - the territorial sea - had long been recognized in international law, up until the Third United Nations Conference on the Law of the Sea, States could not see eye to eye on how narrow or wide this belt should be.

At the start of the Conference, the States that maintained the traditional claims to a three-mile territorial sea had numbered a mere 25. Sixty-six countries had by then claimed a 12-mile territorial sea limit. Fifteen others claimed between 4 and 10 miles, and one remaining major group of eight States claimed 200 nautical miles.

Traditionally, smaller States and those not possessing large, ocean-going navies or merchant fleets favoured a wide territorial sea in order to protect their coastal waters from infringements by those States that did. Naval and maritime Powers, on the other hand, sought to limit the territorial sea as much as possible, in order to protect their fleets' freedom of movement.

As the work of the Conference progressed, the move towards a 12-mile territorial sea gained wider and eventually universal acceptance. Within this limit,

States are in principle free to enforce any law, regulate any use and exploit any resource.

The Convention retains for naval and merchant ships the right of "innocent passage" through the territorial seas of a coastal State. This means, for example, that a Japanese ship, picking up oil from Gulf States, would not have to make a 3,000-mile detour in order to avoid the territorial sea of Indonesia, provided passage is not detrimental to Indonesia and does not threaten its security or violate its laws.

In addition to their right to enforce any law within their territorial seas, coastal States are also empowered to implement certain rights in an area beyond the territorial sea, extending for 24 nautical miles from their shores, for the purpose of preventing certain violations and enforcing police powers. This area, known as the "contiguous zone", may be used by a coast guard or its naval equivalent to pursue and, if necessary, arrest and detain suspected drug smugglers, illegal immigrants and customs or tax evaders violating the laws of the coastal State within its territory or the territorial sea.

The Convention also contains a new feature in international law, which is the regime for archipelagic States (States such as the Philippines and Indonesia, which are made up of a group of closely spaced islands). For those States, the territorial sea is a 12-mile zone extending from a line drawn joining the outermost points of the outermost islands of the group that are in close proximity to each other. The waters between the islands are declared archipelagic waters, where ships of all States enjoy the right of innocent passage. In those waters, States may establish sea lanes and air routes where all ships and aircraft enjoy the right of expeditious and unobstructed passage.

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Navigation

Perhaps no other issue was considered as vital or presented the negotiators of the Convention on the Law of the Sea with as much difficulty as that of navigational rights.

Countries have generally claimed some part of the seas beyond their shores as part of their territory, as a zone of protection to be patrolled against smugglers, warships and other intruders. At its origin, the basis of the claim of coastal States to a belt of the sea was the principle of protection; during the seventeenth and eighteenth centuries another principle gradually evolved: that the extent of this belt should be measured by the power of the littoral sovereign to control the area.

In the eighteenth century, the so-called "cannon-shot" rule gained wide acceptance in Europe. Coastal States were to exercise dominion over their territorial seas as far as projectiles could be fired from a cannon based on the shore. According to some scholars, in the eighteenth century the range of land-based cannons was approximately one marine league, or three nautical miles. It is believed that on the basis of this formula developed the traditional three-mile territorial sea limit.

By the late 1960s, a trend to a 12-mile territorial sea had gradually emerged throughout the world, with a great majority of nations claiming sovereignty out to that seaward limit. However, the major maritime and naval Powers clung to a three-mile limit on territorial seas, primarily because a 12-mile limit would effectively close off and place under national sovereignty more than 100 straits used for international navigation.

A 12-mile territorial sea would place under national jurisdiction of riparian States strategic passages such as the Strait of Gibraltar (8 miles wide and the only open access to the Mediterranean), the Strait of Malacca (20 miles wide and the main sea route between the Pacific and Indian Oceans), the Strait of Hormuz (21 miles wide and the only passage to the oil-producing areas of Gulf States) and Bab el Mandeb (14 miles wide, connecting the Indian Ocean with the Red Sea).

At the Third United Nations Conference on the Law of the Sea, the issue of passage through straits placed the major naval Powers on one side and coastal States controlling narrow straits on the other. The United States and the Soviet Union insisted on free passage through straits, in effect giving straits the same legal status as the international waters of the high seas. The coastal States, concerned that passage of foreign warships so close to their shores might pose a threat to their national security and possibly involve them in conflicts among outside Powers, rejected this demand.

Instead, coastal States insisted on the designation of straits as territorial seas and were willing to grant to foreign warships only the right of "innocent passage", a term that was generally recognized to mean passage "not prejudicial to the peace, good order or security of the coastal State". The major naval Powers rejected this concept, since, under international law, a submarine exercising its right of innocent passage, for example, would have to surface and show its flag C an unacceptable security risk in the eyes of naval Powers. Also, innocent passage does not guarantee the aircraft of foreign States the right of overflight over waters where only such passage is guaranteed.

In fact, the issue of passage through straits was one of the early driving forces behind the Third United Nations Conference on the Law of the Sea, when, in early 1967, the United States and the Soviet Union proposed to other Member countries of the United Nations that an international conference be held to deal specifically with the entangled issues of straits, overflight, the width of the territorial sea and fisheries.

The compromise that emerged in the Convention is a new concept that combines the legally accepted provisions of innocent passage through territorial waters and freedom of navigation on the high seas. The new concept, "transit passage", required concessions from both sides.

The regime of transit passage retains the international status of the straits and gives the naval Powers the right to unimpeded navigation and overflight that they had insisted on. Ships and vessels in transit passage, however, must observe international regulations on navigational safety, civilian air-traffic control and prohibition of vessel-source pollution and the conditions that ships and aircraft proceed without delay and without stopping except in distress situations and that they refrain from any threat or use of force against the coastal State. In all matters other than such transient navigation, straits are to be considered part of the territorial sea of the coastal State.

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Exclusive Economic Zone

The exclusive economic zone (EEZ) is one of the most revolutionary features of the Convention, and one which already has had a profound impact on the management and conservation of the resources of the oceans. Simply put, it recognizes the right of coastal States to jurisdiction over the resources of some 38 million square nautical miles of ocean space. To the coastal State falls the right to exploit, develop, manage and conserve all resources - fish or oil, gas or gravel, nodules or sulphur - to be found in the waters, on the ocean floor and in the subsoil of an area extending 200 miles from its shore.

The EEZs are a generous endowment indeed. About 87 per cent of all known and estimated hydrocarbon reserves under the sea fall under some national

jurisdiction as a result. So too will almost all known and potential offshore mineral resources, excluding the mineral resources (mainly manganese nodules and metallic crusts) of the deep ocean floor beyond national limits. And whatever the value of the nodules, it is the other non-living resources, such as hydrocarbons, that represent the presently attainable and readily exploitable wealth.

The most lucrative fishing grounds too are predominantly the coastal waters. This is because the richest phytoplankton pastures lie within 200 miles of the continental masses. Phytoplankton, the basic food of fish, is brought up from the deep by currents and ocean streams at their strongest near land, and by the upwelling of cold waters where there are strong offshore winds.

The desire of coastal States to control the fish harvest in adjacent waters was a major driving force behind the creation of the EEZs. Fishing, the prototypical cottage industry before the Second World War, had grown tremendously by the 1950s and 1960s. Fifteen million tons in 1938, the world fish catch stood at 86 million tons in 1989. No longer the domain of a lone fisherman plying the sea in a wooden dhow, fishing, to be competitive in world markets, now requires armadas of factory-fishing vessels, able to stay months at sea far from their native shores, and carrying sophisticated equipment for tracking their prey.

The special interest of coastal States in the conservation and management of fisheries in adjacent waters was first recognized in the 1958 Convention on Fishing and Conservation of the Living Resources of the High Seas. That Convention allowed coastal States to take "unilateral measures" of conservation on what was then the high seas adjacent to their territorial waters. It required that if six months of prior negotiations with foreign fishing nations had failed to find a formula for sharing, the coastal State could impose terms. But still the rules were disorderly, procedures undefined, and rights and obligations a web of confusion. On the whole, these rules were never implemented.

The claim for 200-mile offshore sovereignty made by Peru, Chile and Ecuador in the late 1940s and early 1950s was sparked by their desire to protect from foreign fishermen the rich waters of the Humboldt Current (more or less coinciding with the 200-mile offshore belt. This limit was incorporated in the Santiago Declaration of 1952 and reaffirmed by other Latin American States joining the three in the Montevideo and Lima Declarations of 1970. The idea of sovereignty over coastal-area resources continued to gain ground.

As long-utilized fishing grounds began to show signs of depletion, as long-distance ships came to fish waters local fishermen claimed by tradition, as competition increased, so too did conflict. Between 1974 and 1979 alone there were some 20 disputes over cod, anchovies or tuna and other species between, for example, the United Kingdom and Iceland, Morocco and Spain, and the United States and Peru.

And then there was the offshore oil.

The Third United Nations Conference on the Law of the Sea was launched shortly after the October 1973 Arab-Israeli war. The subsequent oil embargo and skyrocketing of prices only helped to heighten concern over control of offshore oil reserves. Already, significant amounts of oil were coming from offshore facilities: 376 million of the 483 million tons produced in the Middle East in 1973; 431 million barrels a day in Nigeria, 141 million barrels in Malaysia, 246 million barrels in Indonesia. And all of this with barely 2 per cent of the continental shelf explored. Clearly, there was hope all around for a fortunate discovery and a potential to be protected.

Today, the benefits brought by the EEZs are more clearly evident. Already 86 coastal States have economic jurisdiction up to the 200-mile limit. As a result, almost 99 per cent of the world's fisheries now fall under some nation's jurisdiction. Also, a large percentage of world oil and gas production is offshore. Many other marine resources also fall within coastal-State control. This provides a long-needed opportunity for rational, well-managed exploitation under an assured authority.

Figures on known offshore oil reserves now range from 240 to 300 billion tons. Production from these reserves amounted to a little more than 25 per cent of total world production in 1996. Experts estimate that of the 150 countries with offshore jurisdiction, over 100, many of them developing countries, have medium to excellent prospects of finding and developing new oil and natural gas fields.

It is evident that it is archipelagic States and large nations endowed with long coastlines that naturally acquire the greatest areas under the EEZ regime. Among the major beneficiaries of the EEZ regime are the United States, France, Indonesia, New Zealand, Australia and the Russian Federation.

But with exclusive rights come responsibilities and obligations For example, the Convention encourages optimum use of fish stocks without risking depletion through overfishing. Each coastal State is to determine the total allowable catch for each fish species within its economic zone and is also to estimate its harvest capacity and what it can and cannot itself catch. Coastal States are obliged to give access to others, particularly neighbouring States and land-locked countries, to the surplus of the allowable catch. Such access must be done in accordance with the conservation measures established in the laws and regulations of the coastal State.

Coastal States have certain other obligations, including the adoption of measures to prevent and limit pollution and to facilitate marine scientific research in their EEZs.

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Continental Shelf

In ancient times, navigation and fishing were the primary uses of the seas. As man progressed, pulled by technology in some instances and pushing that technology at other times in order to satisfy his needs, a rich bounty of other resources and uses were found underneath the waves on and under the ocean floor - minerals, natural gas, oil, sand and gravel, diamonds and gold. What should be the extent of a coastal State's jurisdiction over these resources? Where and how should the lines demarcating their continental shelves be drawn? How should these resources be exploited? These were among the important questions facing lawyers, scientists and diplomats as they assembled in New York in 1973 for the Third Conference.

Given the real and potential continental shelf riches, there naturally was a scramble by nations to assert shelf rights. Two difficulties quickly arose. States with a naturally wide shelf had a basis for their claims, but the geologically disadvantaged might have almost no shelf at all. The latter were not ready to accept geological discrimination. Also, there was no agreed method on how to define the shelf's outer limits, and there was a danger of the claims to continental shelves being overextended - so much so as to eventually divide up the entire ocean floor among such shelves.

Although many States had started claiming wide continental-shelf jurisdiction since the Truman Proclamation of 1945, these States did not use the term "continental shelf" in the same sense. In fact, the expression became no more than a convenient formula covering a diversity of titles or claims to the seabed and

subsoil adjacent to the territorial seas of States. In the mid-1950s the International Law Commission made a number of attempts to define the "continental shelf" and coastal State jurisdiction over its resources.

In 1958, the first United Nations Conference on the Law of the Sea accepted a definition adopted by the International Law Commission, which defined the continental shelf to include "the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 metres, or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas".

Already, as the Third United Nations Conference on the Law of the Sea got under way, there was a strong consensus in favour of extending coastal-State control over ocean resources out to 200 miles from shore so that the outer limit coincides with that of the EEZ. But the Conference had to tackle the demand by States with a geographical shelf extending beyond 200 miles for wider economic jurisdiction.

The Convention resolves conflicting claims, interpretations and measuring techniques by setting the 200-mile EEZ limit as the boundary of the continental shelf for seabed and subsoil exploitation, satisfying the geologically disadvantaged. It satisfied those nations with a broader shelf C about 30 States, including Argentina, Australia, Canada, India, Madagascar, Mexico, Sri Lanka and France with respect to its overseas possessions C by giving them the possibility of establishing a boundary going out to 350 miles from their shores or further, depending on certain geological criteria.

Thus, the continental shelf of a coastal State comprises the seabed and its subsoil that extend beyond the limits of its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 miles from the baselines from which the territorial sea is measured, where the outer edge of the continental margin does not extend up to that distance.

In cases where the continental margin extends further than 200 miles, nations may claim jurisdiction up to 350 miles from the baseline or 100 miles from the 2,500 metre depth, depending on certain criteria such as the thickness of sedimentary deposits. These rights would not affect the legal status of the waters or that of the airspace above the continental shelf.

To counterbalance the continental shelf extensions, coastal States must also contribute to a system of sharing the revenue derived from the exploitation of mineral resources beyond 200 miles. These payments or contributions - from which developing countries that are net importers of the mineral in question are exempt C are to be equitably distributed among States parties to the Convention through the International Seabed Authority.

To control the claims extending beyond 200 miles, the Commission on the Limits of the Continental Shelf was established to consider the data submitted by the coastal States and make recommendations

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Deep Seabed Mining

Deep seabed mining is an enormous challenge that has been compared to standing atop a New York City skyscraper on a windy day, trying to suck up marbles off the street below with a vacuum cleaner attached to a long hose.

Mining will take place at a depth of more than fifteen thousand feet of open ocean, thousands of miles from land. Mining ships are expected to remain on station five years at a time, working without a stop, and to transfer the seabed minerals they bring up to auxiliary vessels.

At the centre of the controversy were potato-sized manganese nodules found on the deep ocean floor and containing a number of important metals and minerals.

On 13 March 1874, somewhere between Hawaii and Tahiti, the crew of the British research vessel HMS *Challenger*, on the first great oceanographic expedition of modern times, hauled in from a depth of 15,600 feet a trawl containing the first known deposits of manganese nodules. Analysis of the samples in 1891 showed the Pacific Ocean nodules to contain important metals, particularly nickel, copper and cobalt. Subsequent sampling demonstrated that nodules were abundant throughout the deep regions of the Pacific.

In the 1950s, the potential of these deposits as sources of nickel, copper and cobalt ore was finally appreciated. Between 1958 and 1968, numerous companies began serious prospecting of the nodule fields to estimate their economic potential. By 1974, 100 years after the first samples were taken, it was well established that a broad belt of sea floor between Mexico and Hawaii and a few degrees north of the equator (the so-called Clarion Clipperton zone) was literally paved with nodules over an area of more than 1.35 million square miles.

In 1970 the United Nations General Assembly declared the resources of the seabed beyond the limits of national jurisdiction to be "the common heritage of mankind". For 12 years from then, up to 1982 when the Convention on the Law of the Sea was adopted, nothing tested so sorely the ability of diplomats from various corners of the world to reach common ground than the goal of conserving that common heritage and profiting from it at the same time.

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The Exploitation Regime

Having established that the resources of the seabed beyond the limits of national jurisdiction are the common heritage of mankind, the framers of the treaty faced the question of who should mine the minerals and under what rules. The developed countries took the view that the resources should be commercially exploited by mining companies in consortia and that an international authority should grant licenses to those companies. The developing countries objected to this view on the grounds that the resource was unique and belonged to the whole of mankind, and that the most appropriate way to benefit from it was for the international community to establish a public enterprise to mine the international seabed area.

Thus, the gamut of proposals ran from a "weak" international authority, noting claims and collecting fees, to a "strong" one with exclusive rights to mine the common heritage area, involving States or private groups only as it saw fit. The solution found was to make possible both the public and private enterprises on one hand and the collective mining on the other - the so-called "parallel system".

This complex system, though simplified to a great degree by the Agreement on Part XI, is administered by the International Seabed Authority, headquartered in Jamaica. The Authority is divided into three principal organs, an Assembly, made up of all members of the Authority with power to set general policy, a council, with powers to make executive decisions, made up of 36 members elected from among the members of the Authority, and a secretariat headed by a secretary-general.

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Technological Prospects

Unfortunately, the road to the market is long, hard and expensive. The nodules lie two to three miles - about 5 kilometres - down, in pitch-black water where pressures exceed 7,000 pounds per square inch and temperatures are near freezing. Many of the ocean floors are filled with treacherous hills and valleys. Appropriate deep-sea mining technology must be developed to accommodate this environment.

Many mining systems have been tried, and some have appeared more promising than others. For a while, hydraulic suction dredge airlifts and a continuous-line bucket system were thought to be a promising answer to the mining dilemma. Another system, the so-called shuttle system, involves sending down a remotely operated, Jules Verne-like vehicle, with television "eyes" and powerful lights, to crawl over the ocean floor, gobble up and crush nodules and resurface with its catch.

Today, the continuous-line bucket system, where empty buckets are lowered to the bottom of the ocean and later raised, partially filled with nodules, has been discarded because of low recovery rates. The shuttle system has been shelved because its operational and investment costs far exceeded the costs of more conventional approaches. However, this system is thought to be the technology of the future. Thus, the current focus is on the hydraulic suction and dredge method. But there are a number of technological problems to be worked out before it will be ready for commercial application.

Keeping a steady ship position, since a vessel cannot anchor 5 kilometres above the sea floor and making sure that the pipe does not snap or that the recovery vehicle is not lost or permanently stuck on the ocean floor are among the many headaches involved in developing the necessary technology for commercial exploitation.

Extracting metals from the nodules is another task altogether. All agree that this phase will be the most expensive, even if only at the initial investment stage. Technologically, however, processing does not pose as much of a challenge as the recovery of manganese nodules. That is because it is thought that the two processing techniques applied to land-derived ores - heat and chemical separation of the metals - will apply just as well to the seabed resources.

Because of their porous nature, recovered nodules retain a great deal of water. Heat processing would therefore require a great amount of energy in order to dry the nodules prior to extracting the metals. It is for that reason that some believe that chemical techniques will prove to be the most efficient and least costly.

Moreover, processing would involve such waste that special barren sites would have to be found to carry out operations. Yet, others believe that the economic viability of seabed mining would be greatly enhanced if a method is devised to process the nodules at sea, saving enormous energy costs involved in the transfer of nodules to land-based processing plants.

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The Question of Universal Participation in the Convention

Prospects for seabed mining depend to a large degree on the market conditions for the metals to be produced from seabed nodules. While one of the driving forces behind the Convention on the Law of the Sea was the prevailing belief in the 1970s that commercial seabed mining was imminent, today the prospects for the inherently expensive process of mining the seabed have greatly receded with changing economic and other conditions since the early 1980s. Indeed, some experts predict that commercial mining operations are not likely to begin until well after the year 2000.

A number of important political and economic changes have taken place in the 10 years that have elapsed since the adoption of the Convention, some directly affecting the deep seabed mining provisions of the Convention, others affecting international relations in general. In the meantime, the prevailing economic prognosis on which the seabed mining regime was built has not been realized.

The Convention on the Law of the Sea holds out the promise of an orderly and equitable regime or system to govern all uses of the sea. But it is a club that one must join in order to fully share in the benefits. The Convention - like other treaties - creates rights only for those who become parties to it and thereby accept its obligations, except for the provisions which apply to all States because they either merely confirm existing customary law or are becoming customary law.

However, as its preamble states, the Convention starts from the premise that the problems of ocean space are closely interrelated and need to be considered as a whole. The desire for a comprehensive Convention arose from the recognition that traditional sea law was disintegrating and that the international community could not be expected to behave in a consistent manner without dialogue, negotiations and agreement.

In this context, it must be underscored that the Convention was adopted as a "package deal", with one aim above all, namely universal participation in the Convention. No State can claim that it has achieved quite all it wanted. Yet every State benefits from the provisions of the Convention and from the certainty that it has established in international law in relation to the law of the sea. It has defined rights while underscoring the obligations that must be performed in order to benefit from those rights. Any trend towards exercising those rights without complying with the corresponding obligations, or towards exercising rights inconsistent with the Convention, must be viewed as damaging to the universal regime that the Convention establishes.

The adoption of the Agreement on Part XI has eliminated this threat. With nearly all States now adhering, even on a provisional basis pending ratification or accession, to the Convention, the threat to the Convention has been eliminated. The Agreement has particularly removed those obstacles which had prevented the industrialized countries from adhering to the Convention. Those same countries have either ratified the Convention or submitted it for their internal legislative procedures. Even more important, is their active participation in the institutions created by the Convention and their strong support for the regime contained in it.

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Pioneer Investors

The Preparatory Commission for the International Seabed Authority and for the International Tribunal for the Law of the Sea was established, prior to the entry into force of the Convention, to prepare for the setting up of both institutions. The Preparatory Commission proceeded with the implementation of an interim regime adopted by the Third United Nations Conference on the Law of the Sea, designed to protect those States or entities that have already made a large investment in seabed mining. This so-called Pioneer Investor Protection regime allows a State, or consortia of mining companies to be sponsored by a State, to be registered as a Pioneer Investor. Registration reserves for the Pioneer Investor a specific mine site in which the registered Investor is allowed to explore for, but

not exploit, manganese nodules. Registered Investors are also obligated to explore a mine site reserved for the Enterprise and undertake other obligations, including the provision of training to individuals to be designated by the Preparatory Commission.

The Preparatory Commission had registered seven pioneer investors: China, France, India, Japan, the Republic of Korea, and the Russian Federation, as well as a consortium known as the Interoceanmetal Joint Organization (IMO). With the Convention in force and the International Seabed Authority being functioning, those pioneer investors will become contractors along the terms contained in the Convention and the Agreement, as well as regulations established by the International Seabed Authority.

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Protection of the Marine Environment

Thor Heyerdahl, sailing the Atlantic in his papyrus raft, Ra, found globs of oil, tar and plastics stretching from the coast of Africa to South America. Parts of the Baltic, Mediterranean and Black Sea are already so polluted that marine life is severely threatened. And waste dumped in the Pacific and Atlantic Oceans has washed up on the shores of Antarctica.

In the United States, long stretches of beaches are often closed because of medical and other waste washing up on shore. And every time an oil tanker is involved in an accident, the world's pulse quickens a bit in fear of a major catastrophe, In fact, every time a tanker cleans its tanks at sea, every time a factory channels toxic residues to coastal waters or a city conveniently releases raw sewage into the sea, every time a service station changes the oil of an automobile and pours the waste oil into the sewers, the oceans become a little more polluted. Eventually, scientists fear, the oceans' regenerative capacity will be overwhelmed by the amount of pollution it is subjected to by man. Signs of such catastrophe are clearly observed in many seas—particularly along the heavily populated coasts and enclosed or semi-enclosed seas.

There are six main sources of ocean pollution addressed in the Convention: land-based and coastal activities; continental-shelf drilling; potential seabed mining; ocean dumping; vessel-source pollution; and pollution from or through the atmosphere.

The Convention lays down, first of all, the fundamental obligation of all States to protect and preserve the marine environment. It further urges all States to cooperate on a global and regional basis in formulating rules and standards and otherwise take measures for the same purpose.

Coastal States are empowered to enforce their national standards and anti-pollution measures within their territorial sea. Every coastal State is granted jurisdiction for the protection and preservation of the marine environment of its EEZ. Such jurisdiction allows coastal States to control, prevent and reduce marine pollution from dumping, land-based sources or seabed activities subject to national jurisdiction, or from or through the atmosphere. With regard to marine pollution from foreign vessels, coastal States can exercise jurisdiction only for the enforcement of laws and regulations adopted in accordance with the Convention or for "generally accepted international rules and standards". Such rules and standards, many of which are already in place, are adopted through the competent international organization, namely the International Maritime Organization (IMO).

On the other hand, it is the duty of the "flag State", the State where a ship is registered and whose flag it flies, to enforce the rules adopted for the control of marine pollution from vessels, irrespective of where a violation occurs. This serves as a safeguard for the enforcement of international rules, particularly in waters beyond the national jurisdiction of the coastal State, i.e., on the high seas.

Furthermore, the Convention gives enforcement powers to the "port State", or the State where a ship is destined. In doing so it has incorporated a method developed in other Conventions for the enforcement of treaty obligations dealing with shipping standards, marine safety and pollution prevention. The port State can enforce any type of international rule or national regulations adopted in accordance with the Convention or applicable international rules as a condition for the entry of foreign vessels into their ports or internal waters or for a call at their offshore terminals. This has already become a significant factor in the strengthening of international standards.

Finally, as far as the international seabed area is concerned, the International Seabed Authority, through its Council, is given broad discretionary powers to assess the potential environmental impact of a given deep seabed mining operation, recommend changes, formulate rules and regulations, establish a monitoring programme and recommend issuance of emergency orders by the Council to prevent serious environmental damage. States are to be held liable for any damage caused by either their own enterprise or contractors under their jurisdiction.

With the passage of time, United Nations involvement with the law of the sea has expanded as awareness increases that not only ocean problems but global problems as a whole are interrelated. Already, the 1992 United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in 1992, placed a great deal of emphasis on the protection and preservation of the oceans' environment in harmony with the rational use and development of their living resources, thus establishing the concept of "sustainable development" embodied in Agenda 21, the programme of action adopted at the Conference.

The necessity to combat the degradation and depletion of fish stocks, both in the zones under national jurisdiction and in the high seas and its causes, such as overfishing and excess fishing capacity, by-catch and discards, has been one of the recurrent topics in the process of implementation of the programme of action adopted in Rio de Janeiro.

In this respect, among the most important outputs of the Conference was the convening of an intergovernmental conference under United Nations auspices with a view to resolving the old conflict between coastal States and distant-water fishing States over straddling and highly migratory fish stocks in the areas adjacent to the 200 nautical-mile exclusive economic zones. This Conference adopted the 1995 Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks which introduces a number of innovative measures, particularly in the area of environmental and resource protection obliging States to adopt a precautionary approach to fisheries exploitation and giving expanded powers to port States to enforce proper management of fisheries resources.

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Marine Scientific Research

With the extension of the territorial sea to 12 miles and the establishment of the new 200-mile EEZ, the area open to unrestricted scientific research was circumscribed. The Convention thus had to balance the concerns of major research States, mostly developed countries, which saw any coastal-state limitation on research as a restriction of a traditional freedom that would not only adversely affect the advancement of science but also deny its potential benefits to all nations in fields such as weather forecasting and the study of effects of ocean currents and the natural forces at work on the ocean floor.

On the other side, many developing countries had become extremely wary of the possibility of scientific expeditions being used as a cover for intelligence gathering or economic gain, particularly in relatively uncharted areas, scientific research was yielding knowledge of potential economic significance.

The developing countries demanded "prior consent" of a coastal State to all scientific research on the continental shelf and within the EEZ. The developed countries offered to give coastal States "prior notification" of research projects to be carried out on the continental shelf and within the EEZ, and to share any data pertinent to offshore resources.

The final provisions of the Convention represent a concession on the part of developed States. Coastal State jurisdiction within its territorial sea remains absolute. Within the EEZ and in cases involving research on the continental shelf, the coastal State must give its prior consent, However, such consent for research for peaceful purposes is to be granted "in normal circumstances" and "shall not be delayed or denied unreasonably", except under certain specific circumstances identified in the Convention. In case the consent of the coastal State is requested and such State does not reply within six months of the date of the request, the coastal State is deemed to have implicitly given its consent. These last provisions were intended to circumvent the long bureaucratic delays and frequent burdensome differences in coastal State regulations.

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Settlement of Disputes

Provisions for the settlement of disputes arising out of an international treaty are often contained in a separate optional protocol. Parties to the treaty could choose to be bound by those provisions or not by accepting or not accepting the Protocol. The Convention on the Law of the Sea is unique in that the mechanism for the settlement of disputes is incorporated into the document, making it obligatory for parties to the Convention to go through the settlement procedure in case of a dispute with another party.

During the drafting of the Convention, some countries were opposed in principle to binding settlement to be decided by third party judges or arbitrators, insisting that issues could best be resolved by direct negotiations between States without requiring them to bring in outsiders. Others, pointing to a history of failed negotiations and long-standing disputes often leading to a use of force, argued that the only sure chance for peaceful settlement lay in the willingness of States to bind themselves in advance to accept the decisions of judicial bodies.

What emerged from the negotiations was a combination of the two approaches, regarded by many as a landmark in international law.

If direct talks between the parties fail, the Convention gives them a choice among four procedures - some new, some old: submission of the dispute to the International Tribunal for the Law of the Sea, adjudication by the International Court of Justice, submission to binding international arbitration procedures or submission to special arbitration tribunals with expertise in specific types of disputes. All of these procedures involve binding third-party settlement, in which an agent other than the parties directly involved hands down a decision that the parties are committed in advance to respect.

The only exception to these provisions is made for sensitive cases involving national sovereignty. In such circumstances, the parties are obliged to submit their dispute to a conciliation commission, but they will not be bound by any decision or finding of the commission. The moral pressure resulting was argued as being persuasive and adequate to ensure compliance with the findings. The Convention also contains so-called "optional exceptions", which can be specified at the time a country signs, ratifies or accedes to the Convention or at any later time. A State may declare that it chooses not to be bound by one or more of the mandatory procedures if they involve existing maritime boundary disputes, military activities or issues under discussion in the United Nations Security Council.

Disputes over seabed activities will be arbitrated by an 11-member Seabed Disputes Chamber, within the International Tribunal for the Law of the Sea. The Chamber has compulsory jurisdiction over all such conflicts, whether involving States, the International Seabed Authority or companies or individuals having seabed mining contracts.

The United Nations and the Law of the Sea

Throughout the years, beginning with the work of the Seabed Committee in 1968 and later during the nine-year duration of the Third United Nations Conference on the Law of the Sea, the United Nations has been actively engaged in encouraging and guiding the development and eventual adoption of the Law of the Sea Convention. Today, it continues to be engaged in this process, by monitoring developments as they relate to the Convention and providing assistance to States, when called for, in either the ratification or the implementation process.

The goal of the Organization is to help States to better understand and implement the Convention in order to utilize their marine resources in an environment relatively free of conflict and conducive to development, safeguarding the rule of law in the oceans.

In this context, the Division for Ocean Affairs and the Law of the Sea (DOALOS) of the United Nations Office of Legal Affairs helps to coordinate the Organization's activities and programmes in the area of marine affairs. It is active in assisting and advising States in the integration of the marine sector in their development planning. It also responds to requests for information and advice on the legal, economic and political aspects of the Convention and its implications for States. Such information is used by States during the ratification process, in the management of the marine sector of their economies and in the development of a national sea-use policy.

The United Nations also gives assistance to the two newly created institutions - the International Seabed Authority and the International Tribunal for the Law of the Sea.

The Future

The entry into force of the Convention, together with extended jurisdiction, new fields of activity and increased uses of the oceans, will continue to confront all States with important challenges. These challenges will include how to apply the new provisions in accordance with the letter and spirit of the Convention, how to harmonize national legislation with it and how to fulfil the obligations incumbent upon States under the Convention.

Another major challenge will be to provide the necessary assistance, particularly to developing States, in order to allow them to benefit from the rights they

have acquired under the new regime. For example, a great many of the States that have established their EEZs are not at present in a position to exercise all their rights and perform duties under the Convention. The delimitation of EEZ, the surveying of its area, its monitoring, the utilization of its resources and, generally speaking, its management and development are long-term endeavours beyond the present and possibly near-term capabilities of most developing countries.

The United Nations will continue to play a major role in the monitoring of, collection of information on and reporting on State practice in the implementation of the new legal regime. It will also have a significant role to play in reporting on activities of States and relevant international organizations in marine affairs and on major trends and developments. This information will be of great assistance to States in the acceptance and ratification of the Convention, as well as its early entry into force and implementation.

A number of new duties falls upon the Secretary-General of the United Nations. These include the depositing of charts and coordinates showing the maritime limits of coastal States and servicing of the Commission on the Limits of the Continental Shelf The Secretary-General is also called upon to convene meetings of States Parties to elect the members of the International Tribunal for the Law of the Sea and to adopt its budget. Meetings of States Parties may also be called for a Review Conference dealing with the provisions on deep seabed mining or for amending the Convention.

The United Nations will continue to strengthen the cooperation that has developed over the last two decades among the organizations in the United Nations system involved in marine affairs. Such close cooperation would be of great benefit to States, since it would avoid duplication and overlapping of activities. It would also help to coordinate multidisciplinary activities related to the management of marine affairs.

With the passage of time, United Nations involvement with the law of the sea is expected to expand as awareness increases that not only ocean problems but also global problems as a whole are interrelated.

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United States Arctic Research Commission Report

US ARCTIC RESEARCH COMMISSION

REPORT ON

GOALS AND OBJECTIVES FOR ARCTIC RESEARCH 2009–2010

FOR THE US ARCTIC RESEARCH PROGRAM PLAN

ABOUT THE US ARCTIC RESEARCH COMMISSION

The US Arctic Research Commission is an independent federal agency created by the Arctic Research and Policy Act (ARPA) of 1984, as amended. It consists of a nonpartisan advisory body of scientists, physicians, indigenous leaders, and industry representatives appointed by the President of the United States and supported by staff located in Washington, DC, and in Anchorage, AK. In addition to establishing the goals in this report, the Commission sets US Arctic research policy and builds cooperative links in Arctic research, from the US Arctic research program, to international partners, and to the State of Alaska. The law requires the Commission to comment to Congress on the progress of the Executive Branch in reaching goals set by the Commission and on their adoption by the Interagency Arctic Research and Policy Committee (IARPC). The Commission plays an active role in the work of several interagency committees, including the Arctic Policy Group, chaired by the US Department of State, which oversees US participation in the eight-nation Arctic Council. The Commission is a statutory member of the North Pacific Research Board and the North Slope Science Initiative, and is a member of various committees of the National Ocean Governance Structure, the interagency Extended Continental Shelf Task Force, the Scientific Ice Expeditions Interagency Committee, involving US Navy nuclear submarines in the Arctic, the Alaska Ocean Observing System, the International Permafrost Association, and the Consortium for Ocean Leadership, among others.

HOW THIS REPORT WAS COMPILED

Under ARPA, the US Arctic Research Commission biennially recommends key goals and objectives for the US Arctic Research Program Plan (hereinafter referred to as the "Plan"). The goals report was released after the Commission collected substantial input from scientific researchers, policymakers, and the public in Alaska, throughout the United States, and in the growing number of nations with Arctic interests. The Commission cosponsored a number of scientific meetings and workshops to help define its research goals and policy, including a June 2009 workshop in Anchorage with the National Institutes of Health's Fogarty International Center, to help understand the basis for the remarkably high rate of behavioral and mental health problems in the Arctic, including suicide, alcoholism, and spousal and child abuse. During the last two years, the Commission led special initiatives and reports, including the *Arctic Marine Shipping Assessment*, an Arctic Council agenda for shipping research, and a white paper on oil spill response research. The Commission occasionally writes "white papers" on other subjects as well, which are posted on the Commission's web site, www.arctic.gov.

WHERE THIS REPORT GOES FROM HERE

Under ARPA, IARPC is charged with revising the nation's five-year Arctic Research Program Plan in order to achieve the goals of this report. The recommendations in this report were conveyed, as required by law, in 2009, and this report elaborates upon those goals as a starting point for IARPC's work to revise the Plan. Federal agencies have been identified to lead revisions under each theme in this goals report and to undertake new initiatives; this report contains specific recommendations for federal agencies and other partners in the US Arctic Research Program. The White House Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) also play major roles in formulating a federal policy and budgets to carry out the plan adopted in response to this goals report.

During 2010, in preparation for the 2011 goals report, the Commission will work closely with OMB, OSTP, and IARPC member agencies to summarize the work of each agency's Arctic research program, including developing the best possible information on the Plan's current budget, estimated at approximately $400 million per year.

COVER PHOTOS

TOP LEFT. USCG Icebreaker Healy in the Arctic, with cranes extended, conducting research. (Photo credit: PA3 J. Bigelow, USCG)

TOP MIDDLE. Coastal erosion. (Photo credit: C. Arp, USGS)

TOP RIGHT. Polar bear on Arctic ice. (Photo credit: Digital Vision)

BOTTOM LEFT. Kivalina girl. (Photo credit: J. Farrell)

BOTTOM RIGHT. Last mooring. (Photo credit: M. Dunn)

BACKGROUND. Iceberg close-up at the Arctic North Pole region of Spitsbergen/Svalbard. (Photo credit: iStockphoto)

BACKGROUND PHOTO, THIS PAGE. (Photo credit: M. Dunn)

US ARCTIC RESEARCH COMMISSION

REPORT ON

GOALS AND OBJECTIVES FOR ARCTIC RESEARCH 2009–2010

FOR THE US ARCTIC RESEARCH PROGRAM PLAN

Mr. President and Members of Congress:

The Arctic region, and Alaska—America's Arctic—provides tremendous value to the United States. Without a significant Arctic Research Program, however, those things we value in and from the Arctic—energy, food, security, biodiversity, fresh water, carbon sinks, pristine wilderness, more direct transport routes, rich indigenous cultures—cannot contribute as well or be sustained. There is little human activity we know of in the Arctic that is not "knowledge based." The Arctic continues to be rich in mysteries that can only be solved with pioneering, exploration and research. With greater knowledge, the Arctic region can contribute more to both the global economy and the environment. Knowledge about Arctic processes can help protect the world from expensive, unnecessary, and destructive climate change.

The US Arctic Research Commission is pleased to present goals it has established for the nation's Arctic Research Program. In developing these goals, we have listened, widely. We are grateful for the advice we have received from Arctic residents, the American public at large, the State of Alaska, the academic community, federal agencies who manage our Arctic assets, and international partners. Since the basic goals we set here remain the same as those set in 2007, much work has begun at the Interagency Arctic Research Policy Committee to see that this research actually happens. What we present now urges an acceleration of that work, and new emphases to mesh with current national priorities related to energy and climate, ocean policy, health, national and homeland security, and keeping the US competitive in the world economy. To highlight a few:

- Fresh with the completion of the 2007–2009 International Polar Year, the first since 1957, the Arctic science community is better prepared now to establish a sustained Arctic observing network. As the world works to create an effective mitigation scheme to reduce greenhouse gas emissions, monitoring will help us understand potentially overwhelming "feedbacks" in the Arctic that could counter those efforts.

- Federal agencies are paying much more attention to the great health disparities and tragic, alarming youth suicide rates experienced by Arctic residents. We must now begin rigorous research to support US-funded clinical efforts to stem suicide rates in the Arctic. A generation of youth is at risk, and new research initiatives could not be more vital.

- Resource managers are more aware of the need to catalogue all our resources, and to expand efforts to map parts of the Arctic for the first time. These programs, tied with pending US accession to the United Nations Convention on the Law of the Sea, can expand US territory in the Arctic. We must be aware that our neighbors also see the same Arctic opportunities in new territory, expanding fisheries, shipping routes, and oil and gas, and only with an active Arctic presence will the United States help shape new patterns of activity in the Arctic to our liking. When it comes to work related to protection of threatened species, the federal government needs better partnerships with the State of Alaska, indigenous peoples who subsist on these resources, and international partners.

- Federal and state agencies responsible for building infrastructure must direct more research to help Arctic residents adapt to climate change. As the Arctic Ocean becomes more accessible, it is also essential that we meet the promise of the Oil Pollution Act of 1990, and have an oil spill research program that will assure

Arctic residents that meaningful improvements and reduction of risk are underway. The American public pays a tax of eight cents a barrel of oil used to reduce spill risks, yet the government cannot be said to have a competitive research program of the scope we promised ourselves after the Exxon Valdez Oil Spill in 1989.

- An Arctic Ocean baseline science plan will enable the policy goals of ecosystem-based management and marine spatial planning called for by the President's Ocean Policy Task Force. But, appropriate funding is needed for science to provide that essential knowledge from the Arctic Ocean. We also need to work with our neighbors in the Arctic to ensure that we have access for science throughout the Arctic Ocean. Too often in recent years, legitimate science has been denied permission to collect data in vast parts of this ocean, and with new territorial claims in the Arctic, the situation could get worse.

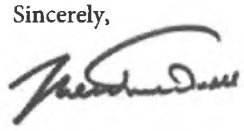
- Finally, we need to light a fire under Arctic research efforts in the humanities: educators, museums, researchers, and native leaders must come together to apply research to the goal of protecting indigenous language, identities, and culture. Without that, we stand to lose huge knowledge—forever—as living generations pass away.

The Commission, the Interagency Arctic Research and Policy Committee, the White House Office of Science and Technology Policy, and the Office of Management and Budget must work together to see that the US Arctic Research Program is better integrated and more transparent, as called for in the Arctic Research and Policy Act of 1984. We are delighted that the United States has, since our recommendation in 2007, reviewed policy at the Presidential level, resulting in US Arctic policy NSPD-66/HSPD-25, and that agencies across the government are paying closer attention to the opportunities and challenges of a newly accessible, rapidly changing Arctic region. It is also good to report that the nation is moving ahead with construction of an Alaska Region Research Vessel, recently named "R/V *Sikuliaq*," funded by the National Science Foundation with stimulus money. Credit is due to many—in the public, the Executive Branch, and the Congress—for making these things happen.

We look forward, soon we hope, to a decision to replace the nation's aging pair of polar icebreakers: with a changed Arctic Ocean, no other platform can provide the nation what it needs for research, law enforcement, environmental protection, emergency response, search and rescue, maritime commerce, national and homeland security.

We thank you for the opportunity to work with some of the most fascinating people in one of the most unique and strategic places on Earth. Our enthusiasm for the Arctic region only grows with what we've been privileged to learn and privileged to do. Godspeed to those who continue to advance the world's knowledge of the Arctic.

Sincerely,



Mead Treadwell, Chair

ABBREVIATIONS AND ACRONYMS

AAAS ..... American Association for the Advancement of Science, http://www.aaas.org
ACF ..... Administration for Children and Families, http://www.acf.hhs.gov
ADEC ..... Alaska Department of Environmental Conservation, http://www.dec.state.ak.us
ADVANCE ..... Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383
AFSC ..... Alaska Fisheries Science Center, http://www.afsc.noaa.gov
AHHI ..... Arctic Human Health Initiative, http://www.arctichealth.org/ahhi
AMAP ..... Arctic Monitoring and Assessment Program of the Arctic Council, http://www.amap.no
AMRAP ..... Alaska Mineral Resource Assessment Program
AMSA ..... *Arctic Marine Shipping Assessment*, http://www.arctic.gov/publications/AMSA_2009_Report_2nd_print.pdf
ANILCA ..... Alaska National Interest Lands Conservation Act of 1980
ANSC ..... Alaska Native Science Commission, http://www.nativescience.org
ANSEP ..... Alaska Native Science and Engineering Program, http://ansep.uaa.alaska.edu
ANTHC ..... Alaska Native Tribal Health Consortium, http://www.anthc.org
AON ..... Arctic Observing Network, http://www.nsf.gov/news/news_summ.jsp?cntn_id=109687
AOOS ..... Alaska Ocean Observing System, http://www.aoos.org
APECS ..... Association of Polar Early Career Scientists, http://apecs.is
ARCUS ..... Arctic Research Consortium of the United States, http://www.arcus.org
ARPA ..... Arctic Research and Policy Act of 1984, as amended, http://www.nsf.gov/od/opp/arctic/iarpc/arc_res_pol_act.jsp
ARRA ..... American Recovery and Reinvestment Act
BASC ..... Barrow Arctic Science Consortium, http://www.arcticscience.org
BEO ..... Barrow Environmental Observatory, http://www.arcticscience.org/researchBases.php
BEST-BSIERP ..... Bering Sea Ecosystem Study (NSF)-Bering Sea Integrated Ecosystem Research Program (NPRB), http://bsierp.nprb.org
BIA ..... Bureau of Indian Affairs, http://www.bia.gov
BIAWG ..... Bering Sea Interagency Working Group
BLM ..... Bureau of Land Management, http://www.blm.gov
CANHR ..... Center for Alaska Native Health Research, http://canhr.uaf.edu
CCHRC ..... Cold Climate Housing Research Center, http://www.cchrc.org
CCSP ..... US Climate Change Science Program, http://www.climatescience.gov
CDC ..... Center for Disease Control and Prevention, http://www.cdc.gov
CDQ ..... Community Development Quota
CEQ ..... Council on Environmental Quality, http://www.ceq.gov
CIMES ..... Center for Island, Maritime, and Extreme Environment Security, http://cimes.hawaii.edu
COMPETES ..... America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science
COSEE ..... Centers for Ocean Science Education Excellence, http://www.cosee.net
CRRC ..... Coastal Response Research Center, http://www.crrc.unh.edu
CRREL ..... US Army Corps of Engineers Cold Regions Research and Engineering Laboratory, http://www.crrel.usace.army.mil
DHHS ..... Department of Health and Human Services, http://www.hhs.gov
DHS ..... Department of Homeland Security, http://www.dhs.gov
DNA ..... Deoxyribonucleic acid
DOC ..... Department of Commerce, http://www.doc.gov
DOD ..... Department of Defense, http://www.defense.gov
DOE ..... Department of Energy, http://www.doe.gov
DOI ..... Department of the Interior, http://www.doi.gov
DOS ..... Department of State, http://www.dos.gov
DOT ..... Department of Transportation, http://www.dot.gov
ECS ..... Federal Interagency Extended Continental Shelf Task Force, http://continentalshelf.gov
ED ..... US Department of Education, http://www.ed.gov
EEZ ..... Exclusive Economic Zone
EPA ..... Environmental Protection Agency, http://www.epa.gov
FAA ..... Federal Aviation Administration, http://www.faa.gov
FDA ..... Food and Drug Administration, http://www.fda.gov
FIC ..... Fogarty International Center, http://www.fic.nih.gov

GEOSS ..... Global Earth Observing System of Systems, http://www.earthobservations.org
HIPAS ..... High Power Auroral Stimulation
HUD ..... Department of Housing and Urban Development, http://www.hud.gov
IARC ..... International Arctic Research Center, http://www.iarc.uaf.edu
IARPC ..... Interagency Arctic Research and Policy Committee, http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp
IASC ..... International Arctic Science Committee, http://www.arcticportal.org/iasc
ICCOPR ..... Interagency Coordinating Committee on Oil Pollution Research, see Title VII at http://www.epw.senate.gov/opa90.pdf
IHS ..... Indian Health Service, http://www.ihs.gov
IODP ..... Integrated Ocean Drilling Program, http://www.iodp.org
IPCC ..... United Nation's Intergovernmental Panel on Climate Change, http://www.ipcc.ch
IPY ..... International Polar Year, http://www.ipy.org
ISAC ..... International Study of Arctic Change, http://www.arcticchange.org
IUCH ..... International Union for Circumpolar Health, http://iuch.net
LOSI ..... Loss of Sea Ice, http://www.afsc.noaa.gov/Publications/ProcRpt/PR2007-05.pdf
MARAD ..... Department of Transportation/Maritime Administration, http://www.marad.dot.gov
MEDEA ..... Measurements of Earth Data for Environmental Analysis
MMS ..... Minerals Management Service, http://www.mms.gov
MOU ..... Memorandum of Understanding
NASA ..... National Aeronautics and Space Administration, http://www.nasa.gov
Navy SupSalv ..... Naval Sea System Command Supervisor of Salvage and Diving, http://www.supsalv.org
NCMHD ..... National Center on Minority Health and Disparities, http://www.ncmhd.nih.gov
NCRR ..... National Center for Research Resources, http://www.ncrr.nih.gov
NEH ..... National Endowment for the Humanities, http://www.neh.gov
NGA ..... National Geospatial-Intelligence Agency, http://www.nga.mil
NIAAA ..... National Institute on Alcohol Abuse and Alcoholism, http://www.niaaa.nih.gov
NICHD ..... National Institute on Child Health and Development, http://www.nichd.nih.gov
NIH ..... National Institutes of Health, http://www.nih.gov
NIMH ..... National Institute of Mental Health, http://www.nimh.nih.gov
NIST ..... National Institute of Standards and Technology, http://www.nist.gov
NMFS ..... National Marine Fisheries Service, http://www.nmfs.noaa.gov
NOAA ..... National Oceanographic and Atmospheric Administration, http://www.noaa.gov
NPCREP ..... North Pacific Climate Regimes and Ecosystem Productivity, http://www.pmel.noaa.gov/foci/NPCREP
NPFMC ..... North Pacific Fisheries Management Council, http://www.alaskafisheries.noaa.gov/npfmc
NPRB ..... North Pacific Research Board, http://www.nprb.org
NRC ..... National Research Council, http://nationalacademies.org/nrc
NREL ..... National Renewable Energy Lab, http://www.nrel.gov
NSF ..... National Science Foundation, http://www.nsf.gov
NSSI ..... North Slope Science Initiative, http://www.northslope.org
NSTC ..... National Science and Technology Council, http://www.ostp.gov/cs/nstc
ONR ..... Office of Naval Research, http://www.onr.navy.mil
OPA90 ..... Oil Pollution Act of 1990
OSRI ..... Oil Spill Recovery Institute, http://www.pws-osri.org
OSTP ..... Office of Science and Technology Policy, http://www.ostp.gov
PICES ..... North Pacific Marine Science Organization, http://www.pices.int
PMEL ..... Pacific Marine Environmental Laboratory, http://www.pmel.noaa.gov
RUSALCA ..... Russian-American Long-term Census of the Arctic, http://www.arctic.noaa.gov/aro/russian-american
SAMHSA ..... Substance Abuse and Mental Health Services Administration, http://www.samhsa.gov
SAON ..... Sustaining Arctic Observing Networks, http://www.arcticobserving.org
SBIR ..... Small Business Innovation Research, http://www.sbir.gov
SCICEX ..... The Scientific Ice Exercises Program, http://www.scicex.org
SDMI ..... Statewide Digital Mapping Initiative, http://www.alaskamapped.org
SEARCH ..... Study of Environmental ARctic CHange, http://www.arcus.org/search/index.php
SFOS ..... UAF's School of Fisheries and Ocean Sciences, http://www.sfos.uaf.edu
SI ..... Smithsonian Institution, http://www.si.edu
SINTEF (Norwegian) ..... Stiftelsen for industriell og teknisk forskning, http://www.sintef.no/Home
TEK ..... Traditional Ecological (or Environmental) Knowledge
UAF ..... University of Alaska Fairbanks, http://www.uaf.edu
UNCLOS ..... United Nations Convention on the Law of the Sea, http://www.un.org/Depts/los/index.htm
UNESCO ..... United Nations Educational Scientific and Cultural Organization, http://portal.unesco.org
USACE ..... US Army Corp of Engineers, http://www.usace.army.mil
USARC ..... US Arctic Research Commission, http://www.arctic.gov
USCG ..... US Coast Guard, http://www.uscg.mil
USDA ..... US Department of Agriculture, http://www.usda.gov
USFWS ..... US Fish and Wildlife Service, http://www.fws.gov
USGS ..... US Geological Survey, http://www.usgs.gov

ABOVE. Bearded Seal. (Photo credit: M. Dunn)
RIGHT. Exploring Kivalina. (Photo credit: J. Farrell)

USARC COMMISSIONERS

Mead Treadwell, Chair
Institute of the North
Anchorage, AK

Michele Longo Eder, Vice-Chair
Attorney at Law
Newport, OR

Vera Kingeekuk Metcalf
Eskimo Walrus Commission
Nome, AK

Helvi Sandvik
NANA Development Corporation
Anchorage, AK

Virgil "Buck" Sharpton, PhD
University of Alaska Fairbanks
Fairbanks, AK

Charles Vörösmarty, PhD
The City College of New York
The City University of New York
New York, NY

Warren M. Zapol, MD
Massachusetts General Hospital
Harvard University
Cambridge, MA

Arden L. Bement, Jr., PhD,
Ex-Officio Member
National Science Foundation
Arlington, VA

CONTRIBUTING FORMER COMMISSIONERS

Duane Laible, P.E.
The Glosten Associates
Seattle, WA

Thomas Royer, PhD
Old Dominion University
Norfolk, VA

Susan Sugai, PhD
University of Alaska Fairbanks
Fairbanks, AK

Walter Parker, PhD
Anchorage, AK

George Newton
Marstons Mills, MA

USARC STAFF

John Farrell, PhD
Executive Director

Cheryl Rosa, DVM, PhD
Deputy Director

Kathy Farrow
Communications Specialist

Toykia Keys
Administrative Assistant

This report is dedicated to Mr. Duane Laible, a USARC Commissioner from 2003 to 2007.

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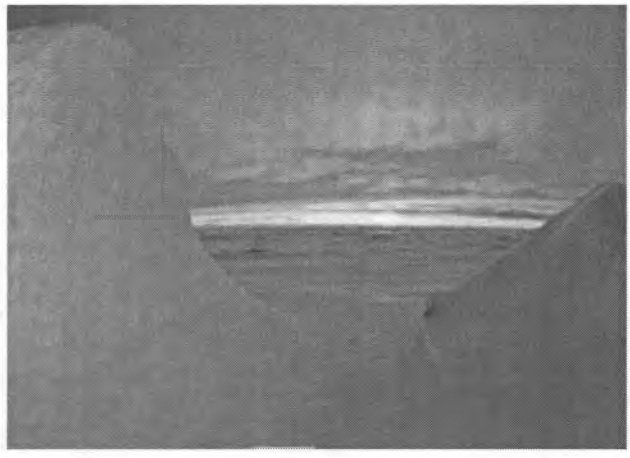
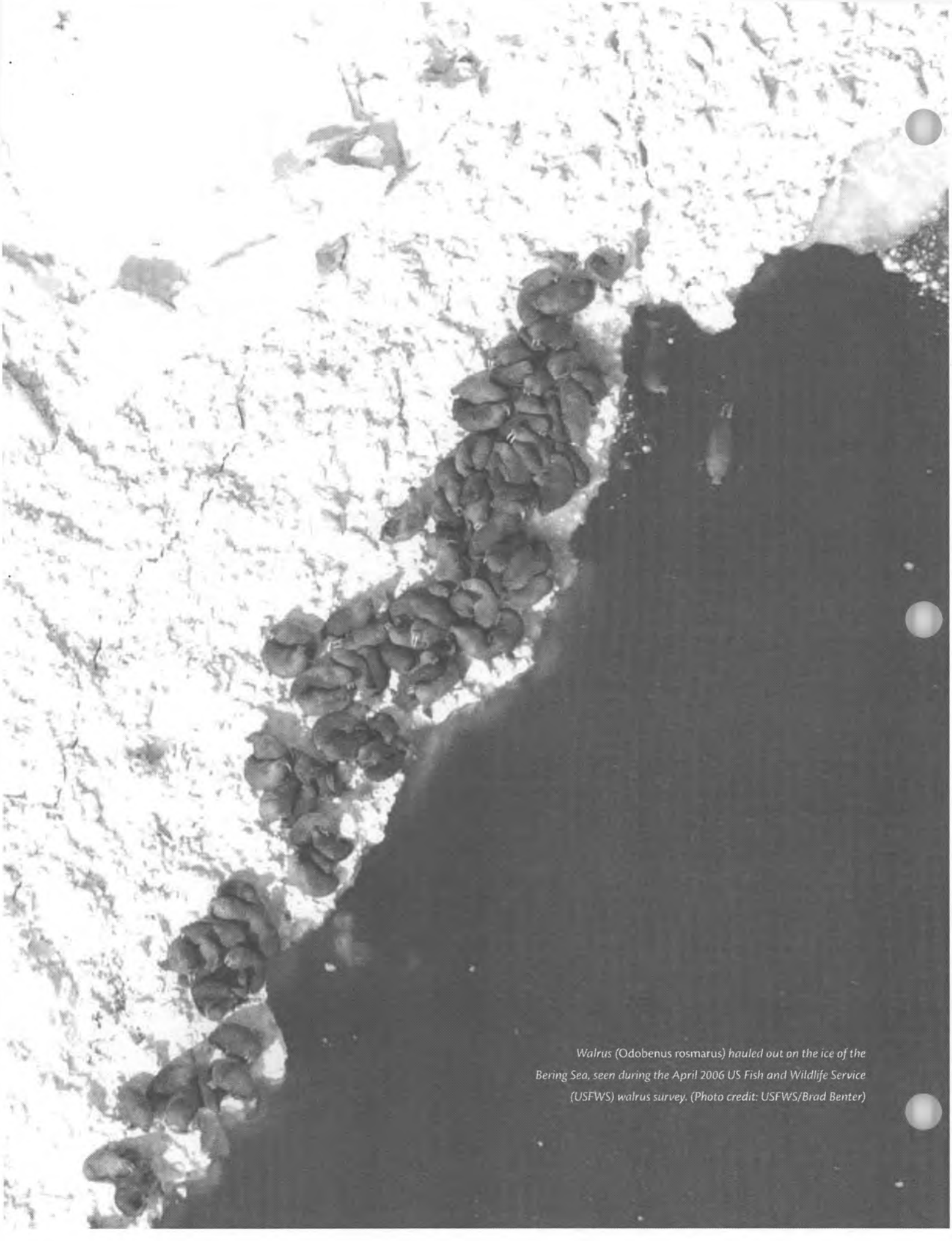
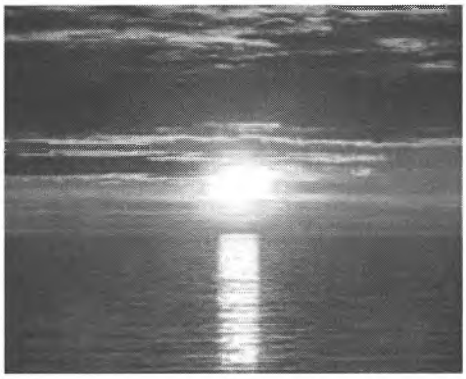


Arctic ice valley sunset.
(Photo credit: M. Dunn)



Walrus (Odobenus rosmarus) *hauled out on the ice of the Bering Sea, seen during the April 2006 US Fish and Wildlife Service (USFWS) walrus survey. (Photo credit: USFWS/Brad Benter)*



Arctic sun.
(Photo credit: M Dennett)

EXECUTIVE SUMMARY

This report conveys to President Barack Obama, Congress, and the American people the nation's highest-priority goals and objectives for Arctic research. These goals are established by the US Arctic Research Commission (USARC) under the authority of the Arctic Research and Policy Act (ARPA) of 1984, as amended.

THE STRATEGIC ARCTIC

Arctic assets are strategic to our nation. Without a strong Arctic research program, the United States cannot be the best steward of these assets. Arctic research plays a key role in addressing fundamental scientific issues and in helping the nation meet its security needs, its economic aspirations, and its responsibilities as an Arctic nation. Polar research allows the nation to exercise global leadership in adapting to and mitigating climate change.

RESEARCH GOALS

The US Arctic Research Program must strengthen its efforts on five central and crosscutting themes.

1. Environmental Change of the Arctic, Arctic Ocean, and Bering Sea

- With international partners, we must continue to develop and "operationalize" SAON (Sustaining Arctic Observing Network) to gain greater understanding of pan-Arctic change. Relevant entities: NOAA, NSF, DOI, DOD, NSSI, DOS, USCG, NPRB, AOOS, OSRI, and BASC.
- The federal interagency initiative, SEARCH (Study of Environmental ARctic CHange), must further address the causes, and global implications of Arctic sea ice reduction, melting ice sheets and glaciers, ocean acidification, methane flux to the atmosphere, and black carbon deposition. These factors can "make or break" the effectiveness of a global climate change mitigation regime. Relevant entities: NOAA, NSF, DOI, DOD, NSSI, DOS, USCG, NPRB, AOOS, OSRI, and BASC.
- President Obama has indicated that the United States will be a leader in global efforts to mitigate climate change and new national initiatives are underway to bolster US adaptation strategies. Arctic research in these areas needs to be mindful of and a contributor to national and global adaptation and mitigation efforts.
- The "newly accessible" Arctic Ocean is inviting to commercial fishing, shipping, tourism, mineral, and energy extraction interests. The United States has barely begun the baseline oceanographic research necessary to support US and Arctic Council goals for ecosystem-based management in the Arctic Ocean. This research should move ahead, patterned to support "marine spatial planning," a tool that enables integrated, forward-

looking, and consistent decision making on the use of the sea. Relevant entities: NSF, NOAA, NPRB, OSTP, NSTC, CEQ, Federal Ocean Governance Structure, DOT/MARAD, USFWS, DOS, and local subsistence-based co-management groups.

2. Arctic Human Health

- Arctic residents face a number of health issues, but in this report, and as a gateway to other topics, we focus on suicide, given the extraordinarily high and increasing rates. The rate is greatest among indigenous youth, and is higher than in any other select population within our nation. Clinical and community intervention researchers must be brought together to better address this epidemic. The Commission proposes support for the National Academy of Sciences (Institute of Medicine and Polar Research Board) to convene a meeting of health researchers, caregivers, indigenous leaders, and experts from a wide range of disciplines to develop a rigorous, evidence-based, and recurring assessment of scientific research and intervention efforts to reduce suicide and other severe and related behavioral problems, including alcoholism, and spousal and child abuse. To be most effective, this assessment must be repeated every decade to enhance Arctic mental health research, to review intervention results, and to guide the scaling up of successful efforts within Arctic communities.

- Domestic abuse is another serious problem that is over-represented in Alaska's rural communities. It is strongly linked to child abuse and is often associated with alcohol abuse. Women in isolated, rural communities are especially vulnerable. Developing a multidisciplinary, coordinated approach to addressing domestic violence and child abuse is critical to improve Arctic human health and social stability in rural Arctic villages. Behavioral and mental health are just one aspect of Arctic human health; other foci include chronic, infectious, and zoonotic diseases, food safety and contaminants, and diet and lifestyle changes, among others. Relevant entities: DHHS (CDC, NIH, SAMHSA, ACF, IHS, and others) NIMH, tribal organizations (e.g., ANTHC and Southcentral Foundation), and the State of Alaska.

3. Civil Infrastructure

- The State of Alaska has developed an adaptation research agenda to respond to the dramatic effects of climate change. The emerging federal research program in this area should integrate with and support these efforts, which include protecting communities from erosion, and adapting buildings and civil infrastructure to thawing permafrost. Relevant entities: Denali Commission, USACE, DOT, HUD, State of Alaska, and USGS.

- The Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) has not met the promise of the Oil Pollution Act of 1990 (OPA90). The Commission urges a significant new funding stream to support improvements in prevention, response, and remediation of oil spills in ice-covered waters. IARPC and ICCOPR must work together. Relevant entities: USCG, NOAA, OSRI, CRRC, MMS, Navy SupSalv, NIST, EPA, and OSTP.

- The *Arctic Marine Shipping Assessment* (AMSA, 2009), completed by the eight Arctic nations in spring 2009, identifies the research necessary to address the opportunities and challenges of Arctic shipping. IARPC, in conjunction with the Committee on Marine Transportation Systems and USARC, should develop an implementation plan. Relevant entities: DOT, USCG, DOS, NOAA, and the State of Alaska.

- Conventional and renewable energy potential in the Arctic has recently been assessed and is considerable. In 2009, the first comprehensive assessment of Arctic oil and gas deposits revealed that the region accounts for about 13% of the undiscovered oil, 30% of the undiscovered natural gas, and 20% of the undiscovered natural gas liquids in the world (Gautier et al., 2009). On the renewable side, over 90% of the United States' tidal energy potential is in Alaska. The Commission recommends that the Department of Energy prepare an Arctic research plan that addresses the nation's energy security interest in developing Alaska's huge renewable and nonrenewable energy potential for export to the lower 48 states, and that also recognizes the importance of providing affordable energy to Alaska's remote villages. Given the links between energy and the environment, the plan should

also address DOE's climate research interests in the Arctic, such as the Atmospheric Radiation Measurement Program. The Commission further urges continued support for the DOE Arctic Energy Office, with emphasis on methane hydrate research (both onshore and offshore), and on tundra travel research, such as the impacts of water withdrawal from tundra for ice road construction, lake recharge, and ground hardness and elasticity over a range of temperatures. The DOE National Renewable Energy Laboratory has established a research program in Alaska that can examine the substantial wind, wave, tidal, geothermal, and biomass potential for serving the many Arctic communities "off the grid" with stable-cost power, with the possibility of exporting renewable energy from the Arctic. Relevant entities: DOE, DOI/USGS, State of Alaska, USDA, and CCHRC.

4. Natural Resource Assessment and Earth Science

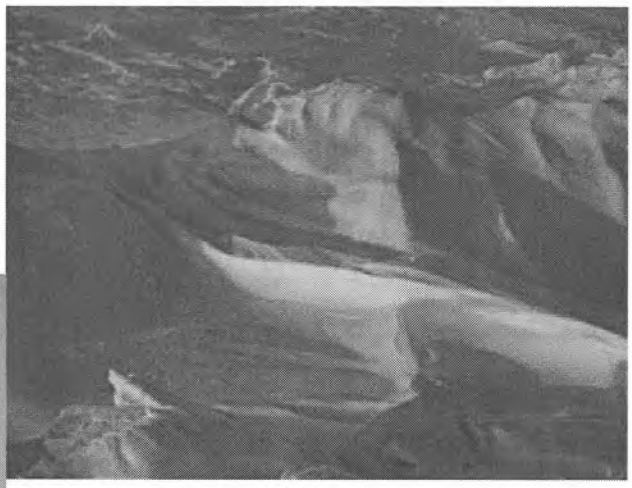
- The Commission applauds the leadership taken by the federal government's interagency Extended Continental Shelf (ECS) Task Force to identify claims that the United States may make to considerably increase its territory in the Arctic Ocean. The Commission has urged Senate ratification of the United Nations Convention on the Law of the Sea. If the United States is not party to this treaty, US scientists may not formally review and assess the claims of other nations in the Arctic. Relevant entities: ECS Task Force agencies, US Congress.

- The Alaska Mineral Resource Assessment Program, required by the Alaska National Interest Lands Conservation Act of 1980, should be funded in core agency budgets.

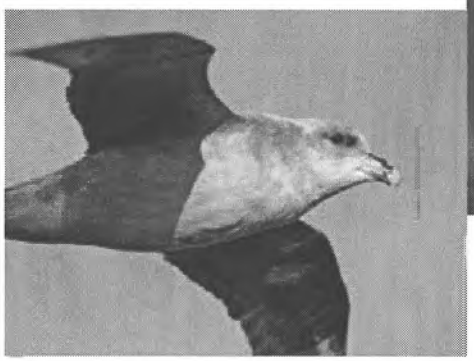
- Federal and state efforts to cooperate in providing an imagery database and digital elevation model are promising and could be successful in bringing Alaska's maps up to the standard of the rest of the nation. Both federal and state governments are urged to agree upon and fund a coherent plan for mapping the US Arctic that federal and state agencies, the research community, and the public can rely on. Relevant entities: DOD/NGA, DOI/BLM/USGS, State of Alaska, DHS, and NASA.

5. Indigenous Languages, Cultures, and Identities

- The Commission recommends that federal agencies continue, through IARPC, to develop and fund a research plan to help prevent extinction of the diverse languages spoken by Arctic peoples. In two meetings of IARPC principals, a commitment to this goal has been agreed upon. It is time to develop an integrated plan that is funded. Relevant entities: NSF, NEH, SI, BIA, HHS, ED, USDA, the State of Alaska, and Native Alaskan organizations.



RIGHT. Snow-and-ice-patterns.
(Photo credit: M. Dunn)
BELOW. Close up of a Northern Fulmar.
(Photo credit: M. Dunn)



LEFT. Chryasora melanaster.
(Photo credit: K. Raskcoff and E. Kristof)
BELOW. A sun dog at sunrise.
(Photo credit: M. Dunn)

RESEARCH INFRASTRUCTURE

To have an effective Arctic research program, the United States must invest in human capital, research platforms, and infrastructure, including new polar class icebreakers, and sustained sea, air, land, space, and social observing systems. The value of Arctic research is based on the quality of its researchers and the support of the public. Our research programs must work hand in hand with educators, support improved Arctic and ocean "literacy," and support training of young scientists with a focus on the Arctic. We must also enhance the educational "pipeline" that renews and sustains the research community examining Arctic problems and helps keep America competitive. The United States must renew international partnerships, strengthen and stabilize competitive funding for academic research, and build closer ties with the Arctic's indigenous residents. Relevant entities: OSTP, NSF, NOAA, NASA, USCG, Navy, and Native Alaskan organizations.

The Commission urges the President and Congress to commit to replacing the nation's two polar class icebreakers. Further, we call upon all agencies involved in Arctic research, through IARPC, to restore support for the Alaska Native Science Commission (ANSC) and the Barrow Arctic Science Consortium (BASC). NSF previously funded these programs to support its own logistics needs, but the benefits of both are enjoyed by many federal agencies that conduct Arctic research. Both served as key vehicles for involving Alaska Natives in the US Arctic Research Program. The Commission also encourages additional US and Japanese government support for the International Arctic Research Center (IARC), which serves as an international nexus for integrating and synthesizing Arctic climate change research. Relevant entities: NSF, DOC/NOAA, USCG, DOS, NASA, DOI, and DOD/USACE.

RESEARCH POLICY

The Arctic Research and Policy Act (ARPA) of 1984, as amended, established Arctic scientific research policy for the United States. This law promises much that has yet to be delivered. USARC, IARPC leadership, and the White House Offices of Science and Technology Policy and Management and Budget must work together, with Congress, to see that Arctic research policy is robust, and is translated into an effective, integrated, and forward-looking national Arctic Research Program Plan and associated budget as promised in ARPA. The new US Arctic policy (NSPD-66/HSPD-25) is a good start, but much work remains.

As called for in the Arctic Research and Policy Act of 1984, the Commission will continue to work for greater cooperation and coordination with other nations and the State of Alaska. Simply put, IARPC needs to meet regularly and produce the integrated plans and reports called for in ARPA.

As the federal government fulfills its responsibilities to manage lands, oceans, wildlife, and resources under its jurisdiction in the Arctic, we urge full funding of the North Slope Science Initiative (NSSI) and the Alaska Ocean Observing System (AOOS) as mechanisms for bringing appropriate stakeholders to the table. Appropriate federal-state scientific cooperation can help avoid expensive lawsuits over matters such as offshore drilling and Endangered Species Act determinations.

Internationally, USARC particularly emphasizes strengthening Arctic science cooperation with Russia. We urge the United States to continue its initiative to assure access to the Arctic Ocean for scientific researchers and to be mindful in its visa and immigration policy of the needs of students and researchers to cross national borders, regularly and predictably, to conduct their work.

USARC intends, as it develops its 2011 goals report, to further discuss and revise US Arctic research policy. Solid efforts are now underway to include local and traditional knowledge in US Arctic research. Support for marine mammal co-management programs will benefit by developing a joint USARC/IARPC research policy. The federal government spends approximately $400 million per year on Arctic research, and the results have helped identify important changes in the Arctic environment, enabling policymakers to respond to them.

The US Arctic Policy (NSPD-66/HSPD-25) has helped agencies identify their roles in America's new Arctic policy. Each of those agencies is likely to find new research needs as a result of those efforts. USARC looks forward to working with IARPC, OMB, and OSTP to bring about the integrated Arctic research program plan and budget called for in the ARPA.

Ice flats. (Photo credit: Digital Vision)

Pacific walrus.
(Photo credit: M. Dunn)

INTRODUCTION

THE STRATEGIC ARCTIC

Arctic assets are strategic to our nation. Without a strong Arctic research program, the United States cannot be the best steward of these assets. Arctic research plays a key role in addressing fundamental scientific issues and in helping the nation meet its security needs, its economic aspirations, and its responsibilities as an Arctic nation. Polar research allows the nation to exercise global leadership in adapting to and mitigating climate change.

America became an Arctic nation in 1867, with the purchase of Alaska. Although Arctic assets such as whale oil and seal fur helped fuel the US economy before 1867, history recounts that bringing Alaska into the United States, and later into the Union, was not without controversy. Many citizens thought that Alaska had no value at all, or, at the time of Statehood, no capability to support itself.

Today, the value of the Arctic is much more evident to Americans. Arctic assets help defend our continent, and are key to the security of European and Asian nations as well. In global commerce, the Arctic region helps feed our nation and the world with its robust fisheries. The Arctic fuels life on three continents with its oil, natural gas, and, increasingly, its huge potential hydro, wave, wind, tidal, geothermal, and biomass resources. Likewise, the Arctic plays a strategic role in global air and sea transport, and telecommunication, and as the Arctic Council's recently completed *Arctic Marine Shipping Assessment* (AMSA, 2009) showed, shipping might play an even greater role in the future.

Life on Earth itself might not exist without the shielding of solar radiation provided by the magnetosphere, created by the North and South magnetic poles. Global climate is moderated by Arctic cold. Polar sea ice and adjacent snow cover on land reflect major amounts of solar radiation back into space, cooling the planet. Boreal forests and permafrost underlying the taiga and tundra are major storehouses of carbon that might, in a warmer climate, be released into the atmosphere, exacerbating warming.

In addition to feeding, powering, defending, and protecting us, Arctic assets inspire us and teach us. From the smallest organisms at the base of the food chain, to the larger seals, birds, walrus, and bears at the top, Arctic living resources are diverse, sought after, and appreciated, and they are a popular tourist attraction. The Arctic's indigenous peoples contribute to global culture and knowledge in ways that are increasingly necessary and valuable. Today's Arctic residents continue to consider themselves pioneers, and are known in popular circles for exploration and discovery, and also in television shows such as the History Channel's "Ice Road Truckers," and the Discovery Channel's "The Deadliest Catch."

These Arctic assets are strategic, useful, and sustainable, but only if they are understood. To this end, the United States and other nations are engaged in research in Arctic science, history, medicine, social science, law, and other disciplines. In this US Arctic Research Commission report, we demonstrate that further, important research is required to better understand and protect our Arctic assets.

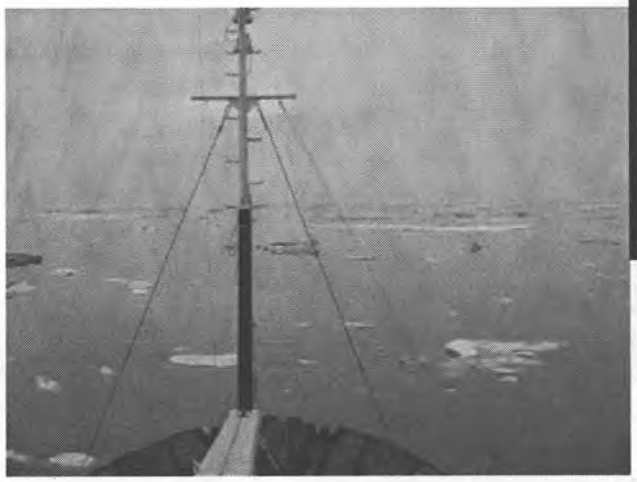
RESEARCH GOALS

The US Arctic Research Program must strengthen its efforts on five central and crosscutting themes:

1. *Environmental Change of the Arctic, Arctic Ocean, and Bering Sea*
2. *Arctic Human Health*
3. *Civil Infrastructure*
4. *Natural Resource Assessment and Earth Science*
5. *Indigenous Languages, Cultures, and Identities*

The Commission identified these five themes for the US Arctic Research Program in its 2007 goals report. The Interagency Arctic Research and Policy Committee (IARPC) adopted this report in 2007, and since then, the Commission and IARPC have been working together to revise the US Arctic Research Program's Five Year Plan that is called for in the Arctic Research and Policy Act of 1984, as amended. This plan will have up-to-date, integrated objectives in five areas outlined below. The development of each of these programs is at a different level of maturity. The Commission has modified the environmental change theme to include a new emphasis on the Arctic Ocean, which requires a new plan and commitment of resources.

The dramatic environmental changes occurring in the Arctic, which result from a changing climate, impact all five of these goals. Thus, USARC calls for a commitment to long-term and stable funding of research to ensure that appropriate observations are made in Arctic networks, and that the resulting time-series data are collected, distributed, and analyzed. These data will allow scientists to identify and better understand longer-term trends in climate, and to differentiate them from annual variability in weather. Although NSF and international partners have made progress in designing SAON, a strong need remains for further institutional commitment by NOAA and NASA, among other agencies, to finance and operate the system in the long term within the context of the Global Ocean Observing System and Global Climate Observing System. Such a need, on a broader scale, could be addressed by creating a National Climate Service, analogous to the National Weather Service, as has recently been proposed.



ABOVE. Aglantha. (Photo credit: R. Hopcroft)

LEFT. Bow and Ice, Herald Canyon. (Photo credit: S. Thornton)

RESEARCH INFRASTRUCTURE

To have an effective Arctic research program, the United States must invest in human capital, research platforms, and infrastructure, including new polar class icebreakers, and sustained sea, air, land, space, and social observing systems. The value of Arctic research is based on the quality of its researchers and the support of the public. Our research programs must work hand in hand with educators, support improved Arctic and ocean "literacy," and support training of young scientists with a focus on the Arctic. We must also enhance the educational "pipeline" that renews and sustains the research community examining Arctic problems and helps keep America competitive. The United States must renew international partnerships, strengthen and stabilize competitive funding for academic research, and build closer ties with the Arctic's indigenous residents. Relevant entities: OSTP, NSF, NOAA, NASA, USCG, Navy, and Native Alaskan organizations.

The Commission finds that the US Arctic Research Program's core asset—its people—needs attention and greater support. Comparing the first half of this decade (2001–2004) with the preceding one (1991–1995), NSF found that although 11% more bachelor's degrees were awarded in the earth, atmospheric, and ocean sciences in the most recent period, the number of doctoral degrees in these fields fell by 11%. Science and engineering doctorate production has depended heavily upon foreign students, who earn 33% of the total science doctorates and more than half of those in engineering (National Science Board, 2006).

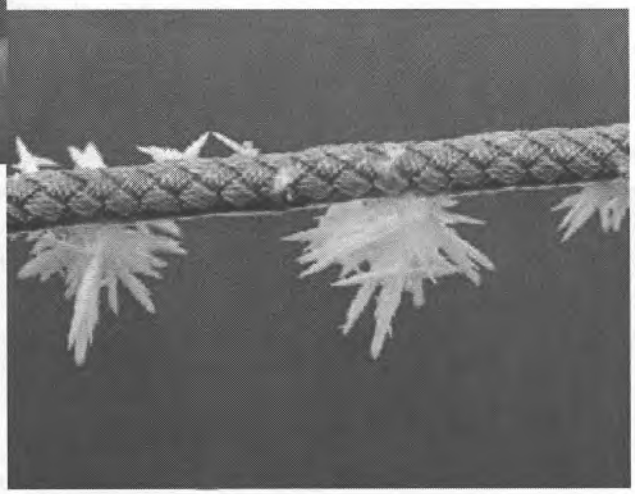
As we complete the International Polar Year (2007–2009), we hope the nation will develop a new generation of polar researchers to carry on this vital work. The Commission calls on federal agencies and Congress to address this goal head on, with clearer, sustainable commitments to extramural funding of Arctic research programs. Outreach and education programs, which saw new initiatives during the International Polar Year, should be continued. Programs such as the Alaska Native Science and Engineering Program (ANSEP) at the University of Alaska help mentor native Alaska Native students of high-school age to join undergraduate and graduate programs at the university level. The Centers for Ocean Science Education Excellence (COSEE), including, COSEE Alaska, also play a critical role in bringing together the ocean sciences research community with educators and the general public, thereby encouraging new collaborations to create and disseminate knowledge, increase public understanding of scientific discovery, and enhance educational opportunities.

The Commission also acknowledges the success of two other programs. The NSF ADVANCE program, designed to recruit and retain women in science and engineering careers within universities, has significantly addressed the gender balance in academia. On an international scale, the Commission acknowledges the success of the Association of Polar Early Career Scientists (APECS). APECS is an international and interdisciplinary organization for young researchers (ranging from undergraduates to early faculty members, educators, and others with interests in polar regions) that stimulates research collaborations and develops leadership by facilitating networking, providing opportunities for professional development, and promoting education and outreach.

In addition to people, Arctic research relies heavily upon infrastructure such as satellites with sophisticated sensor packages, icebreakers with research equipment and laboratories, field stations and laboratories, networks of monitoring stations, buoys and cabled marine observatories, permafrost boreholes and tunnels, and autonomous unmanned vehicles.

Since the Commission's 2007 goals report, significant new investments have been made—or commitments are in place—for a new Alaska Region Research Vessel (R/V *Sikuliaq*), SAON, and new laboratories, including the Barrow Global Climate Change Research Facility on Alaska's North Slope, and NOAA's $51M Ted Stevens Marine Research Institute in Juneau, Alaska.

LEFT. Growlers. (Photo credit: K. Crane)
BELOW. Ice crystals. (Photo credit: M. Dunn)



The US government owns and operates three icebreakers capable of operating in the Arctic Ocean, two of which (*Polar Sea* and *Polar Star*) are considered "polar class." These vessels, essential platforms from which to conduct Arctic research, as well as to conduct many other critical missions, are both over 30 years old, beyond their service lives, and many reports (e.g., NRC, 2007a) have called for them to be replaced. The Chair of the National Academies study, Dr. Anita Jones wrote, "Our committee reaffirmed the value and efficacy of the USCG/research community partnership and recommended replacing the aging icebreakers with new ships, designed with research community involvement. The Coast Guard should be funded to build and operate the new ships" (Jones, 2007). A more recent report, from the Congressional Research Service (O'Rourke, 2009), recommends that Congress do the following:

- Approve the Coast Guard's current plan to study requirements for future icebreakers and then derive an acquisition strategy based on the results of these studies—a plan that might result in an initial replacement icebreaker entering service 8 to 10 years from now.
- Hold hearings to solicit additional information on the issue of polar icebreaker modernization; or direct the Coast Guard to provide such information.
- Direct the Coast Guard to include the option of nuclear power in its studies of requirements and design options for future icebreakers.

The Commission also highlights the need for stronger international and interagency partnerships. In some cases, US-Russian programs are failing due to a lack of high-level commitment and attention, and because of difficulties experienced by scientists in gaining access to certain areas, such as the offshore Russian Exclusive Economic Zone. Although important bilateral research programs exist with many nations, this report highlights the value of improving our joint work with Japan (which has put a strong priority on Arctic research climate change and in methane hydrates), Iceland (whose experience in alternative energy can help the United States achieve climate goals and sustain US Arctic residents), Norway (where government and industry supported oil-in-ice programs are vital to improving the safety of transportation and energy development throughout the Arctic), and Canada (where common work on ocean floor bathymetry and geology are helping both nations prepare extended continental shelf claims under the United Nations Convention on the Law of the Sea).

RESEARCH POLICY

The Arctic Research and Policy Act (ARPA) of 1984, as amended, established Arctic scientific research policy for the United States. This law promises much that has yet to be delivered. USARC, IARPC leadership, and the White House Offices of Science and Technology Policy and Management and Budget must work together, with Congress, to see that Arctic research policy is robust, and is translated into an effective, integrated, and forward-looking national Arctic Research Program Plan and associated budget as promised in ARPA. The new US Arctic policy (NSPD-66/HSPD-25) is a good start, but much work remains.

The Arctic Research and Policy Act requires federal agencies and the White House to present a clear, integrated Arctic research budget to the Congress and the public. The Commission is taking steps to see that this requirement is realized. Greater transparency of our Arctic science programs should quantify the balance between the government's internally conducted science, and that of extramural competitive science—and help the Commission, IARPC, and Congress determine whether that balance should shift.

The Commission calls for a strengthening of IARPC's ties to the National Science and Technology Council. It calls upon the US Coast Guard to reactivate the moribund Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), created by Congress in the Oil Pollution Act of 1990 (OPA90). It calls for continued work on the US Ocean Action Plan, predicated on the work of the US Commission on Ocean Policy, and on the new results from President Obama's Ocean Policy Task Force. And throughout, the Commission urges federal agencies to clearly identify and sustain competitive funding opportunities for the academic research sector, the nation's most vital resource in Arctic research.

With respect to international aspects of Arctic research, the Commission continues to encourage the US Senate to ratify the United Nations Convention on the Law of the Sea and the Stockholm Convention on Persistent Organic Pollutants treaty. The work of the eight-nation Arctic Council has been, and remains, vital to international collaborative efforts on scientific research. The call for research cooperation in the 2008 Ilulissat Declaration, issued by the five Arctic coastal States (United States, Canada, Russia, Norway, and Denmark), is also strongly supported by the Commission. The declaration states:

The five coastal states currently cooperate closely in the Arctic Ocean with each other and with other interested parties. This cooperation includes the collection of scientific data concerning the continental shelf, the protection of the marine environment, and other scientific research. We will work to strengthen this cooperation, which is based on mutual trust and transparency, inter alia, through timely exchange of data and analyses.

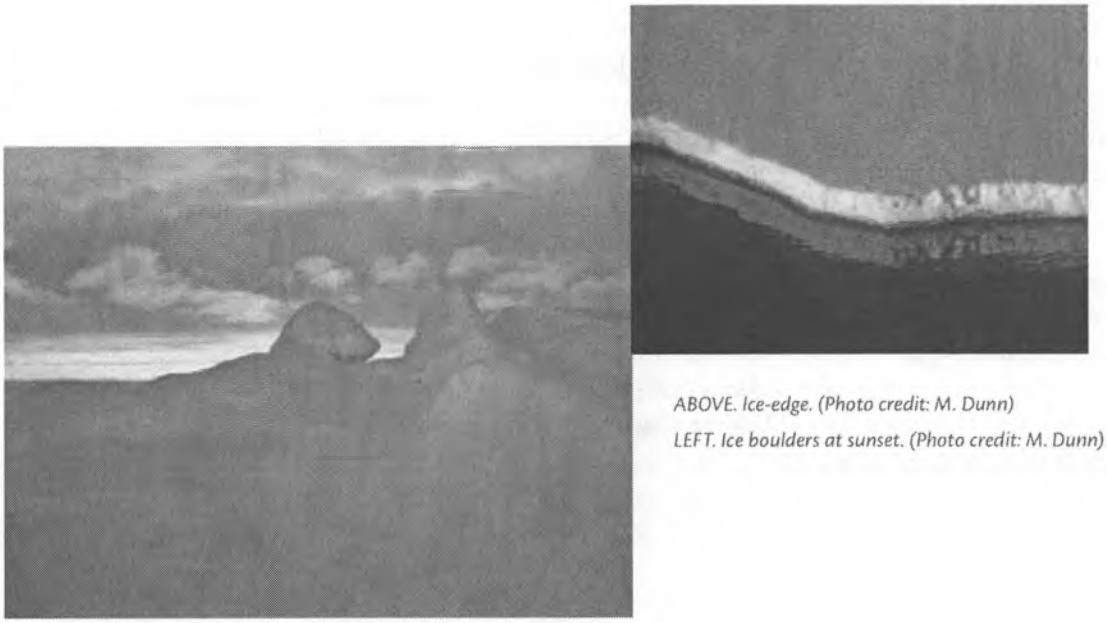
Inherent in the ability to conduct international research in the Arctic is the issue of access. If scientists are denied the ability to enter to the Exclusive Economic Zones of Arctic coastal states to conduct marine scientific research, or face insurmountable obstacles associated with national visa and immigration policies, or in the ability to bring equipment into and out of countries, then research is stymied, to the benefit of none. The Commission has witnessed many examples where international cooperation and coordination of Arctic research not only successfully addresses key scientific issues, but also serves as a means of building positive relationships among countries, furthering understanding, and improving diplomacy among nations. The 2004 Arctic Coring Expedition of the international Integrated Ocean Drilling Program is a perfect example.

CONCLUSION

The Commission's 2009–2010 report coincides with the conclusion of the first International Polar Year (IPY) in 50 years. Although the 2007–2008 IPY has drawn to a close, we must continue the research momentum begun during this period. Scientific results are still coming in, and will be reported at upcoming international conferences. Cooperation must be maintained. Infrastructure, as well as knowledge and understanding, must be the IPY legacy.

This Commission strongly endorses President Obama's address to the members of the National Academies, on April 27, 2009, where he called science "more essential for our prosperity, our security, our health, and our environment than it has ever been," and promised to make major investments—more than 3% of the gross domestic product—in research and innovation, exceeding what was invested in 1964, at the height of the space race. He also emphasized the importance of using funds to encourage high-risk, high-return research and to support researchers at the beginning of their careers.

The Commission urges enhanced levels of stable funding, especially for large interdisciplinary research facilities in the Arctic. These facilities form the long-term base of cutting-edge scientific research in these inhospitable areas. Antarctic research has profited from such a base of support for facilities and equipment, allowing initial laboratory analyses of collected samples to be conducted in the field. The Arctic needs a similar US science commitment. Such funding is also needed to remediate the unfunded mandates of several federal agencies, with the notable exception of NSF, to participate in supporting the IPY's legacy. The last Polar Year, which expanded into the International Geophysical Year in 1957, initiated decades of sustained scientific research on Earth processes and provided the data and technologies responsible for revealing the magnitude of our current environmental changes. Sadly, the recently completed IPY is unlikely to repeat this achievement, as the funding not only did not increase, but for many agencies it decreased.

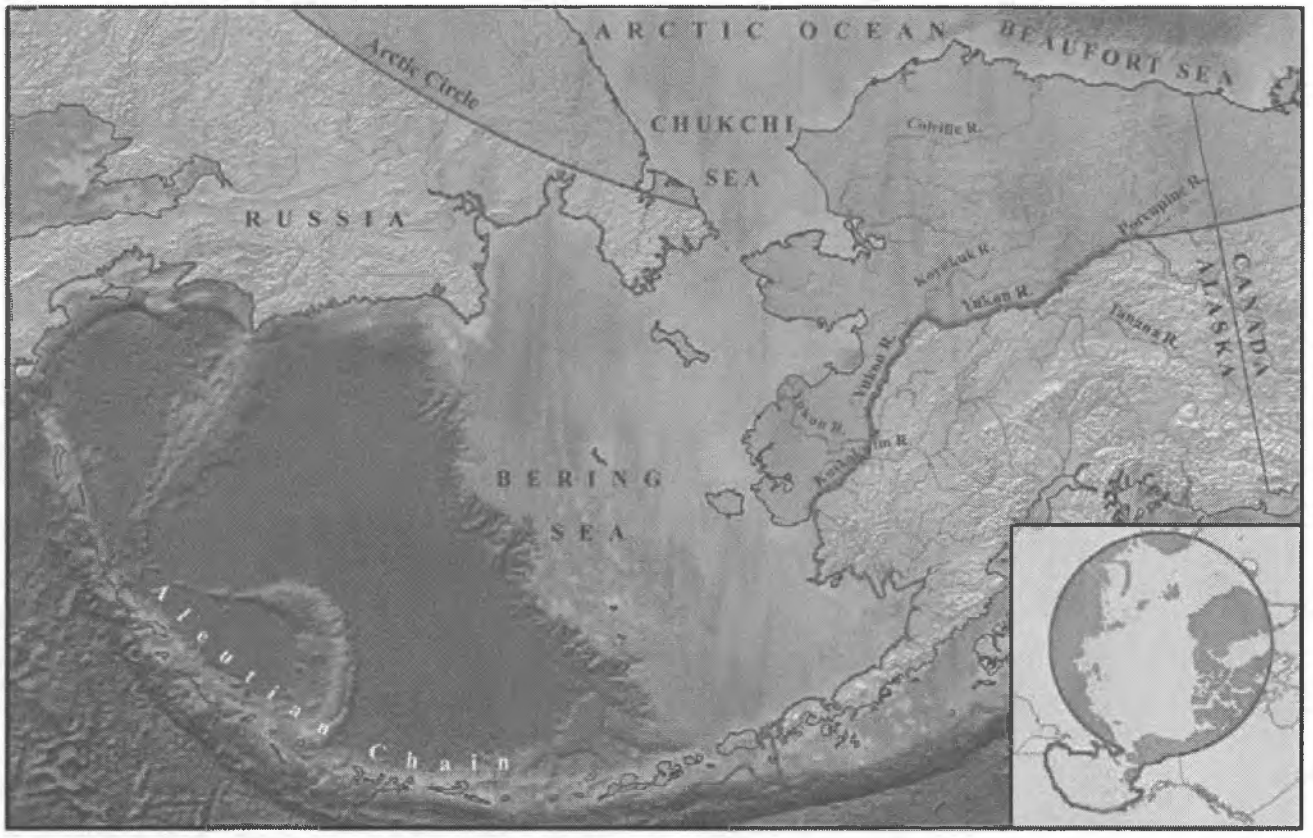


ABOVE. Ice-edge. (Photo credit: M. Dunn)

LEFT. Ice boulders at sunset. (Photo credit: M. Dunn)

ARCTIC BOUNDARY AS DEFINED BY THE ARCTIC RESEARCH AND POLICY ACT (ARPA)

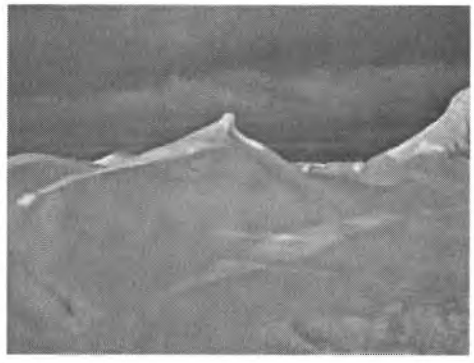
All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi seas; and the Aleutian chain.[1]



ACKNOWLEDGEMENT: Funding for this map was provided by the National Science Foundation through the Arctic Research Mapping Application (http://armap.org) and Contract #0520837 to CH2M HILL for the Interagency Arctic Research Policy Committee (IARPC).
MAP AUTHOR: Allison Gaylord, Nuna Technologies. May 27, 2009.

[1] The Aleutian chain boundary is demarcated by the "contiguous zone" limit of 24 nautical miles.

(Photo credit: M. Dunn)



Ridge peaks in the late-day sun.
(Photo credit: M. Dunn)

MAJOR RESEARCH PROGRAM RECOMMENDATIONS

The US Arctic research program must strengthen its efforts on five central and crosscutting themes.

1. Environmental Change of the Arctic, Arctic Ocean, and Bering Sea
2. Arctic Human Health
3. Civil Infrastructure
4. Natural Resource Assessment and Earth Science
5. Indigenous Languages, Cultures, and Identities

In 2007, the USARC *Report on Goals and Priorities for US Arctic Research* focused on building a robust and effective interagency program based on these five major themes. They span a wide range of basic and applied research topics, from Earth system science, to human health initiatives, to the social sciences, to engineering and technology development. Arctic change and its relation to global climate change is a thread that weaves these five themes together. In 2007, we added theme five—research related to indigenous languages, cultures, and identities. It represents the first research goal brought forward in the Commission's history with a basis in the humanities and social sciences rather than in the physical, biomedical, or geophysical sciences, or in applied engineering.

In 2009, we urge IARPC to continue its work to revise and strengthen the US Arctic Research Program's five-year plan along the same five themes. We applaud IARPC's work to make a new start on themes two through five, and its work to develop SAON as a major contribution to theme one. As noted above, we modified the first theme to include a new emphasis on the Arctic Ocean. In this report, we also recommend a series of new or renewed initiatives under each of the five themes, several of which have a strategic, immediate impact upon the nation. Our recommendations are included below in the discussion of each theme.

1 ENVIRONMENTAL CHANGE OF THE ARCTIC, ARCTIC OCEAN, AND BERING SEA

INITIATIVES RECOMMENDED BY THE COMMISSION

- With international partners, continue to develop and "operationalize" SAON to gain greater understanding of pan-Arctic change.

- SEARCH must further address the troubling lack of understanding of global climate impacts from processes such as Arctic sea ice reduction, melting glaciers and ice sheets, ocean acidification, methane release, and black carbon deposition. These factors can make or break the effectiveness of a global climate change mitigation regime.

- The "newly accessible" Arctic Ocean is inviting to commercial fishing, shipping, tourism, mineral, and energy extraction. The United States has barely started the baseline oceanographic research necessary to support US and Arctic Council goals for ecosystem-based management in the Arctic Ocean. This research should move forward, patterned to support marine spatial planning, a tool that enables integrated, forward-looking and consistent decision making on the use of the sea. Although legislation is pending in Congress to help plan this study effort through a National Research Council process, we urge IARPC to work with its members, the North Pacific Research Board, the Alaska Ocean Observing System (AOOS), and the North Slope Science Initiative (NSSI) to develop a plan and new sources of funding for an Arctic Ocean initiative similar to the Bering Sea Ecosystem Program-Bering Sea Integrated Ecosystems Research Program (BEST-BSIERP), the historic partnership between the National Science Foundation and the North Pacific Research Board. In this vein, the President's Ocean Policy Task Force heard widespread calls for better Arctic Ocean baseline research during its field visit to the Arctic and first regional public meeting in Anchorage, August 18, 2009.

Within the US Arctic Research Program Plan, the largest focus of current work is on understanding climate change. Work in the Arctic has made major contributions to global climate change science, both through the US Climate Change Science Program (CCSP) and the United Nation's Intergovernmental Panel on Climate Change (IPCC). Observing systems established in the Arctic are set to make major data set contributions to the Global Earth Observing System of Systems (GEOSS). Likewise, these observing systems have contributed to and have benefitted from emerging local observing systems and science programs, such as AOOS, NSSI, and the Barrow Environmental Observatory (BEO).

Below, we suggest ways to further improve the process of building SAON and we suggest ways SEARCH can put those observations to work with immediate benefits to global efforts to mitigate climate change.

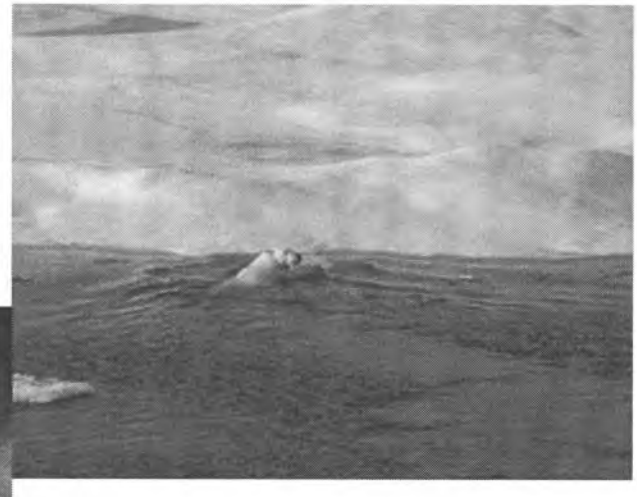
SUSTAINING ARCTIC OBSERVING NETWORK (SAON)

In April 2007, and in response to the recommendation of this Commission, IARPC called for the development of a government-wide Arctic Observing Network to observe key parameters of Arctic climate and society, and to allow us to begin to understand the causes and consequences of Arctic change. As a basis for this work, in 2006, the National Academy of Sciences prepared a report, *Toward an Integrated Arctic Observing Network* (NRC, 2006). In 2007, with leadership from NOAA and NSF, IARPC prepared a summary, *Arctic Observing Network (AON): Toward a US Contribution to Pan-Arctic Observing* (Jeffries et al., 2007), which reviewed ongoing and future federal Arctic observing activities and developed a strategy to enhance, coordinate, and integrate US observing efforts.

Twice now, foreign ministers of the Arctic Council's eight nations committed support for an international SAON effort; the US participates in an international initiating group to enhance cooperation. The greatest source of extramural funding for US principal investigators to develop projects in support of pan-Arctic observing has been NSF's Office of Polar Programs, which initiated this support prior to the present IPY, and continues it from the core NSF budget and the 2009 economic stimulus package. Enhanced coordination and integration of observing activities, and management of data and information, are now enabling scientists to respond with increased agility to many of the questions posed by SEARCH, IPCC, and others.

RECOMMENDATIONS

The Commission recommends that IARPC make a long-term commitment to an operational SAON. To date, most of the AON/SAON work has been conducted through NSF-funded short-duration research grants, with specifically designed, hypothesis-driven research objectives. For the long-term, AON/SAON needs a "home" and a commitment to provide continuing funding because the power and value of Arctic observations are inherently linked with the consistency and length of time over which they are made. The question of how this enduring effort will be structured and financially supported has yet to be fully answered within the United States, specifically within IARPC, or within the international SAON initiating group. All of the following entities need to be part of the enduring picture: NOAA, NASA, NSF, the State of Alaska, the University of Alaska's facilities, including Toolik Field Station, research programs such as the NPRB, and core interagency efforts in Alaska, such as AOOS, BEO, NSSI, and the Prince William Sound Oil Spill



ABOVE. Polar bear. (Photo credit: E. Kristof)
LEFT. Reindeer. (Photo credit: M. Dunn)

LEFT. Belugas in the Bering Sea seen during the April 2006 US Fish and Wildlife Service (USFWS) walrus survey. (Photo credit: USFWS/Brad Benter)
BELOW. Drilling through ice. (Photo credit: M. Dunn)

Recovery (OSRI). For example, support for AOOS would be a valuable US investment in ocean research and monitoring that would help us understand sea ice variability, cross-shelf ecosystems, and climate change.

To help achieve sustained funding, both in the United States and internationally, AON/SAON organizers need to develop a specific list of gaps in their capability to monitor high-priority science objectives. How many rivers are yet to be gauged for water flow? How many buoys are needed to define Arctic Ocean circulation patterns, sea ice thickness and distribution, and changing atmospheric temperatures and pressures? What new satellites are needed to collect required data sets? The Commission is prepared to advocate funding or partnerships to fill these gaps, when such a list is produced. We recommend that the next revision of the US Arctic Research Plan include specific, hard sensor and data management targets to make capitalization and operating cost targets of the observing network far more transparent.

When fully implemented, AOOS will be able to detect changes in the marine environment, in marine ecosystems, and in living resources. These abilities will be critical in the Arctic, such as in the Bering Strait region and off the North Slope of Alaska. The information from this system will also be used to predict future changes and their consequences. Because of the pivotal role of the Bering Strait in AON and in the nation's ocean monitoring network within the highly productive Bering Sea ecosystem, the Commission stresses the need for long-term support for AOOS as a line item in either the NOAA or ONR budget.

From a scientific standpoint, the Commission further recommends that AON/SAON work closely with predictive modeling efforts, marine spatial planners, and resource and wildlife managers to ensure that the data being collected meet the needs of these downstream users. A working group empaneled by the Commission to look at scaling issues has identified a set of questions to be considered as data collected on a small, local scale are extrapolated to form regional or global predictions. Also, model predictions on large or even global scales need to be modified to provide output on smaller scales. The working group report on scaling issues will be posted at http://www.arctic.gov after publication in 2010.

STUDY OF ENVIRONMENTAL ARCTIC CHANGE (SEARCH)

SEARCH is a comprehensive US national initiative to study Arctic climate change (SEARCH SSC, 2001). To date, it is the most robust interagency program convened by IARPC in response to Commission goals, and the program has made major contributions. Over 70 projects have been funded by several different agencies. These projects are focusing on the nature, extent, and possible future system-scale change in the Arctic environment by observing, understanding, and ultimately responding to environmental change. The science conducted by SEARCH spans terrestrial, oceanic, atmospheric, and social systems in the Arctic. Given the nature of the initiatives, SEARCH and AON are closely linked. Some consider AON the "front-end" observing component of SEARCH, which includes understanding and responding as two major programmatic goals.

SEARCH focuses on four major activities:

- Long-term observations to detect and monitor environmental change
- Modeling to synthesize observations, test hypotheses, and attempt to predict future change
- Process studies to understand the science behind environmental forces, interactions, and feedback
- Helping citizens and governments respond to the impact of change on ecosystems and societies by providing an understanding of what has been learned

Careful planning of SEARCH was required given the broad interdisciplinary science agenda, interagency interests, long time horizon, and international aspects. These program attributes have permitted evolution of a science advisory structure comprised of a committee with three panels: (1) Observing Change, (2) Understanding Change, and (3) Responding to Change. Thus, while the initiative is fundamentally science-driven, it also informs policymakers. The implementation blueprint is presented in *SEARCH: Plans for Implementation During the IPY and Beyond*, published in 2005. Each panel's agenda is distilled into a series of specific tasks and actions:

OBSERVING. Activities include: data rescue; improving observation density, collocation, and integration; improving coverage to close observation gaps; developing optimal observation and sampling strategies; observing key processes and studying feedbacks; acquiring paleoclimate and paleoenvironmental data over critical time periods; developing networks; developing data archival and distribution systems; and using innovative technologies.

Caribou trophies.
(Photo credit: J. Farrell)

UNDERSTANDING. Types of activities include: model-based assimilation of currently available observations; improving and expanding model capabilities; model simulations for forecasting and for guiding observing system design; developing and using of proxy records; diagnostic analyses of synthesized observations and paleoreconstructions; and studying interactions between the Arctic environment and socioeconomic and cultural changes.

RESPONDING. Types of activities include: providing stakeholder-driven guidance to observe and identify useful predictions; interpreting modeling/analysis results in the context of local knowledge; assessing responsiveness and effectiveness of institutions in addressing social and economic concerns about climate change; and developing community-based networks and cooperatives to facilitate these activities.

RECOMMENDATIONS

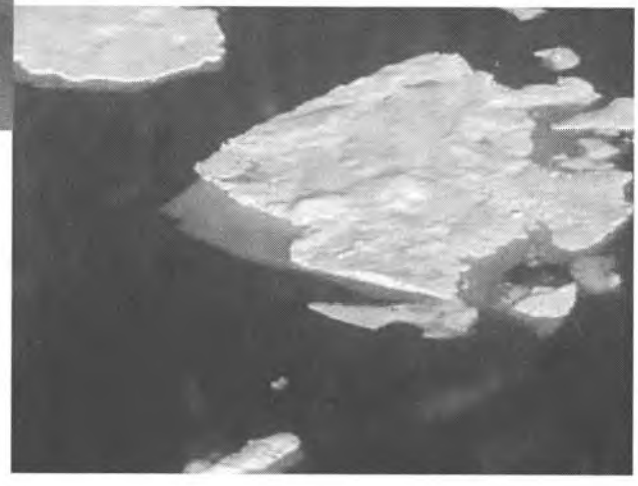
First, expeditiously, SEARCH must further address the lack of understanding of the global climate impacts from Arctic sea ice reduction, melting glaciers and ice sheets, ocean acidification, methane release, and black carbon deposition. These factors significantly impact the effectiveness of any global climate change mitigation regime. These questions gain importance as the United States prepares for future Conferences of the Parties in the United Nations Framework Convention on Climate Change, such as the recently held conference in Copenhagen.

Key science questions include: What is the contribution to Earth's heat budget from lost reflection of Arctic sea ice? Is it true that "Arctic amplification," where temperatures rise in northern latitudes to a much greater degree than global averages, means a large volume of greenhouse gases are set to be released from decomposing organic matter in warming permafrost? If so, will those gases "overpower" any mitigation scheme adopted to reduce anthropogenic greenhouse gas emissions? Do scientific results back up the hypothesis, embodied in the Arctic Council's Task Force on Black Carbon and other short-term forcers of climate change, that reducing methane and black carbon emissions could help slow the retreat of sea ice?

Second, SEARCH is the best example of both the success and the shortcomings of the current coordination process of US Arctic research. Although the Arctic Research and Policy Act requires an integrated Arctic research budget, IARPC, OMB, and OSTP have not produced one. That breach should be rectified, not only to gauge SEARCH's progress toward its objectives, but also to provide greater transparency for this important program. Lacking this information, neither the Commission nor Congress can conclude what kind of further funding is needed.

Third, US agencies supporting climate related research in the Arctic region should make sure that their Arctic programs are integrated with SEARCH. NSSI, NPRB, and AOOS activities, conducted outside direct agency command and control, should also be included. Likewise, SEARCH activities should be clearly recognized and integrated into any upcoming revisions of national climate change science programs and ocean science programs, as well as international, pan-Arctic climate research programs such as the International Study of Arctic Change (ISAC), under the aegis of the International Arctic Science Committee (IASC) and the Arctic Council's Arctic Monitoring and Assessment Program (AMAP).

Fourth, the Commission commends the process used to date by IARPC's lead agency, NSF, to outsource coordination of SEARCH activities to the Arctic Research Consortium of the United States (ARCUS). ARCUS leadership of SEARCH efforts has helped keep extramural climate research (that performed by academic institutions rather than government agencies) strong, and has supported a bottom-up, rather than top-down, process for setting research priorities. We urge the continuation of this leadership model, and its replication, where possible, with IARPC's other thematic



LEFT. Mountains from above. (Photo credit: J. Farrell)
BELOW. Sea ice. (Photo credit: J. Farrell)

programs. It is also critical to engage the private sector, which has commercial interests in the nature of Arctic change, for example, through policy forums and funded research avenues (e.g., Small Business Innovation Research).

Fifth, we urge SEARCH to respond further to the increasing need for more precise modeling of climate change in the Arctic region. Resource management decisions ranging from the Endangered Species Act status of polar bears, oil and gas development, fisheries openings and closures, shipping regulations, and onshore tundra travel, among others, rely on high-quality regional as well as global assessments and predictions.

Sixth, the Commission applauds the active, continuing synthesis and outreach components of SEARCH embodied in the *State of the Arctic Report* (Richter-Menge et al., 2008) and the continuing Arctic Report Card, annual Web-based updates (e.g., Richter-Menge and Overland, 2009). SEARCH findings played an important part of IPY outreach programs as well, and those outreach programs should continue. We recommend regular SEARCH synthesis workshops to help integrate SEARCH efforts across the government.

RUSSIAN-AMERICAN LONG-TERM CENSUS OF THE ARCTIC (RUSALCA)

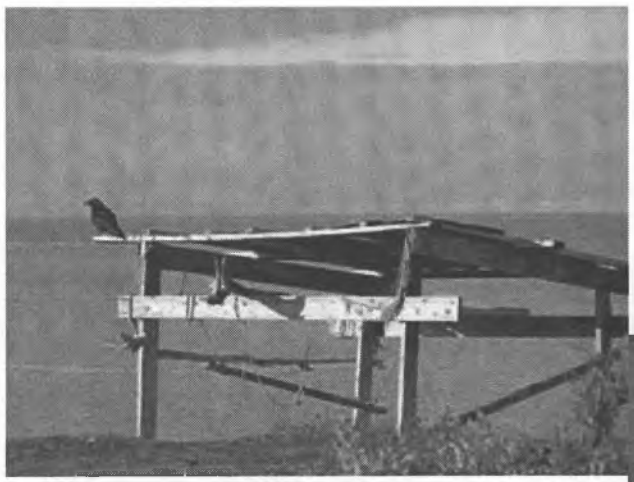
The RUSALCA program makes long-term observations in US and Russian territorial waters to better understand the causes and consequences of the reduction in sea ice cover in the northern Bering and Chukchi seas. Among the "consequences" is the rapid change in the marine ecosystem that is being observed, coincident with the retreat of sea ice. The program is based on a memorandum of understanding (MOU), beginning in 2003, between NOAA and the Russian Academy of Sciences.

Support for RUSALCA Bering Strait oceanographic moorings (that monitor currents, temperature, salinity, productivity, and nutrients) in Russian and American waters are funded annually by NOAA, NSF, and Russia's Roshydromet. As an integral part of AON, long-term support for these moorings is an essential part of our IPY legacy. Scientific data derived from this effort help us understand how climate change will affect storms in our coastal communities, how marine mammal and fisheries resources will vary, and how transportation needs in the Arctic will evolve.

The RUSALCA program began in summer 2004 with a multidisciplinary cruise on the Russian R/V *Khromov* to investigate seawater-column physics, nutrient chemistry, and biology. Moorings deployed in the western Bering Strait in 2004 have been recovered and redeployed annually. Beginning in 2007, the RUSALCA program has planned joint annual cruises focusing on the physics in the Bering Strait region, and an even more extensive multidisciplinary cruise was carried out in 2009 and will be repeated in 2012. The 2008 field program successfully recovered and redeployed eight moorings across the entire Bering Strait and retrieved oceanographic data confirming a record warm Pacific water flux in 2006 and 2007. On August 22, 2009, the RUSALCA mission embarked from Nome, Alaska, on the R/V *Khromov* for a 40-day voyage into the Bering Strait and northward to the Pacific side of the Arctic Ocean. Due to the severe reduction in sea ice cover, the expedition was able to take the first fish trawl at 77°N above the Chukchi Plateau, about 300 km north of the 2004 northernmost site.

RECOMMENDATION

USARC strongly urges an immediate appropriation of funding to NOAA's Arctic and Ocean Exploration programs, including a line item for the RUSALCA program, to honor the MOU between the governments of Russia and the United States, through NOAA. Failure to regularly fund the American contribution to this joint research effort jeopardizes future access to Russian territorial waters and opportunities to share sampling platforms. Elsewhere in this report, the Commission recommends further work to strengthen US-Russian cooperation in Arctic research.



LEFT. Fish drying rack on Kotzebue Sound. (Photo credit: J. Farrell)
BELOW. Arctic tundra. (Photo credit: B. Molnia)

BERING SEA AND ARCTIC OCEAN ECOSYSTEM STUDIES

In every biennial USARC *Report on Goals and Objectives for Arctic Research* (herein referred to as USARC Goals Report) since 1995, a key priority has been research in the Bering Sea. For several reasons, most related to the greater accessibility and human use of the Arctic Ocean, we expand that priority to include the Arctic Ocean, especially the Chukchi and Beaufort seas off the US coast.

BERING SEA

Information from the Bering Sea research effort helps support management decisions associated with this highly productive ecosystem. The Bering Sea contains vast numbers of marine birds and mammals as well as productive commercial fish and shellfish species that total to more than 50% of all landings (by volume) in the United States. The Bering Sea also provides over 25 million pounds of subsistence foods used by nearly 55,000 Alaskan Native residents, primarily in small rural communities.

Prior USARC goals reports expressed concern about the deficiency of integrating observations and data from many projects and programs, and emphasized our lack of ability to predict changes occurring in the Bering Sea system resulting from natural and human factors. Since then, considerable attention has been directed toward these priorities. Many of the key agencies and institutions that support such research joined in a Bering Sea Interagency Working Group (BIAWG), created by IARPC, which meets annually. BIAWG has drafted a strategy to coordinate and integrate research of the Bering Sea ecosystem and its living marine resources. The working group report (BIAWG, 2006) focused on four core questions:

1. How does the Bering Sea ecosystem respond to climate change and variability?
2. Is the current warming of the Bering Sea due to decadal variability, or a result of a long-term secular trend?
3. Can we predict the effects that the warming and changing sea-ice dynamics will have on the biological resources of the Bering Sea (commercial, subsistence, ecological, and protected)?
4. What measurable factors (physical, chemical, and biological) serve as the best indicators of ecosystem change at different trophic levels and different spatial/temporal scales?

Organizations represented on the BIAWG, their areas of interest or responsibility, and their budgetary commitments are:

- ALASKA OCEAN OBSERVING SYSTEM (NOAA/AOOS) anticipates a Bering Sea monitoring program expenditure of > $1M per year (subject to congressional approval).

- BERING ECOSYSTEM STUDY (BEST, NSF) has $21M of extramural research, including $11M for ship time over four years of expeditions, and resources for a subsequent year of analysis and reporting. During the expeditions, support is budgeted for two to three months of icebreaker time and three to four months of ice-strengthened ship time annually.

- ALASKA FISHERIES SCIENCE CENTER (AFSC, NOAA NMFS) conducts studies mandated by the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, and the Marine Mammal Protection Act. AFSC conducts routine surveys and assessment studies on Bering Sea living marine resources, including groundfish, rockfish, juvenile salmon, forage fish, crab, Steller sea lion, northern fur seal, harbor seal, ice seal, gray whale, northern right whale, and humpback whale. NOAA provides ship time on its research vessels *Miller Freeman* and *Oscar Dyson*. AFSC scientists are also responsible for two interagency coordinated research efforts:

  - NORTH PACIFIC CLIMATE REGIMES AND ECOSYSTEM PRODUCTIVITY (NPCREP) project (FY07 $2M, FY08 $4M, level funds thereafter) detects and measures ecosystem changes. NPCREP will expand existing, and initiate new, long-term observing sites on the Bering Sea shelf and, upstream, in the Gulf of Alaska.

  - LOSS OF SEA ICE (LOSI), proposed in FY08 ($2M), extends fish assessment surveys farther north, initiates annual assessments for ice-dependent seals, and models the population dynamics of new species that may be managed if fishing is extended northward. Scientists from AFSC, PMEL, and NPRB drafted the LOSI implementation plan with a targeted start date of spring 2009.

- PACIFIC MARINE ENVIRONMENTAL LABORATORY (PMEL, NOAA) PMEL scientists partner with AFSC scientists and compete for NPRB and NOAA grants.

- NORTH PACIFIC RESEARCH BOARD (NPRB) provided $16M in extramural funding for the Bering Sea Integrated Ecosystems Research Program (BSIERP), including funds for ship time for six fiscal years starting in 2007. NPRB anticipates a planning year, three major field seasons during calendar years 2008–2010, and two years of analysis and reporting.

- UNIVERSITY OF ALASKA FAIRBANKS (UAF), School of Fisheries and Ocean Science (SFOS) faculty members, among others in the nation, compete for BEST, NPRB, and NOAA funds to support researches on the Bering Sea ecosystem.

- US FISH AND WILDLIFE SERVICE (USFWS) has management responsibilities for sea otters, Pacific walrus, and polar bears, and manages refuges in and adjacent to the Bering Sea. USFWS is also the trust agency for all migratory birds and regulates and monitors their spring and sport harvest. USFWS also manages threatened, endangered, and at-risk species. USFWS and USGS conduct seabird counts.

- NORTH PACIFIC FISHERIES MANAGEMENT COUNCIL (NPFMC) has implemented an Arctic Fisheries Management Plan that covers the offshore area from 3–200 miles into the Chukchi and Beaufort seas. We recognize the growing contributions of community-based groups earning funds through the North Pacific Fishery Management Council's Community Development Quota (CDQ), and urge their integration into the science program.

- USARC provides advice and makes recommendations to the President and Congress on Arctic research needs.

In 2007, NSF and NPRB formalized a $52M joint management plan for a six-year study of the Bering Sea ecosystem, a partnership to support a comprehensive, vertically integrated study, during 2007–2012, through NSF's BEST and NPRB's BSIERP programs. The plan concentrates research efforts on the eastern Bering Sea shelf between the Aleutian Islands and St. Lawrence Island. NSF provides support for the lower trophic levels, up to and including macrozooplankton and benthic infauna, and supports social science projects focusing on the relationships between a changing marine environment and the adjacent communities. NPRB supports studies of the upper trophic levels, macrozooplankton and benthic fauna, up the food

ABOVE. US Airforce Long Range Radar Site near Kotzebue. (Photo credit: J. Farrell)
RIGHT. Kivalina resident. (Photo credit: J. Farrell)

chain to include humans, their communities, and social and economic impacts. Protocols for jointly considering the scientific proposals to the two organizations, as well as coordinated planning efforts and data sharing protocols assure coordinated research.

Recommendations

USARC applauds this ground-breaking cross-agency collaboration between NSF and NPRB, and now urges Congress and NSF to support the alignment and overall synthesis of the BEST and BSIERP programs, such as through an NSF announcement of opportunity, to ensure the greatest return on the initial investment.

In response to a NPRB request for proposals, the North Pacific Marine Science Organization (PICES) released PICES Scientific Report No. 33 (Kruse et al., 2006), which addressed the previously articulated USARC need for research on the ability to predict changes occurring in the Bering Sea from natural and human-induced causes. Some recommendations resulting from the workshop echo concerns shared by USARC, and include:

1. Ecosystem-level and community-level conservation thresholds are relatively new ideas in marine conservation. Because they will require new kinds of indicators, research is needed to develop and apply them in the Bering Sea.

2. New research is needed to understand how to synthesize the large set of Bering Sea data records into a reasonable number of ecosystem status indicators.

3. Enhancements to the ocean/ecosystem monitoring network are needed to fill ecological data gaps at several points (plankton, benthic infauna and epifauna, seasonal species interactions and movements, small pelagics, and cephalopods) to improve predictive models and the development of ecosystem indicators.

4. A healthy relationship between Alaska Native communities and the marine ecosystem requires a high level of attention. Socioeconomic objectives related to the marine environment should be developed for the region, along with their indicators and reference points. Effective solutions will likely require policy that is formulated from the integration of traditional ecological knowledge (TEK) with complementary scientific research from a variety of disciplines, such as biology, ecology, economics, political science, and sociology. Co-management groups funded by NOAA and USFWS, including the Alaska Sea Otter and Sea Lion Commission, the Alaska Nanuuq (polar bear) Commission, the Eskimo Walrus Commission, the Alaska Eskimo Whaling Commission, and other marine

USARC Chair Mead Treadwell and USCG Avionics Electrical Technician First Class Jody Sullens on a USCG Hercules C-130 Arctic Domain Awareness flight over the Beaufort Sea. (Photo credit: J. Farrell)

mammal commissions, can provide important observational data through TEK, which is crucial to maintaining and incorporating Alaska Native involvement and partnership, and closely link scientific research to support socioeconomic and social-ecological goals.

5. Plans should be developed to better communicate results to scientists, policymakers, and decision makers, and the general public.

USARC welcomes the lead that NPRB has taken in soliciting international input in developing ecological indicators for the Bering Sea and in reiterating the need for dedicated federal funding to each of the collaborating BIAWG programs. NPRB is also commended for successful outreach activities and encouragement of TEK.

Finally, USARC recommends support to develop AOOS in the Bering Strait region as described in the Bering Strait Regional Case Study in the *Arctic Marine Shipping Assessment* (AMSA, 2009).

ARCTIC OCEAN

Significant research in the Arctic Ocean has been funded by DOI's Minerals Management Service (MMS), NOAA, NSF, private oil and gas exploration enterprises, and others. NPRB and AOOS are poised to provide funding for Arctic Ocean research, subject to developing an integrated science plan. The North Pacific Fisheries Management Council's moratorium on commercial fishing in the US Arctic Ocean Exclusive Economic Zone points out the need for good baseline ecosystem studies in the area. Oil and gas exploration plans, and greater shipping use of this ocean, further point out the need for solid understanding of the biology of this region to avoid adverse impacts. Internationally, many policy analysts and decision makers have suggested the Arctic Ocean is a good place to apply marine spatial planning and ecosystem-based management across national jurisdictions and in the high seas. Such an effort requires an enhanced understanding of the Arctic ecosystem rooted in multiyear data sets.

How do we get there? The Commission thanks AOOS and NPRB for its leadership in convening experts on this question. A workshop on Arctic Research and Monitoring on January 23, 2009 followed an initial Arctic Research and Monitoring Collaboration Roundtable held in the summer of 2008 (Dorman, 2009). The goal was "*to share information and promote collaboration among the many entities with increasing activities in marine research and monitoring in the Alaska maritime Arctic (Chukchi and Beaufort Seas), including the oil and gas industry, local, state and federal agencies, and nongovernmental and academic organizations.*"

Two researchers presenting at the workshop, Russ Hopcroft and John Walsh, were cited in the workshop report as having a common conclusion: "*...although the anthropogenic and natural forces driving climate change in the Chukchi and Beaufort largely come from outside the area, the impacts have*

already started, will be large, fundamental, and irreversible, will require more precise coupling of models (atmosphere, snow, sea ice and ecosystem), and will necessitate significant adaptation by virtually all trophic levels in the ecosystem, from microbes to man."

A number of organizational steps were discussed at the workshop. Most current "investors" in Chukchi and Beaufort research from federal, state, private industry, and academic institutions were present, and collaboration in data sharing was increased as a result. An integrated science plan should be produced by an active group of stakeholders who represent these broad constituencies.

USARC has cosponsored several workshops, symposia, conferences (such as the annual Alaska Marine Science Symposium), and other efforts on Arctic Ocean research, and will continue to do so.

Recommendations

First, IARPC, in the context of the national review of ocean policy called for by President Obama, should establish an umbrella science plan for the Arctic Ocean, and put a structure in place with clear research objectives. As a guide, we recommend that IARPC use the report from the workshop on Arctic Research and Monitoring sponsored by AOOS and NPRB (Dorman, 2009) and the NPRB Arctic synthesis report by Hopcroft and others (Hopcroft et al., 2006).

Second, a research plan for the Arctic Ocean should be patterned to support marine spatial planning. We recognize the newly accessible Arctic Ocean is inviting to commercial fishing, shipping, tourism, mineral, and energy extraction. The United States has barely started the baseline oceanographic research necessary to support US and Arctic Council goals for ecosystem-based management in the Arctic Ocean.

Third, USARC recommends that NSF and NPRB move forward together and obtain support from other groups such as AOOS and NSSI to create and support an initiative to understand the Arctic Ocean marine ecosystem similar to their joint effort on the Bering Sea ecosystem through the six-year, $52M BEST-BSIERP effort.

Fourth, recent studies have begun examining the impact of environmental pollutants, bioaccumulation, and climate change on food safety and health. Because the Arctic is a unique and to a great extent an unexplored or measured environment with regard to health issues, it requires a specialized research approach to meet the health care needs of its people. To the end, the Commission calls on the US Senate to ratify the Persistent Organic Pollutants treaty. Arctic indigenous residents unfairly endure multiple health disparities; research into such ailments should appeal to a wide variety of institutes and centers at NIH and NIMH as well as the Fogarty International Center. For example, infectious diseases, cancer, heart disease, obesity, diabetes, and various mental health issues are overrepresented in Arctic populations.

Fifth, consistent with the recommendations from the first International Arctic Fisheries Symposium, held in Anchorage in October 2009, the Commission calls for increased cooperative research as a basis upon which decisions will be made for future Arctic fisheries. The symposium should also be reconvened regularly so that scientists and policymakers from several countries, representing different perspectives, may come together and discuss common issues.

Sixth, international focus on ocean acidification must include the current and potential impacts on the ecosystems of the Bering Sea and the Arctic Ocean, which contain waters that are already more corrosive to carbonate (i.e., lower carbonate ion concentration) than in the equivalent Arctic water masses in the Atlantic sector. What is the current impact of acidification on species that are particularly susceptible to dissolution, such as pteropods (among the food sources for salmon), or on larval blue king crab, or on shellfish, such as scallops? In the United States, funding has been provided to NOAA, NSF, and EPA to focus greater attention on ocean acidification, and the National Academy of Sciences and The Oceanography Society recently released publications on this topic (see December 2009 issue of *Oceanography* at http://tos.org/oceanography/issues/issue_archive/22_4.html). The impacts of acidification on Arctic waters must be an integral part of these activities and reports.

Prized catch of bowhead whale in Barrow, Alaska.
(Photo credit: C. Rosa)

2 ARCTIC HUMAN HEALTH

US Arctic residents suffer from a wide range of severe physical and behavioral health issues with a far higher incidence in comparison to their counterparts in the lower 48 states. Life expectancy among the Alaskan indigenous population (approximately 15% of the total Alaskan population, or 100,000 people, according to the US Census Bureau) can be short and tragic. Death rates due to accidents and suicides of young adults are the most frequent and infant mortality rates are higher (Wigle et al., 2005) than for natives in the lower 48 states. Over one-third of rural Alaskan women become victims of an intimate partner (Wagner et al., 1995). Although the transition from a traditional subsistence lifestyle and socioeconomic system toward a cash economy has brought rapid economic change and new technologies, it has also markedly increased the prevalence in the native population of acute and chronic diseases such as cancer, diabetes, hypertension, obesity, cardiovascular diseases, alcoholism and drug abuse, as well as domestic violence, child abuse, accidents, and mental illness, including mood disorders, and suicide.

The US Arctic Research Program needs to make a generational commitment to conduct research to improve the plight of Alaska's native people, described in the Pulitzer Prize winning series, "A People in Peril" (1988, *Anchorage Daily News*). Despite over 20 years of public awareness of the health problems of indigenous people in Alaska, and meritorious attempts at prevention and control of some of these diseases by the health agencies of the State of Alaska, the Indian Health Service, and more recently the empowered tribal health consortia, there are precious few examples of improvement and, instead, there has been a progressive increase in the rates of suicide, alcoholism, and accidents in Alaska Natives. In addition, their death rate from lung cancer is increasing. The Arctic's First People have many threats and challenges before them.

As IARPC establishes its priorities for US Arctic Human Health research, DHHS has designated the Fogarty International Center at the National Institutes of Health (NIH) as the point of contact for Arctic health research matters. We applaud the leadership Fogarty has given in responding to the Commission and the IARPC mandate to develop an Arctic Health Research Program Plan. We encourage other federal agencies dealing with Arctic health research issues—the Department of Health and Human Services (e.g., Centers for Disease Control and Prevention [CDC], individual NIH institutes, the Substance Abuse and Mental Health Services Administration [SAMHSA]), EPA, DOI, and others—to dedicate more resources to Arctic health research.

CDC and the various institutes and centers at NIH spend approximately $24M annually on research activities in Alaska, and a portion is directed to assessing and improving human health. For example, studies of the weight, nutrition, and health of Alaska Natives are conducted by the UAF Center for Alaska Native Health Research (CANHR), which was established through a grant awarded by NIH's National Center for Research Resources (NCRR). Because Arctic residents unfairly endure multiple health disparities, and are considered "underserved" in the majority of rural areas, research into such ailments should appeal to a wide variety

of institutes and centers at NIH. For example, infectious diseases, cancer, heart disease, and mental health all have their unique aspects within Arctic populations.

There is a growing circumpolar collaboration in Arctic health research, supported by the work of the International Union for Circumpolar Health (IUCH), the Arctic Council's Sustainable Development Working Group, and the individual efforts of Arctic nations and research institutions. Unfortunately, despite the enormous toll on the people of Alaska and the Arctic, there are no NIH-sponsored studies of depression, alcoholism, suicide, or cancer in Alaska Natives. The Commission has identified several research approaches to improve health in Native communities. These include expanding the understanding of traditional healing methods and improving more clinically based approaches. Further investigation of genetic factors may assist in identifying and understanding any propensity that may exist for cancer, other chronic diseases, or mental health problems in indigenous populations.

Inupiat living in Northwest Alaska have one of the highest youth suicide rates in the world (Wexler, 2006). This situation is an unacceptable expression of the depression and alcoholism caused by a variety of known and unknown malignant factors, including cultural and language devaluation, loss of cultural identity, climate change, and the lack of jobs and work in native communities. Other countries (e.g., New Zealand) have faced similar problems in their native population and have succeeded in reducing the suicide rates. We need to make Alaska a healthier place for Alaska Natives to live in. The Commission has found that the nation's medical researchers, with specific expertise in these health problems, do not have enough awareness of the health challenges faced by Alaska Natives. NIH and the National Institute of Mental Health (NIMH), while sympathetic to these problems, have told the Commission that more proposals are necessary from the national medical research community in order to see more funding directed to research in this area. The Commission calls upon NIH and NIMH to work together with the NAS/IOM and the research community as a whole and Alaska Native researchers and practitioners to expand Arctic health research. Toward this end, and at the request of and with support from the Commission, on June 2 and 3, 2009, the Fogarty International Center of the National Institutes of Health convened a workshop on suicide and other behavioral health issues in Anchorage, and the proceedings from this workshop were published in early 2010 (Levintova et al., 2010). Specialists from a variety of Arctic disciplines, indigenous leaders, and representatives from various NIH institutes and centers attended.

Part of the discussion focused on a Commission recommendation, stated below, that NIH, NIMH, the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Center on Minority Health and Disparities (NCMHD), the National Institute on Child Health and Development (NICHD) and other appropriate government agencies support a "decadal" review on Arctic human mental health research to be conducted by both the National Academies' Institute of Medicine and Polar Research Board. This review and Institute of Medicine report would empanel experts from many different disciplines. It would work closely with the Arctic region's indigenous leaders, health researchers and practitioners, state officials and others to bring research, intervention, and clinical work together. The workshop discussion showed that an appropriate review would focus on the epidemiology and causes of the excessive morbidity and mortality caused by suicide, domestic violence, addictions, and other mental and behavioral conditions so frequent among Arctic populations. This review should also identify methods for future genetic, genomic, and functional imaging studies of natives living at high latitudes to learn if the strategies for enhancing the resilience of the native population can benefit from preventive and interventional methods that are more developed and successful with other at-risk populations elsewhere.

RECOMMENDATIONS

First, the Commission recommends that IARPC follow through on its commitment to develop an overarching US Arctic human health research plan. This plan should include state-of-the-art advances in genomics and genetics. Further, it should encourage the study of high-latitude physiological

differences, improve the knowledge of Arctic epidemiology, and integrate work across the various centers and institutes of NIH, with the work funded by other agencies, such as CDC, SAMHSA, EPA, DOI (including USGS, BIA, USFWS), Food and Drug Administration (FDA), NOAA, and Alaska and tribal healthcare providers

Second, we must immediately bring research to bear on a deadly problem with causes and treatments that may be unique to the Arctic. Suicide rates in the Arctic are appalling, and greater among indigenous Arctic youth than any other group within our nation. Clinical research and community intervention efforts must come together to address this epidemic. The Commission urges the National Academy of Sciences, through the Institute of Medicine and Polar Research Board, to bring together health researchers and practitioners, indigenous leaders, and experts from a wide range of disciplines to develop a rigorous, evidence-based, iterative, and recurring assessment of intervention efforts. To be most effective, this effort must be decadal, to establish research priorities, review results, guide the scaling up of successful pilot programs into widespread clinical interventions, and to track the progress and success of the research agenda.

Third, the Arctic Human Health Initiative (AHHI), a US-led contribution to IPY has been a significant contributor to international coordination of Arctic health research. The Commission calls for continuation and greater funding of this CDC-affiliated initiative so that it may conduct, to a much greater extent, the research that the proposal calls for. Leadership from NIH, CDC, and SAMHSA will be essential in this effort. Because the Arctic is a unique and to a great extent an unexplored or unmeasured environment with regard to health issues, it requires a specialized research approach to meet the health care needs of its people. Genetic analysis has shown that Arctic indigenous peoples are significantly different from those at lower latitudes. An IARPC health plan needs to coordinate closely with each working group of the Arctic Council toward this objective.

Fourth, recent studies have begun examining the impact of environmental pollutants and climate change on food safety and health. We applaud work that EPA has done in this area, and also the Alaska Department of Environmental Conservation (ADEC), Division of Environmental Health, through a new initiative to monitor fish for heavy metals such as mercury. State and federal research and mission agencies need to strengthen cooperation with Alaska tribes and subsistence communities as these efforts continue.

Fifth, the Arctic presents itself as an ideal location for the development of innovative technologies for medicine-at-a-distance or telemedicine and telepsychiatry. The Commission recommends supporting and promoting such innovation by grants from NIH and other agencies. These innovations could have broad value to other parts of the nation and the world. Initial work on this subject, supported by the State of Alaska and the US Department of State, and conducted by Hild et al. (2000), should be updated, advanced, and implemented.

LEFT. After the hunt. (Photo credit: C. Rosa)
BELOW. Kotzebue graveyard. (Photo credit: J. Farrell)

Kivalina revetment.
(Photo credit: J. Farrell)

3 CIVIL INFRASTRUCTURE

Arctic climate and conditions have always called for unique methods in transportation, housing, telecommunications, sanitation, energy production, navigation, and mapping. As climate change impacts the Arctic, thawing permafrost, reducing sea ice, strengthening storms, and eroding coastlines, civil infrastructure is facing new challenges. Long-held engineering standards assumed that the permafrost regime would be perpetually stable. Realization that permafrost might thaw significantly during the lifespan of a building, a pipeline, or a road system requires research to develop new methods of design and construction. Seasonal restrictions adopted to protect tundra and permafrost during road construction, pipeline building, and oil exploration have expanded as winters have become milder or shorter; that, too, has caused a need to reexamine methods.

As protective winter sea ice retreats from the coastlines, storm surges reach the shore, making it vulnerable to erosion. For example, in the village of Shishmaref, inhabited for 400 years, climate change is destroying homes, water, sanitation systems, and other infrastructure, which requires relocation of the entire village. Shishmaref is not an isolated example; the village of Kivalina is another case where, for example, fuel depots are perilously close to the approaching erosional front.

Research and innovative engineering solutions are needed to create new infrastructure to accommodate the demands of an Arctic that is increasingly accessible, whether by land, sea, or air. The Commission has long recommended infrastructure research within the US Arctic Research Program. Since the 2007 goals report, and with the leadership of the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL), IARPC has committed to develop an integrated plan. At the start, the Commission recommended that infrastructure research cover a wide variety of topics, such as permafrost, shoreline erosion, construction techniques, and building codes, methods to reduce the cost of living (primarily housing) in Alaska, oil spills, energy use, and marine transportation. Such a program plan will serve as intellectual underpinning for broad research on civil infrastructure in the Arctic.

CRREL, in coordination with the University of Alaska Fairbanks and the Denali Commission, conducted a USARC-sponsored workshop toward an infrastructure research program plan in April 2010, in Fairbanks, Alaska. The focus of the workshop was to identify state, national, and international partners, prioritize actions in each field, and identify pilot projects and other opportunities to test the feasibility of larger research efforts.

USARC has encouraged the participation and cooperation of other agencies to work with CRREL in this process. For civil work, sanitation, and housing, we will continue to discuss the roles that the Department of Transportation (DOT), Federal Aviation Administration (FAA), Denali Commission, State of Alaska, Department of Housing

and Urban Development (HUD), Department of Energy (DOE), NSSI, and USGS can play. For oil spill research, in this report, we are recommending a second set of collaborations. Two interagency entities created by law, IARPC, and the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), chaired by the US Coast Guard, in the Department of Homeland Security, have responsibility to work in this area. Specific recommendations on ways to better ways to implement oil spill research are described in a USARC white paper (see http://www.arctic.gov for the white paper). The scientific community has suggested that one of the greatest needs in responding to oil spills is understanding where the oil will go (e.g., spill trajectories, ocean circulation models) in the event of a spill. Clearly, current research has just begun, and a more comprehensive initiative is needed by entities such as AOOS, MMS, other ICCOPR agencies, and industry.

For shipping research identified by the *Arctic Marine Shipping Assessment* (AMSA, 2009), we recommend a third collaboration, with the participation of DOT, MARAD, the Committee on Marine Transportation Systems, the National Academies Transportation Research Board, the US Coast Guard, and others.

For energy research unique to Arctic assets and conditions, we have encouraged DOE to maintain funding for the Arctic Energy Office, and to remove restrictions to allow work on renewable energy as well as fossil fuels. DOE has responded by staffing a representative of the National Renewable Energy Laboratory (NREL) in Alaska and has begun developing a renewable energy research plan. Such a plan will become an integral component of a climate mitigation strategy.

For telecommunications, we convened a workshop on the use of the Iridium network in high Arctic research (no other system is available to civil users at high latitudes), and we encouraged the Arctic Council's Arctic telecommunications assessment.

For Alaska's Arctic mapping needs, the Commission encouraged collaboration among the Statewide Digital Mapping Initiative (SDMI), federal geographic data committees, and the Civil Applications Committee, which is a "window" for the use of classified assets such as spy satellites by civil government agencies.

CRREL and IARPC are encouraged to work together with two centers addressing civil infrastructure research that have been established on the UAF campus. The Alaska Center for Climate Assessment and Policy, funded by NOAA, is one of a national group of Regional Integrated Sciences and Assessments programs. It is a partnership among scientists at UAF and University of Alaska Anchorage, state and local planners, including those at the National Weather Service and United States Army Corps of Engineers, and stakeholder groups, including Alaska Native tribal governments, industries, and nongovernmental organizations. A third civil infrastructure center at UAF, focused on energy, is authorized but not funded.

The Alaska Aviation Safety Project, funded at Alaska's Department of Transportation through NASA, is a second source of collaboration in research to improve mapping, aviation safety, and use of new telecommunications and navigation techniques. Its sister project, Capstones, funded by FAA, used remote Arctic conditions to develop a new method of air-traffic control, automatic dependent surveillance-broadcast, which is being implemented over time across the United States and in other nations. In 2008, the National Aeronautic Association awarded the academic, government, and industry team (Commercial Aviation Safety Team), which pioneered this technology, aviation's highest honor, the Robert J. Collier Trophy, joining the ranks of others who had reached aerospace milestones, including Orville Wright, Howard Hughes, Chuck Yeager, and the crew of Apollo 11. The Commission congratulates these applied research programs for their work, and encourages further research by DOT and NASA to improve safety of aviation in the Arctic. The Cold Climate Housing Research Center (CCHRC) is a partnership between the university and industry to conduct research to advance understanding and application of cold climate housing principles. CCHRC's own research plan can support the IARPC approach.

The Commission includes baseline mapping of the Arctic in the topic of "civil infrastructure" for obvious reasons, such as the impact, over time, of erosion, storm surge, and inundation of coastlines. Maps provide essential data necessary to conduct scientific research in support of civil infrastructure. The State of Alaska created SDMI and charged it with developing and implementing a plan to upgrade the state's digital imagery and elevation data. Currently, these framework data sets for Alaska are well below national quality standards and are outdated; the most recent statewide aerial imagery acquisition occurred in the early 1980s. New and higher-quality imagery is essential for understanding landscape changes that have occurred due to climate warming and development, and provide a needed current baseline against which future change can be assessed. The only statewide digital topographic data for Alaska was generated by digitizing 1950s vintage USGS quadrangle-scale map products and have local horizontal errors that exceed 1 km. SDMI received state support over the last three years during which it collected all available digital high-resolution imagery and elevation data and lifted licenses so that all state and federal agencies, native organizations, educators, and researchers have access to these data sets through the Web. Given the early and significant success of this program, USARC encourages Alaska to continue to fund SDMI and to broaden the program's scope such that it becomes an integral component of SAON and AON activities as appropriate.

With respect to oil spills, the Commission has worked not only to identify a research agenda, but also a potential source of funding—the Oil Spill Liability Trust Fund—which is authorized to support US oil spill research programs but is seldom used to any great degree. We also learned that the OPA90's ICCOPR, chaired by USCG, seldom meets, does not publish its meeting agenda or minutes, and does not have an updated national research plan, as called for by OPA90. Yet, when an Arctic Ocean offshore lease sale commands $2.7 billion in bids, as it did in early 2008, the nation should certainly find the means to improve spill prevention and response techniques and to have better baseline research on the fate and effects of oil spills, and the restoration of Arctic environments.

The Commission has engaged in constructive dialogue with many players, and concludes that an oil spill research agenda would be relatively easy to put together if funding for research is made available (see white paper on this topic at http://www.arctic.gov). Participants that would be involved in such a program include USCG, NOAA, NSSI, MMS, OSRI, NOAA, DOT's Office of Pipeline Safety, and the State of Alaska.

ABOVE. Coastal erosion.
(Photo credit: C. Arp, USGS)
LEFT. Wind power near Kotzebue.
(Photo credit: J. Farrell)

Retrogressive thaw slump.
(Photo credit: B. Molnia)

The Commission chair and staff visited with principal investigators at the Joint Industry Program at SINTEF, Trondheim, Norway, where oil spill response techniques were tested in spring of 2009 in ice-covered waters, with the support of the US government and industry. Former Commissioner Walter Parker attended the 2009 Arctic Marine Oil Pollution conference, hosted by Canada, on the Commission's behalf. In March, 2008, as part of the *Arctic Marine Shipping Assessment* (AMSA, 2009), the NOAA Coastal Response Research Center (CRRC) at the University of New Hampshire held a workshop, "Opening the Arctic Seas: Envisioning Disasters, Framing Solutions," with the encouragement and support of the Commission and other agencies. The Commission helped organize a US-Canadian conference held in Anchorage in October 2008 called, "Northern Oil and Gas Research Forum '08, Current Status and Future Directions for the Beaufort Sea, North Slope and Mackenzie Delta," to bring researchers on this topic and others together.

And, finally, on the topic of marine transportation, USARC has devoted a significant amount of time to identifying needs for Arctic research. We have held extended conversations with MARAD, USCG, and others, and worked with MARAD on a 2008 Arctic Transportation Conference. We have worked extensively with the US Navy/NOAA/USCG Joint office and the National Ice Center to sponsor three symposia on "Impacts of an Ice-Diminishing Arctic on Naval and Maritime Operations." The Commission is proud to have provided, with our former Deputy Director Dr. Lawson Brigham, leadership for the Arctic Council Protection of the Arctic Marine Environment Working Group's *Arctic Marine Shipping Assessment*, available at the USARC Web site http://www.arctic.gov. We have been briefed by Congressman Don Young on his sponsorship of implementing legislation for the *Arctic Marine Shipping Assessment*, and appreciates how it would support research for "safe, secure, and reliable" Arctic shipping.

The creation, by the Department of Homeland Security, of a new Center of Excellence for Island, Maritime, and Extreme Environment Security (CIMES) is a promising step toward ensuring security and disaster mitigation as marine transportation continues to expand across trans-arctic routes. CIMES is a partnership among the University of Hawaii, UAF, and University of Puerto Rico Mayagüez, with UAF holding the role of developing monitoring capabilities to discriminate and track marine vessels and oil spills in ice-laden waters and under extreme conditions of cold and dark.

RECOMMENDATIONS

First, USARC commends IARPC for commissioning and CRREL for leading the development of an integrated Arctic infrastructure research plan. We urge that process to continue to completion with the broad participation discussed in this report, and to provide good targets for congressional funding in years to come. Infrastructure research should include government staff scientists, engineers, and contractors, "extramural" competitively funded university researchers, and private industry. As government agencies fund much of the infrastructure needs of the Arctic, we encourage these agencies to adopt research findings through pilot projects in their normal course of business.

Second, the Commission recommends IARPC work with the State of Alaska to support the State's adaptation research agenda to respond to the dramatic effects of climate change.

The emerging federal research program in this area should integrate with and support these efforts, which include protecting communities from erosion, and adapting buildings and civil infrastructure to thawing permafrost. Information on the process and findings can be reached at http://climatechange.alaska.gov.

Third, the Commission recommends the President, Congress, NOAA, and USCG take steps to ensure the US oil spill research program meets the promise of the Oil Pollution Act of 1990. The Commission urges use of the Oil Spill Liability Trust Fund, which collects eight cents per barrel on domestic oil production and imports, as authorized, to support a significant new funding stream for oil spill research in the Arctic. We recommend a target of at least $10M per year, to be made competitively available, for Arctic/Subarctic spill research on an agenda to be adopted jointly by IARPC, ICCOPR, with the participation of the State of Alaska, the North Slope and Northwest Arctic Boroughs, OSRI, CRRC, and industry operating in the Arctic region. This research should support improvements in prevention, response, and remediation of oil spills in ice-covered waters and help resource management agencies integrate spatial planning into spill prevention and response in the Arctic Ocean.

We have urged Congress to "inflation proof" the OSRI "endowment" in the Oil Spill Liability Trust Fund, to raise its principal from the $23 million set aside in 1990 to at least $35 million.

We urge Congress not to change the leadership of the ICCOPR, but to use its oversight to make sure it meets regularly, is transparent in its deliberations and decisions, and that a national plan as well as an Arctic regional plan are developed and funded. If Congress chooses to create a Regional Citizens Advisory Committee for the Arctic Region, as it has with Prince William Sound and Cook Inlet, we would urge that committee to include USARC representation, to have a science budget, and to work closely with entities planning and carrying out oil spill research in the Arctic region.

Fourth, the *Arctic Marine Shipping Assessment*, completed by the eight Arctic nations in spring 2009, identifies the research necessary to address the opportunities and challenges of Arctic shipping (AMSA, 2009). IARPC should include this research in its infrastructure research plan, and US DOT and other agencies should identify means to provide competitive extramural funding to carry out the research.

Fifth, since the Commission's 2007 goals report, the conventional and renewable energy potential of the Arctic has been further assessed and shown to be dramatic. The Commission recommends that DOE include the Arctic Energy Office in its core budget, and that it be placed within the DOE organization such that it has authority to continue sponsoring fossil energy research as well as to expand its role into sponsoring renewable energy research. (The Commission was not consulted by DOE when it cut funding for the Arctic Energy Office, though that consultation is required by law.) Through this office and other DOE programs, the Commission urges research related to capture and production of Arctic methane and methane hydrates (both onshore and offshore). Five of the eight Arctic nations, including the United States, are members of the International Partnership for the Hydrogen Economy. Given the challenges of dealing with Arctic marine oil spills and black carbon in the Arctic, and given that Arctic shipping requires specialized vessels to begin with, the Commission urges the United States and its partners to institute pilot projects on alternative-fueled fishing and commercial vessels in the Arctic region. Finally, the Commission acknowledges that NREL has established an Alaskan research program that can further address the dramatic wind, wave, tidal, geothermal, and biomass potential to serve the many "off the grid" Arctic communities with stable-cost power and to provide new methods to export energy from the Arctic. We urge appropriate funding of that program once a plan is developed.

Sixth, federal and state efforts to cooperate in providing an imagery database and digital elevation model are promising and could be successful in bringing Alaska's maps up to the standard seen by the rest of the nation. Federal and state governments are urged to agree upon and fund a coherent plan for mapping the US Arctic that federal and state agencies, the research community, and the public can rely on.

Red Dog Mine.
(Photo credit: J. Farrell)

4 NATURAL RESOURCE ASSESSMENT AND EARTH SCIENCE

As has been clear since the 1968 discovery of North America's largest oil and gas reservoir at Prudhoe Bay in the Alaskan Arctic, subsequent discoveries and a recent assessment of oil and gas potential by the USGS, the Arctic is rich in conventional energy. Arctic tidal, geothermal, wind, wave and biomass energy potential are also strong. There are large deposits of mineral deposits in the Arctic, including gold, diamond, lead, zinc, nickel, iron ore, and molybdenum. The Arctic's living resources are diverse, with some the largest mammals (Moore and Huntington, 2008), biggest herds, richest fisheries (as the Bering Sea is in the "Arctic"), and longest migrating species of birds making their homes there. Most of these resources are found on public lands. As a significant owner of Arctic resources, the United States has a responsibility to know what it owns, to understand basic biology, geology, and natural history of its assets, and to understand the population dynamics of the living resources it manages—alone, or in concert with the State of Alaska and other nations.

Toward this end, the Commission recommended first in its 2003 goals report that IARPC adopt a Resource Assessment Theme in the US Arctic Research Program. In later reports, the Commission amended this theme to include basic earth science. Leadership within IARPC for developing this research plan was taken on since the last goals report by USGS.

The Commission, in its deliberations with the public, industry, government, and academic community, finds at least three elements that should be in a resource assessment and earth science research plan, including:

- An assessment of the mineral and energy resources of the Arctic region, especially those on public lands of the United States and Alaska
- An assessment of the living resources of the Arctic region, especially those on the public lands of the United States and Alaska, and those that migrate across national borders
- An earth science plan that takes into account the major geographic and geophysical "unknowns" of the Arctic region, including the geology and tectonics of the Arctic Ocean and the Bering Sea, and studies of the magnetic pole and the magnetosphere

The Commission finds that the US government has a spotty record of keeping one research promise required by the Alaska National Interest Lands Conservation Act (ANILCA) of 1980. That act, which ended one of the loudest environmental debates in Congress, set aside large areas in Alaska for national parks, monuments, wildlife refuges, and wild and scenic rivers. Set as a compromise while millions of acres were set aside from development, ANILCA calls for a continuing Alaska Mineral Resource Assessment Program (AMRAP) to determine the mineral potential of Alaska's public lands. Our recommendation that DOI restore core

funding for this program, and that IARPC include AMRAP in an Arctic Research Program Plan, is based on the requirements of this law.

Earth science initiatives should continue to incorporate fundamental geophysical and geological research (especially in the Arctic Ocean) so that as a nation, we understand our land, its value, and the extent of our offshore sovereignty beyond the current EEZ. The United States and the four other Arctic coastal nations are currently in the midst of drawing new sovereign borders in the Arctic Ocean, and the United States may gain an area of Arctic undersea territory that is roughly the size of California. In this vein, USARC supports US accession to the United Nations Convention on the Law of the Sea, and the interagency Extended Continental Shelf Mapping Initiative.

The Commission continues to urge the Obama Administration, the Department of Defense (especially the Navy), and affiliated entities to continue efforts to declassify military data for civilian scientific purposes. Declassification of bathymetric (water depth) data, collected by US nuclear submarines, has significantly improved our understanding of the Arctic Ocean, and the construction of maps, and to help define the nation's offshore sovereign boundary. The Central Intelligence Agency's recent resurrection of the scientific group MEDEA (Measurements of Earth Data for Environmental Analysis), which searches intelligence data archives for information that can be publicly released in order to shed light on environmental change, is also an encouraging development.

While we have addressed Arctic mapping and gas hydrates research in the Arctic Infrastructure portion of this report, it may be appropriate for those research objectives to join the Resource Assessment and Earth Science program plan as well. Our recommendation for core DOI and congressionally created long-term funding for NSSI will support resource assessment and earth science under this theme, as well as the climate and infrastructure research programs covered by other themes. The Commission was not consulted, as the Arctic Research and Policy Act requires, when the government's FY 2009 spending plan for NSSI was revised down and the 2010 budget for NSSI was significantly cut.

Since the last USARC goals report, the Commission has worked with and heard from leaders of the Integrated Ocean Drilling Program (IODP), which conducts deep ocean drilling for earth science and deep biosphere science objectives around the world. The Commission notes with dismay the challenges IODP has had in gaining access to Bering Sea drill sites within the Russian Arctic EEZ to conduct

RIGHT. Picking berries. (Photo credit: B. Molnia)
BELOW. Piloting C-130. (Photo credit: J. Farrell)

marine scientific research, and in the science infrastructure recommendations, the next section of this report, we recommend diplomatic approaches to solving this problem.

In 2008, the Commission visited the HIPAS Observatory, outside of Fairbanks. There, we were briefed on magnetosphere and aurora studies, including research on the exchange of ionized particles to and from the atmosphere though the workings of lines of force emanating from the magnetic north pole. The Commission has also been briefed during its field visits to Svalbard and meetings on the Oregon State University campus on other magnetosphere research being conducted into the Arctic. The polar regions are the only venue on Earth where some of this research may be conducted. Development and incorporation of a magnetosphere research plan under this theme will be useful in determining our research infrastructure and funding goals for the coming years.

DOI committed USGS employees in Anchorage to take a leadership role in developing this thematic research plan for IARPC. Their effort is supported within the larger DOI. To obtain information from others, USGS will send survey letters to the appropriate federal and state agencies to better understand each organization's 20-year vision for resource assessment, the level of support for such assessment, partnerships, staff levels, and the requisite infrastructure. The results of this information-gathering effort were discussed at DOI meetings in 2009, and will be turned into an integrated plan to report to IARPC.

RECOMMENDATIONS

First, the Commission commends the DOI's USGS for its leadership in assembling a research plan under the theme Resource Assessment and Earth Science, and urges it to include assessments of Arctic energy and minerals, assessments of Arctic onshore living resources, and an Arctic earth science plan, with clear goals allowing appropriate funding decisions to be made.

Second, the Commission applauds the leadership taken by the federal government's interagency ECS Task Force to identify claims the United States may make to dramatically increase its territory in the Arctic Ocean. The Commission has urged ratification of the United Nations Convention on the Law of the Sea so that US scientists may be part of reviewing other nations' claims in the Arctic.

Third, the AMRAP, required by ANILCA, should be funded in core agency budgets of the nation's public land management agencies within the Departments of Interior, Agriculture, Defense.

Fourth, the Commission urges DOI to institute and maintain a basic level of funding for this NSSI program. Congress created NSSI as a collaborative research program to support integrated, ecologically sensitive land management on the North Slope of Alaska. The Commission thinks the government should find a "dedicated" source for NSSI as it has for the NPRB, the Prince William Sound OSRI, and the Denali Commission so that long-term science commitments can be made.

Transporting zinc ore at the Red Dog Mine port. (Photo credit: J. Farrell)

ABOVE. Nikaitchuat Ilisagvik school children singing Inupiaq songs in Kotzebue, Alaska. (Photo credit: J. Farrell)
RIGHT. Life is good. (Photo credit: M. Robards)

5 INDIGENOUS LANGUAGES, CULTURES, AND IDENTITIES

Language helps us define the cultural diversity of our planet and serves as the strongest pillar to our diverse cultural heritage. Language is a fundamental indication of who we are, that is, of our identity. Although critical, language is one of the most vulnerable elements of our cultural being. Some languages expand and grow, so that their speakers number in many millions, whereas many minority languages decline and even become extinct, such as when the last native speaker of the Alaskan language Eyak died in January 2008. Of the thousands of known languages, fewer than 10 are used by nearly 60% of the global population and more than 500 are extinct. When speakers of endangered minority languages switch to other languages as their mode of communication and education, huge amounts of cultural information can be lost forever, including historical data, place names, and clues to changing natural phenomena, such as climate conditions or wildlife population levels. A peoples' cultural identity is endangered by language loss.

In the US Arctic, language vulnerability is especially acute in the current generation. Indigenous people are being separated from their cultural past. As many indigenous languages do not have long-standing written traditions, the cultural legacy they carry—as well as the languages themselves—are poorly recorded. Languages passed down by the spoken word, rather than the spoken and written word, cannot be easily enhanced via the most common societal means, such as formal education, public programs, book printing, and writing. This creates a volatile mix, and the loss of language invariably impacts cultural tradition, human history, and traditional ecological knowledge. These losses prompt a shift in the cultural and identity of younger generations.

Without a research plan to address Arctic language, cultural preservation, and revitalization, the path to language extinction in the North is likely to shorten. The thematic addition of languages, identities, and cultures to the US Arctic Research Program Plan should address the following goals, originally proposed in the Commission's 2007 goals report:

- Regular, permanent census processes to understand the diversity of languages spoken by Arctic people, and the viability of those languages for future generations
- Documented procedures to ensure that languages and place names spoken and given by Arctic people are recorded, preserved, and transmitted
- Defined policy options and processes for language preservation that have succeeded in the Arctic and elsewhere are made available to Arctic policymakers and residents

RECOMMENDATIONS

First, the Commission applauds IARPC for the attention it has given the goal of developing a research plan and program for indigenous languages, identities, and cultures. The Commission urges one agency among likely participants—NSF, the National Endowment for the Humanities, the Department of Education, DOI's Bureau of Indian Affairs, the Smithsonian Institution—to take clear leadership in establishing this research plan. IARPC is behind in meeting even its initial target of a status report on common goals and objectives in the area of indigenous languages and cultures, set for September 2007. A research program plan can take advantage of congressional initiatives supporting immersive language study of indigenous languages in the nation's schools, an Arctic Council initiative to derive best practices around the North, and other efforts by United Nations agencies such as UNESCO to help preserve cultural heritage in the North.

Second, to better achieve these goals, the Commission proposes the following new tactics and strategies:

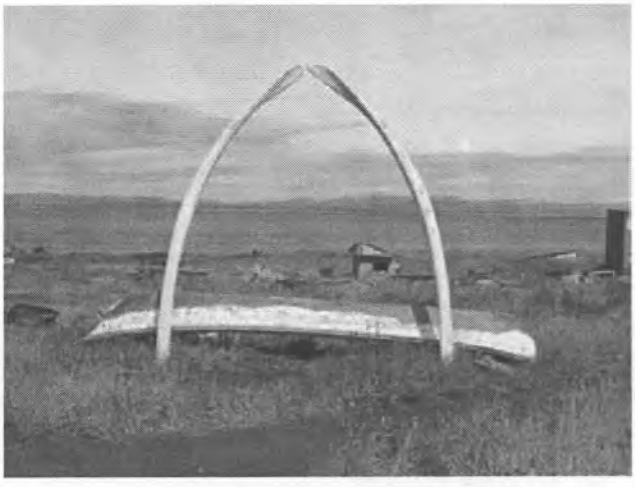
- DEVELOP NEW APPROACHES: Promote new interdisciplinary and cross-agency initiatives that integrate language documentation with language support, education, heritage preservation, cultural and museum research, outreach and public programs. An excellent example of this is the "Endangered Languages and Indigenous Knowledge" initiative of the National Museum of Natural History and the Smithsonian Institution. With respect to research, this effort will coordinate the study and promotion of indigenous languages by Smithsonian scholars in understanding the world's cultural and natural diversity, its origins, and functions on a variety of scales, focusing specifically on indigenous systematics, classifications, and natural world observations; the analysis of language structures, especially the general principles of human language and most clearly seen in endangered languages; and documentation and broadly accessible databases.

- COLLABORATE AND SHARE: Create a database of current programs run by various federal agencies in support of northern indigenous languages, cultures, community health and wellness, sustainable ways of living; expand interagency and inter-program collaboration, data and resource sharing; make information about ongoing efforts and opportunities at the federal (and state) level available to prospective users, researchers, and communities.

- MAKE GOOD USE OF AVAILABLE RESOURCES AND BEST-WORKING PROGRAMS: Identify resources that are critical to the efforts in support of indigenous languages, cultures, and identities (e.g., certain libraries, museums, archives, heritage databases, public programs, individual elders, and knowledge keepers); research policy options and processes for language/culture preservation that have succeeded in the Arctic and elsewhere, so that they can be made available to Arctic policymakers and residents.

- INCREASE VISIBILITY: Put support for local languages, cultures, identities, and community well-being firmly among the priorities of federal programs focused on the North; measure program success by the products with the lasting impact on the ground rather than by the amount of money spent.

- INCLUDE STAKEHOLDERS IN THE DECISION MAKING: Expand the role of local/indigenous advisers to federal programs in support of northern languages, cultures, and community well-being; use local offices of federal agencies for public outreach and feedback, including tribal consultation, to the many ongoing efforts.



Bowhead whale jawbone arch in Kivalina, Alaska.
(Photo credit: J. Farrell)

ABOVE. Sun dog. (Photo credit: M. Dunn)
RIGHT. Surveying sea ice conditions. (Photo credit: J. Farrell)

INITIATE RESEARCH ON EMERGING TOPICS

The rapidly evolving Arctic region presents a wide variety of important topics that require scientific research in order to provide information to decision makers. Such topics include:

- ALASKA NATIVE POPULATION STATISTICS. What are the key causes of death in Alaska Natives and especially in youth? What is the true incidence of suicidal behavior, self-destructive acts, and alcoholism? What is the death rate of Alaska Natives and the rate of migration to urban settings? Why is the incidence of alcoholism so high in indigenous peoples? What are the effects when multiple stressors, such as socioeconomic pressures and high-latitude conditions, that are evolving in response to climate change? What are the best counter-measures to reduce alcoholism and suicide in this vulnerable population? What techniques are most successful throughout the world to sustain native populations and how might they best and most expediently be adapted to the US Arctic population?

- CARBON SINKS, SOURCES, AND FLUXES IN THE ARCTIC. Given the large and increasingly active reservoirs of carbon in the Arctic, such organic carbon locked in permafrost, and methane sequestered in gas hydrate deposits, scientists need to develop a better understanding of carbon cycling, and its associations with climate and environmental change. Attention must also be paid to understanding and mitigating the impacts of black carbon in the Arctic and to quantifying, by monitoring, the efflux of carbon to the atmosphere from Arctic environments.

- ARCTIC FISHERIES. Climatic-induced changes in ocean temperatures and other properties are changing the ecosystem, and may be contributing to the migration of fish stocks. Our understanding of the standing stock of fish in the Arctic is minimal. What's there now? What stocks are moving in, or out? What is the health of the stocks and what threats do they face? What are the needs of subsistence fishermen?

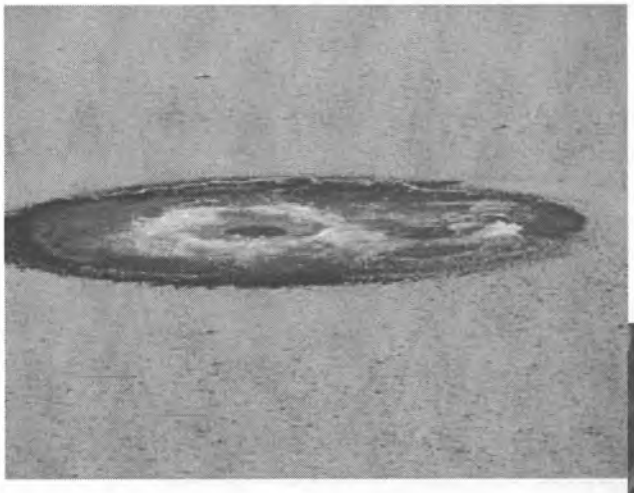
- AUTONOMOUS UNMANNED SYSTEMS. Application of these aerial and marine technologies has great promise in the Arctic given the remoteness of the region, and the difficult and dangerous operating environment. Specific applications include surveying for forest fires, observing marine mammals in a nonintrusive manner, and making environmental observations over much greater areas than previously possible. Research into increasing endurance, expanding operational environments, developing sensors and detectors, and developing novel deployment and retrieval methods are a few lines of inquiry.

- RENEWABLE ENERGY. Energy costs are volatile in the short run, but are increasing overall, which places greater emphasis on developing renewable energy, particularly in remote Arctic environments. Research needs to be conducted on how to adapt renewable technologies, such as solar power, wind power, hydroelectricity, micro hydro, hydrokinetic, biomass, and biofuels, to and for Arctic environments. Research is also needed to address issues such as "next generation" batteries that can work effectively in cold weather conditions, and the effective electrification of off-road vehicles such as all-terrain vehicles, snow machines, and small boats and outboard motors.

- NOVEL APPROACHES TO FOSSIL ENERGY. Fossil fuel development is core to the economies of most Arctic nations, and directed research can reduce the impact of Arctic fossil fuel development on the environment. Promising new or alternative methods of exploration, production, transportation, and carbon sequestration that were presented to the Commission in the last two years include advances in directional drilling, efforts to reduce noise or change the seasons for seismic surveying, prospects for using tunneling and other mining techniques to take oil development underground, eliminating the need for above-ground facilities in wildlife refuges, and an expanding practice in offshore Arctic underwater oil and gas production facilities. Transport improvements that may be attainable include novel means to protect subsea pipelines from ice scour, the use of rigid airships (developed, in part so far, with NASA and DOD funds) to move heavy equipment and materials into remote sites, and use of remotely piloted vehicles for wildlife monitoring. Potential Arctic-specific carbon capture and sequestration techniques have also been shown to the Commission. Given that much of the oil, heavy oil, gas, shale gas and gas hydrates, coal, and coalbed methane deposits to be found in the US Arctic are on federal lands, the Commission thinks research into these promising techniques should be undertaken in concert with industry, the State of Alaska, and international partners in producing and consuming countries.

- EMERGING INFECTIOUS DISEASES. The risks from an avian flu, and from other new, previously unknown, and in some cases drug-resistant infectious diseases pose a significant threat to global health. Such diseases have emerged in Alaska, and elsewhere in the Arctic, and in some cases vector through the Arctic via migrating populations. Some Arctic birds are thought to harbor bacteria that carry antimicrobial drug-resistant determinants.

- BIOACCUMULATION OF TOXINS. Research is required to assess and monitor the levels of toxins, such as mercury, and other contaminants in game and fish stocks, most recently halibut, heavily relied upon by Alaskans for food, and ultimately to determine methods to minimize such contamination.



ABOVE. Seal hole. (Photo credit: M. Dunn)
RIGHT. Bering Strait starfish. (Photo credit: K. Crane)

- ARCTIC BIOPROSPECTING. A report by the United Nations University Institute of Advanced Studies reports that private entities are searching for and developing products and treatments from DNA found in Arctic plants and animals. New products include ice cream and anti-stroke medications. One company has used "antifreeze proteins" collected from Arctic organisms to improve the texture, taste, and safety of frozen foods. Another company is attempting to use proteins from the arctic squirrel, which can lower its temperature to below freezing, to help stroke victims recover more quickly.

- MARINE MAMMAL RESEARCH. Biologists contend that the rapid decrease in summer sea ice extent and thickness, particularly over the last few years, is negatively impacting marine mammal populations. Research is needed to better understand whale, walrus, polar bear, and seal populations, and how they are responding to their changing environments. Issues that need to be addressed include: determining populations, their sustainability, and "take" levels; developing better means to collaborate and cooperate with indigenous peoples in marine mammal research; developing new methods to track the movements of individuals and populations; better projecting climate change, environmental conditions, migration routes, and food habitats; and obtaining more frequent population counts.

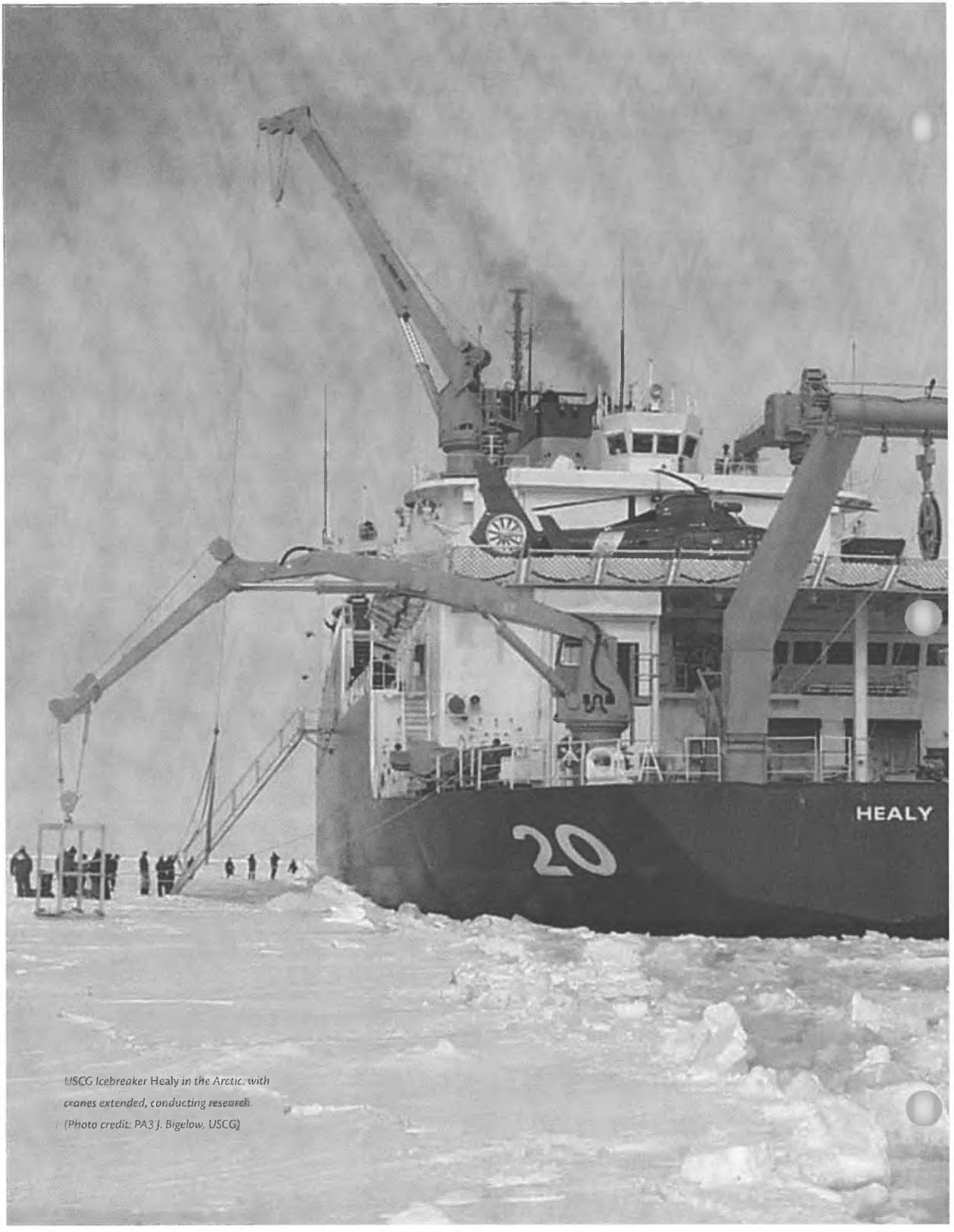
- GLACIER AND ICE SHEET DYNAMICS. Recent observations of smaller glaciers and the larger Greenland ice sheet suggest that climate warming is resulting in a much more complex set of dynamical processes than previously thought. Because the melting of this ice has the capacity to significantly impact global sea levels, research needs to address questions regarding the processes and rates of the dynamics in this part of the global cryosphere.

- SCALING ARCTIC RESEARCH. The scientific community has a rich legacy of studies focused on local, place-based studies. Although these studies are an important foundation for scientific understanding of the Arctic, there are a growing number of techniques and approaches that enable researchers to observe, simulate, and analyze trends over much large spatial scales, including the domain of the full pan-Arctic. Tangible strategies to bridge scales and to ensure a consistency of conclusions obtained from studies cast over often disparate temporal and spatial domain scales will be necessary before a full understanding of the behavior of the full Arctic system can be secured.

- ARCTIC EARTH SYSTEM MODELS. Many of the most critical strategic decisions facing policymakers involve the behavior of a highly coupled Arctic system, in terms of its biogeophysical as well as its human dimension elements. How well the scientific community can develop a coherent picture of how the full system behaves in response to continued greenhouse warming, loss of sea ice, and the implications of potential interventions associated with geoengineering—among many other rapid changes—will dictate the capacity of policymakers to mitigate, respond, and adapt to change. Due to its richness of processes, close coupling of subsystems, and sharp time and space boundaries, the Arctic portion of the Earth system becomes a particularly challenging one to simulate. Next-generation Arctic Earth System Models are stimulating new advances in process field studies, observational network deployments, and numerical and cyberinfrastructure capabilities, which together will improve the fidelity of these computer simulations and also enhance their capacity to create policy-relevant scenarios of the future.

- OBSERVING AND MODELING ARCTIC SEA ICE. Although this subject is not necessarily new, it demands greater attention given the overall decline, and the dramatic changes in sea ice extent and thickness over the past 30 years.

- GEOENGINEERING. We encourage and support international efforts to conduct research into the potential of climate intervention techniques, more commonly referred to as "geoengineering," for example, methods for carbon capture and storage and for solar radiation management. Research needs to assess how such techniques may be used to respond to climate change, and how to reduce the risks of deployment. It is imprudent to wait until there is a crisis before identifying potential climate intervention processes. Advanced study will help reduce the risk of such techniques, if and when it is necessary to use them. Such research does not alleviate the need to conserve resources, reduce greenhouse gas emissions, or to create clean technologies.



USCG Icebreaker Healy *in the Arctic, with cranes extended, conducting research. (Photo credit: PA3 J. Bigelow, USCG)*

Last mooring.
(Photo credit: M. Dunn)

RESEARCH INFRASTRUCTURE

REINVEST IN ARCTIC RESEARCH

FEDERAL AGENCY SUPPORT FOR EXTRAMURAL RESEARCH

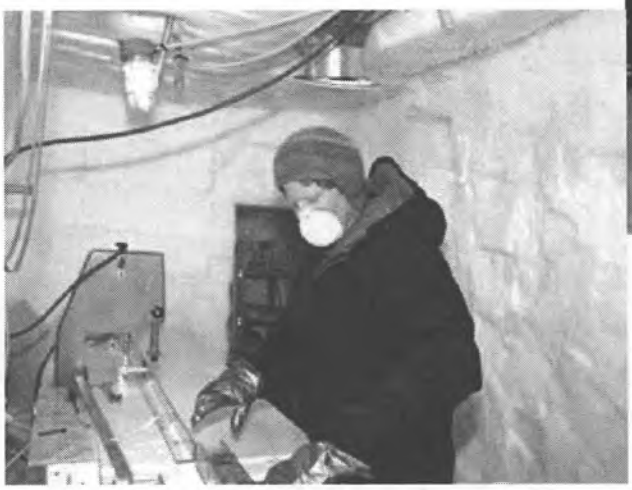
Sustaining a strong and vital government-sponsored Arctic research program requires federal agencies to set clear goals and objectives, establish robust leadership, and develop long-term, coordinated extramural support for research conducted by academic scientists. In light of budget challenges, however, many of the mission-focused government agencies have retrenched, and have cut support for extramural programs, or reorganized, in order to maintain internal initiatives. These changes do not necessarily serve the greater interests of Arctic research, especially in terms of educating and training future researchers and managers to deal with the challenges facing the Arctic.

The Commission reminds agencies of the following clause in public law: "All Federal agencies shall consult with the Commission before undertaking major Federal actions relating to Arctic research" (*Arctic Research and Policy Act*, SEC. 105. (c)). USARC will redouble efforts to work closely with agencies to encourage greater balance between extramural and intramural Arctic research. USARC commits to working with IARPC to ensure that this aspect of the law is followed, calling for an open budget process and a comprehensive and balanced approach.

SUSTAINABLE RESEARCH PROGRAMS BUILD HUMAN CAPACITY

It's all about people. A nation's most valuable resource is the vitality of its scientific workforce. Research requires scientists and technology experts. Despite broad and continued support for the President Bush's 2006 American Competitiveness Initiative, and Congress's America COMPETES Act to promote excellence in technology, education, and science, there has been, until 2009, a major, overall decline in the level of federal funding for peer-reviewed, investigator-driven, extramural Arctic research in Earth and ocean observations and marine ecosystem dynamics at a time when ocean policy, climate change adaptation, and sustainable fisheries management all require more.

This trend has been especially troubling because many educators and resource managers are approaching retirement and sufficient new scientists are not being taught and trained. Only a vibrant research and educational enterprise with consistent funding will attract a new generation of scientists to Arctic research that is critical to dealing with change already occurring in the Arctic. USARC asserts that Arctic research is essential in order for the United States to



LEFT. Mark Twickler, University of New Hampshire, working on chemical samples in the science trench at GISP2. (Photo credit: R. Alley)
ABOVE. Viewing sea ice from a USCG Hercules C-130. (Photo credit: J. Farrell)

adapt to change while simultaneously achieving its national competitiveness goals. Priority needs to be given to funding projects that help build the human capacity to conduct scientific research.

FUNDING AMERICA'S ARCTIC SCIENCE

Generally, as national science funding expands across the board, greater resources are available for the Arctic Research Program. In 2009, President Obama and Congress worked to expand financial support for scientific research, including that associated with the Arctic. The FY09 operating budget, and the President's FY10 budget both included significant increases in scientific research budgets, and the American Recovery and Reinvestment Act of 2009 (ARRA) also provided a significant boost for research. In particular, NSF's first ARRA-identified expenditure was funding for the Alaska Regional Research Vessel, recently named the R/V *Sikuliaq* [pronounced [see-KOO-lee-auk], an Inupiaq word meaning "young sea ice," an initiative that the Commission has long supported. Will this recent support endure? A recent history of appropriations provides appropriate, longer-term context for consideration.

The omnibus FY08 appropriations bill was passed by Congress and signed by the President in December 2007. For the fourth year in a row, federal investment in research declined in real dollars. Of particular concern in the development of this budget was that going into the House-Senate joint conference, increases of approximately 10% were requested for many of the various federal research agencies. The negotiations, however, resulted in only a 1.1% increase for one of the nation's key science support agencies, NSF. Given an expected inflation rate of 2.4%, there was a loss of 1.3% within this agency in real dollars. Similar decreases occurred at NIH and other agencies that sponsor extramural research.

These cuts were particularly troublesome during the first IPY since 1958, with the potential to mark a new milestone in Arctic research. Many IPY aspirations for new US research activities were not met, and these research needs continue.

The United States must fully address the research funding goals that President Obama presented in *The Audacity of Hope,* and that the previous president and the Congress endorsed in the American Competitiveness Initiative and the America COMPETES Act. USARC joins the American Association for the Advancement of Science in drawing attention to this serious condition. We encourage the President and Congress to continue their recent turn around in support, and to make it enduring.

Recommendation

President Obama's recent commitment (April 27, 2009 speech at the National Academy of Sciences Annual Meeting) to invest more than 3% of the gross domestic product in research and innovation is most promising, and the Commission strongly encourages Congress to help him achieve this goal.

DEVELOP AND SUSTAIN ARCTIC RESEARCH INFRASTRUCTURE

The term "Arctic research infrastructure" covers a wide range of basic physical and organizational structures integral to the scientific research enterprise. Below, we address a variety of observing networks, vessels, satellites, laboratories, research centers, and emerging technologies, such as autonomous vehicles used under the sea, and in the air. A great challenge in scientific research is maintaining an appropriate balance in financial support for infrastructure, and the associated management and operations budgets, compared to budgets to conduct the scientific research with data collected from such infrastructure.

Arctic Observing Network (AON)

As described earlier, USARC supports implementation and further growth of AON, and recommends collaboration with other Arctic nations and the International Arctic Science Committee (IASC) to integrate AON into the international global observing and data management systems, up to, and including GEOSS. Key government decisions are necessary now to implement the AON vision of the Committee on Designing an Arctic Observing Network (NRC, 2006).

Polar Icebreakers

USARC has long supported a strong and viable national icebreaker fleet, and has been an ardent advocate of a timely and rational replacement program for the aging vessels *Polar Sea* and *Polar Star*. All of USARC's key points in this regard were communicated to the NRC Committee on the Assessment of US Coast Guard Polar Icebreaker Roles and Future Needs. USARC is pleased to see that these points were incorporated into the report published by the Council in 2007 (NRC, 2007a).

- The United States should continue to project an active and influential presence in the Arctic to support its interests. This presence requires a US government polar icebreaking capability to assure year-round access throughout the region.
- National interest in the polar regions require that the United States immediately program, budget, design, and construct two new polar icebreakers to be operated by the US Coast Guard.
- Polar icebreakers are essential instruments of US national policy in the changing polar regions. To assure adequate national icebreaking capability into the future, a presidential decision directive should be issued to clearly align agency responsibilities and budgetary authorities.

These recommendations are consistent with NSPD-66/HSPD-25, released in 2009. Further, in 2010, after additional cost-benefit studies are complete, USARC urges the President and the Congress to commit to building two new polar class icebreakers to meet US needs in the polar regions.

Earth Observing Satellites

In concert with the latest NRC study (NRC, 2007b) on what AAAS calls "the crisis in Earth observation from space," USARC also expresses grave concern that the network of satellites upon which the United States and the world have relied upon for global observations is at great risk. These observations are critical for anticipating the impacts of global change as well as being essential for weather forecasting; hurricane and storm warning; management of agriculture, forestry, and fisheries; and national security. Budget cuts and reallocations at NASA and NOAA will decrease satellite missions by 40% by the end of the decade. As noted in the NRC study, this trend toward a sharply diminished US capacity in Earth observations had also resulted from an explicit redirection of NASA's priorities away from Earth observations and toward missions to the Moon and Mars.

USARC supports recommendations of the NRC study for restoring US capabilities in Earth observations from space to acceptable levels, including:

- Reconstituting specific key observation capabilities that have recently been deleted from scheduled NOAA satellite series
- Accelerating NASA's current launch schedule to shrink the data gaps implied by current plans

- Committing to the 17 highest-priority new Earth-observation missions, out of more than 100 candidates evaluated for the 2010–2020 time period

The study concluded that its recommendations could be funded until 2020 by returning the Earth science budget at NASA to its FY1998–2000 level and stabilizing the budget of NOAA's National Environmental Satellite, Data, and Information Service at only slightly above the FY07 level, adjusted for inflation.

The February 2008 news release by the Office of Science and Technology Policy about the Bush Administration's plans to significantly enhance the nation's civil Earth observation capabilities was encouraging. Reinstating critical climate measurement capabilities (once part of the National Polar-Orbiting Operational Environmental Satellite System effort) and funding a new set of space research missions in NOAA and NASA to advance our understanding of changes in Earth's climate, ocean, and land surfaces is a welcomed development that USARC encourages Congress and this administration to support.

Other Emerging Technologies and Observatories

As noted in the above-mentioned NRC reports, Arctic scientific research objectives frequently depend on platforms such as observatories, ships, submarines, satellites, aircraft, and other technologies to detect natural phenomena and to collect data. The Arctic presents a wealth of opportunities to test and employ research platforms on land, in the sea, and in the air. Much of this infrastructure, however, lacks support and long-term commitment. The need is especially keen when international consensus and investments are involved. Coordination will reduce costs and increase effectiveness. Therefore, USARC recommends that IARPC help lead an international assessment of Arctic research infrastructure needs, and then work with public and private institutions to make appropriate investments in new platforms to support the nation's Arctic research program.

The Commission supports the following infrastructure opportunities as vital. Some of these elements have been addressed (NRC, 2006) as AON elements, and others have recently been funded, such as the Alaska Regional Research Vessel:

- Alaskan Permafrost Observatory
- Barrow and Bering Sea Cabled Observatories
- Barrow Arctic Research Center
- Hydrological Sensor Systems
- Technologies—Telemedicine, Communications, and Wireless Sensing Networks
- Unmanned Autonomous Aircraft and Underwater Systems
- Alaska Regional Research Vessel (ARRV)

ABOVE. IODP Arctic coring expedition. (Photo credit: M. Jakobsson)
RIGHT. Ice coring. (Photo credit: M. Dunn)

REINVIGORATE THE INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE (IARPC)

The primary objective of the 1984 Arctic Research and Policy Act was to produce and implement a comprehensive national policy and plan for Arctic scientific research. To this end, the Act created USARC, which develops and recommends to Congress and the President an integrated national Arctic research policy, and biennially publishes a *Report on Goals and Objectives*. IARPC responds to the report by formulating a five-year *US Arctic Research Program Plan* and by revising it biennially.

Growing interagency relationships are reinvigorating IARPC under the leadership of the NSF Director. In light of evolving national priorities, this interagency effort is transforming. Participants are becoming actively engaged, and IARPC is strengthening its internal partnerships. We encourage regular meetings of IARPC, and active involvement with USARC and representatives from the Executive Office of the President (specifically, the Office of Management and Budget, the Office of Science and Technology Policy, the Council for Environmental Quality, and the Natural Security Council). In its efforts, IARPC should engage the public and endeavor to improve its strategic planning and integration of Arctic research across federal agencies. We also encourage IARPC to work closely with the National Science and Technology Council that plans and oversees other interagency research initiatives.

RECOMMENDATIONS

First, the Commission recommends that IARPC expand its membership and planning activities to include independent, federally created entities that can play a major role in Arctic research. The North Pacific Research Board, the North Slope Science Initiative, Alaska Ocean Observing System, and the Prince William Sound Oil Spill Recovery Institute—all created by Congress—are essential to making the goals of this report happen. The Denali Commission, also created by Congress, has the capability to support "pilot projects" that can advance research goals. Further, there is an increasing contribution to research by "community development quota" groups in western Alaska that exist as the result of federal fishing quota allocations.

Second, the Commission recommends that IARPC, under NSF's leadership, meet its statutory obligations and "provide the necessary coordination, data, and assistance for the preparation of a single integrated, coherent, and multi-agency budget request for Arctic research" as per Section 108 (a) 5 of the Arctic Research and Policy Act. This budget will be produced annually, in conjunction with the release of the President's budget. As per Section 105(c), IARPC agencies "shall consult with the commission before undertaking major Federal actions relating to Arctic research." The Commission supports bringing both IARPC and the Interagency Coordinating Committee on Oil Pollution Research under the umbrella of the White House NSTC.

Third, consistent with the two prior recommendations, the Commission asks that the White House Office of Science and Technology Policy and the Office of Management and Budget actively participate in integrating Arctic research plans and budgeting and budget reporting as explicitly called for in the Arctic Research and Policy Act of 1984.

LEFT. Nuclear icebreaker in the fog.
(Photo credit: J. Farrell)
BELOW. Launching a mooring.
(Photo credit: M. Dunn)

REVIEW AND REVISE US ARCTIC POLICY AND INTERNATIONAL COMMITMENTS

President Bush released a new Arctic Region Policy in January 2009 following a comprehensive two-year review and assessment that was recommended in USARC's 2007 goals report. This policy, designated National Security Presidential Directive 66 and Homeland Security Presidential Directive 25, builds upon the previous review, completed in 1994 (Presidential Decision Directive 26) during the Clinton administration. At that time, circumpolar cooperation was just getting started. The Arctic Council was established in 1996 as a high-level intergovernmental forum to foster and promote cooperation, coordination, and interaction among the Arctic States, including the United States, with the involvement of Arctic indigenous communities and other Arctic inhabitants on common Arctic issues.

We commend the Obama Administration for the initiatives it has taken to implement this policy. Some examples: The Ocean Policy Task Force has paid close attention to the imperatives of an increasingly accessible Arctic Ocean and the need to establish a baseline integrated ecosystem science program that can bring together and build upon significant work done to date. The US Navy completed an "Arctic Roadmap" that will provide a basis for Arctic research and operational investments in the decade to come. USCG has conducted a "High Latitude Study" and continues to advance its operations in the Arctic region. DOS has commenced negotiations on search and rescue cooperation in the Arctic and has announced an initiative with EPA to address black carbon and other short-term forcers of Arctic climate change.

We now know that climate change in the Arctic will impact research, civil infrastructure, energy supplies, indigenous cultures, fisheries, national security, and global transportation—to name a few. The policy in place mandates an integrated US strategy that will allow us to better adapt our goals and international commitments in the areas of research, safety, search and rescue, environmental protection, economic development, health and ecological risks, biodiversity, offshore oil and gas development, shipping activities, marine pollution, and cultural tourism.

ENGAGE THE NEXT GENERATION OF ARCTIC RESEARCHERS AND RESIDENTS

Many Arctic residents, and particularly indigenous peoples, contribute significantly to the success of scientific research efforts. Highly successful co-management agreements, such the Alaska Sea Otter and Sea Lion Commission, the Alaska Nanuuq (polar bear) Commission, and the Eskimo Walrus Commission, have been established with USFWS. These entities biosample subsistence-harvested marine mammals, thus providing researchers with valuable materials and data on animal populations and behaviors. Other forms of traditional and TEK provided by Alaska Natives have also been critical to success. Likewise, NOAA has a cooperative agreement with the Alaska Eskimo Whaling Commission to co-manage the subsistence harvest of bowhead whales. Similarly, this agreement provides researchers with valuable samples and data. Despite the importance of these research relationships, funding for co-management agreements, like extramural research funding, are often cut off when agency budgets tighten.

Communication and collaborative efforts need to be improved between researchers unfamiliar with Arctic people and local communities of indigenous Alaskans. Constructive and culturally sensitive engagement with the communities that provide logistical and other research support are critically needed, and will go a long way toward better communication and collaboration in future scientific research and policy efforts. Higher priority must be placed on incorporating and translating local traditional knowledge into scientific research issues that impact Arctic residents. Scientific progress is not a one-way street, from the Arctic outward. Instead, research results from studies of Arctic climate change, ecosystems, oceanography, human health, resource assessment, polar technology, and infrastructure must be communicated and disseminated back to Arctic residents in manners that best serve their needs.

USARC recommends renewed federal support for the Alaska Native Science Commission, which was established to bring together research and science in partnership with indigenous communities. The Commission recommends that IARPC agencies develop new mechanisms to create stronger collaboration with Arctic residents and the public at large. Too often federal agencies hold stakeholder meetings in Washington, DC, or other urban centers at times that conflict with local subsistence activities essential for Arctic communities. In addition, because travel from Arctic communities to Alaska urban hubs and beyond is costly, researchers and federal managers should seek out opportunities, such as the annual Alaska Federation of Natives meetings, to acquire input on research concerns of Arctic communities and user groups.

Communication among researchers, resource managers, and communities will lead to valuable collaborations that will assist in future research and in dealing with emergency situations. For example, in examining the response to the *Selendang Ayu* oil spill off Unalaska Island in the Aleutians, the key lessons learned were the need for more input from local organizations and individual community members, and better communication between the Unified Command and the local entities (Brewer, 2006).

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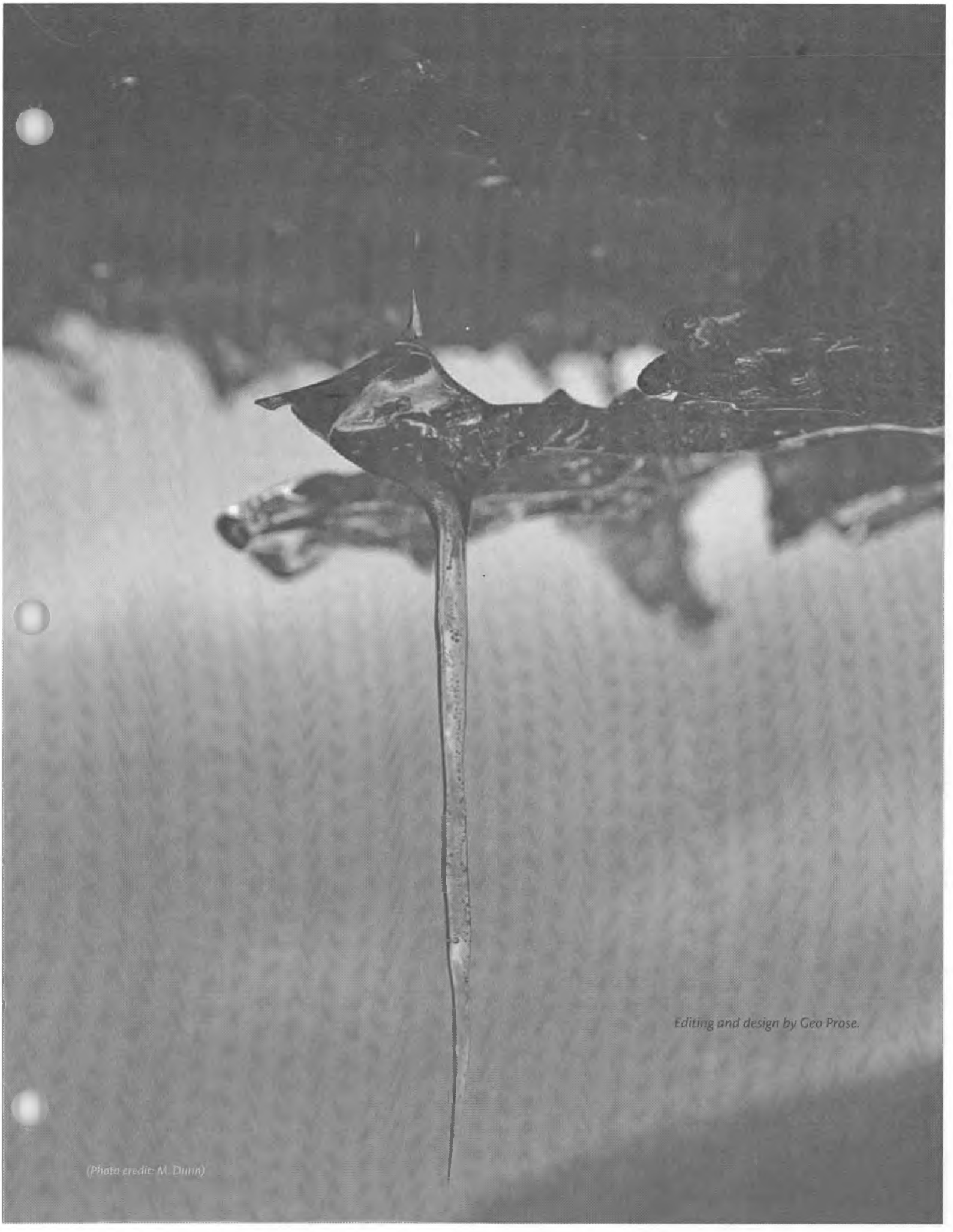

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WWW.ARCTIC.GOV

USARC OFFICES

VIRGINIA (WASHINGTON, DC) OFFICE
4350 N. FAIRFAX DRIVE, SUITE 510
ARLINGTON, VIRGINIA 22203
T-703.525.0111
F-703.525.0114
EMAIL: INFO@ARCTIC.GOV

ALASKA OFFICE
420 L STREET, SUITE 315
ANCHORAGE, ALASKA 99501
T-907.271.4577 OR 907.271.4576
F-907.271.4578
EMAIL: INFO@ARCTIC.GOV

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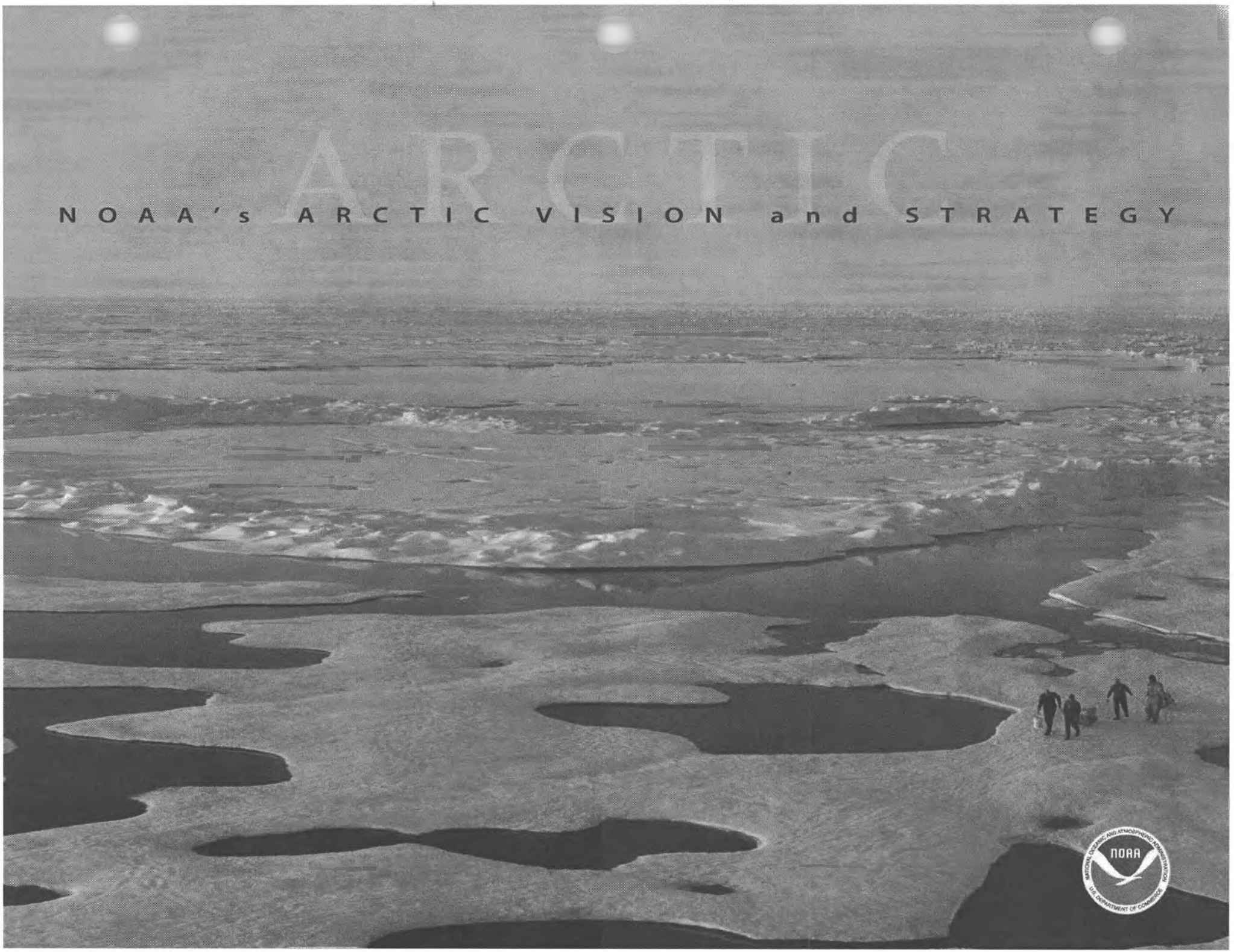
National Oceanic and Atmospheric Administration Report


ARCTIC
NOAA's ARCTIC VISION and STRATEGY
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

NOAA'S ARCTIC VISION & STRATEGY

National Oceanic & Atmospheric Administration
April 2010

NOAA Arctic Tiger Team

Laura K. Furgione
Assistant Administrator
Office of Program Planning and Integration

Douglas DeMaster, Ph.D.
Science and Research Director
Alaska Fisheries Science Center

John A. Calder, Ph.D.
Climate Program Office

Ashley Chappell
Office of Coast Survey

Amy E. Holman
Alaska Regional Coordinator

Elizabeth S. McLanahan
Office of International Affairs

James E. Overland, Ph.D.
Pacific Marine Environmental Laboratory

Jeremy M. Potter
Office of Ocean Exploration and Research

Tracy L. Rouleau
Office of Program Planning and Integration

NOAA's Arctic Vision and Strategy is a draft report that has been prepared for external review. Once feedback is obtained from partners and stakeholders who will benefit from these enhanced and coordinated efforts in the Arctic region, this report will be finalized.

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NOAA's Arctic Vision & Strategy

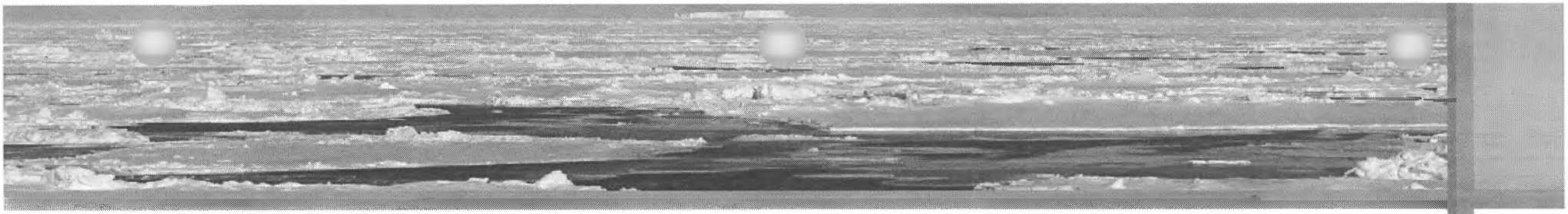
Executive Summary

"For centuries annual sea ice has protected the Arctic and its inhabitants. Now the Arctic, both on land and sea, is being transformed by significant warming. The melting of sea ice in the Arctic Ocean is happening at a faster pace than we had predicted, and an ice-diminished Arctic Ocean is creating many new opportunities. These opportunities must be pursued in ways that will ensure our precious ecosystems and Arctic communities remain healthy and resilient, now and for future generations."

The Honorable Dr. Jane Lubchenco,
NOAA Administrator and Under Secretary of
Commerce for Oceans and Atmosphere

The Arctic (Figure 1) has profound significance for climate and functioning of ecosystems around the globe. The region is particularly vulnerable and prone to rapid change. Increasing air and ocean temperatures, thawing permafrost, loss of sea ice, and shifts in ecosystems are evidence of widespread and dramatic ongoing change. As a result, critical environmental, economic, and national security issues are emerging, many of which have significant impacts for human lives, livelihoods, and coastal communities. Though NOAA has numerous and diverse capabilities that support these emerging issues, a strategic approach that leverages NOAA's existing priorities and strengths, as well as those of our national and international partners, is needed. This document provides a high-level framework and six strategic goals to address NOAA's highest priorities in the region. It is based upon assumptions that the region will: 1) continue to experience dramatic change, 2) become more accessible to human activities, and 3) be a focus of increasing global strategic interest.

NOAA envisions an Arctic where decisions and actions related to conservation, management, and use are based on sound science and support healthy, productive, and resilient communities and ecosystems. The agency seeks a future where the global implications of Arctic change are better understood and predicted.



NOAA will focus its efforts on the following six priority goals needed to realize this vision:

1) Forecast Sea Ice
2) Strengthen Foundational Science to Understand and Detect Arctic Climate and Ecosystem Changes
3) Improve Weather and Water Forecasts and Warnings
4) Enhance International and National Partnerships
5) Improve Stewardship and Management of Ocean and Coastal Resources in the Arctic
6) Advance Resilient and Healthy Arctic Communities and Economies

These goals were selected because they represent areas where NOAA can address urgent and timely issues that meet two key criteria: providing the information, knowledge, and policies to meet NOAA mandates and stewardship responsibilities, and providing the information, knowledge, and services to enable others to live and operate safely in the Arctic. Each goal also fulfills international goals and establishes, enhances, or leverages partnerships with other Arctic nations, international organizations, government agencies, and non-governmental organizations, academia, and local communities. The goals are also geared towards generating large societal benefits relative to the resources required and strengthening NOAA's engagement, politically, scientifically, internationally, and publicly.

NOAA will next develop and execute a five-year Arctic Action Plan to achieve these goals. Development and execution of the plan will require coordination across all NOAA Line and Staff Offices and collaboration with local, regional, federal, non-governmental, and academic partners. As a starting point, NOAA will establish a single point of contact within NOAA Senior Executive Leadership who will be accountable for achieving the Arctic goals. The Arctic Action Plan will also include an engagement strategy for reaching internal and external employees, partners, and stakeholders, as well as a detailed budget strategy. NOAA is committed to enhancing its current involvement in research and management programs in the Arctic, and anticipates an initial investment of $10 million towards the implementation of this strategy, recognizing that additional funds will be needed to achieve the goals.

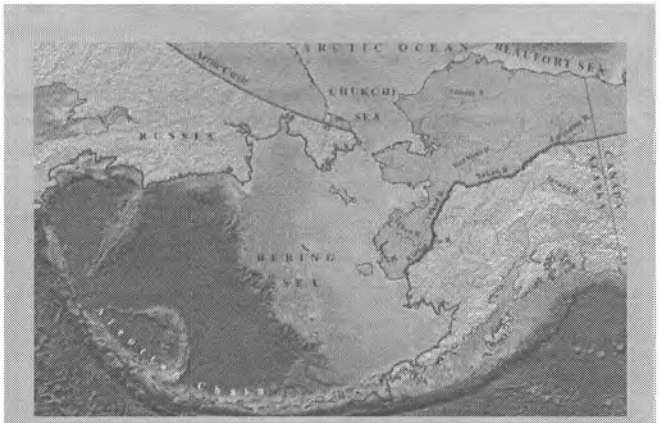


Figure 1. The Arctic: As used in this document, the term "Arctic" means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain. For purposes of this document only, this map illustrates the Arctic as defined under the Arctic Research and Policy Act and does not represent or reflect the position of NOAA with respect to the international boundaries and limits depicted therein. Map courtesy of the Interagency Arctic Research Policy Committee.

Introduction

Evidence of a Changing Arctic

There is now widespread and dramatic evidence of overall change in the Arctic region. Many of these observations are highlighted in the annual NOAA Arctic Report Card (www.arctic.noaa.gov):

- **Atmosphere** – Recent Arctic temperature increases are more than double those found at more southerly latitudes. The Arctic's 2008 annual mean air temperature over land was the fourth warmest on record, which continues a long-term upward trend.
- **Sea Ice** – Four of the last five years represent the lowest sea ice extents on record, with open water extending later into the fall prior to freeze-up. Thick multi-year sea ice has decreased 35 percent in the last five years.
- **Ocean** – From the Aleutian Islands to Barrow, Alaska, ocean ecosystems are shifting due to a combination of Arctic warming, large natural variability, and sensitivity to changing sea ice conditions.

These changes in Arctic climate have local to global implications. The Polar Regions, though physically remote from the population centers of the globe, have profound significance for the planet as a thermostat to stabilize the Earth's climate. They act not only as regulators of global temperature, but also as barometers of change. National security concerns are increasing as reductions in sea ice and other climate-induced changes bring increased opportunities for economic development and increased access to Arctic resources. These economic drivers, in turn, can further threaten ecosystems and Arctic inhabitants already impacted by the rapidly changing climate. The risks to national security and sound Arctic stewardship are further intensified because the science that underpins many of the decision-making processes and support services is largely inadequate.

International and domestic interest in the Arctic is increasing in concert with broader discussions regarding climate change, national security, and stewardship. Some examples include:

- The U.S. Government's issuance in January 2009 of a National Arctic Policy (National Security Presidential Directive (NSPD 66)/ Homeland Security Presidential Directive (HSPD 25),
- The November 2009 issuance of the Navy Arctic Road Map, developed by the Navy Task Force Climate Change,
- The Secretary of Commerce's February 2009 approval of the North Pacific Fishery Management Council's Arctic Fishery Management Plan, which prohibits expansion of commercial fishing in U.S. federal waters in the Beaufort and Chukchi Seas,
- Recent decisions on listings of Arctic marine mammals under the Endangered Species Act and Marine Mammal Protection Act,
- Establishment of the Extended Continental Shelf Interagency Task Force to support a potential claim as allowed under United Nations Convention on the Law of the Sea (2007),
- The State of Alaska's move to take immediate actions and plan longer-term research and operations addressing a broad range of impacts (Governor's Climate Change Sub-Cabinet 2007, Joint Alaska Climate Impact Assessment Commission 2007), and
- The Interagency Ocean Policy Task Force's recognition of the Arctic as an area of special emphasis in its interim report (see sidebar).

The *Interim Report of the Interagency Ocean Policy Task Force* (September 2009) identified "Changing Conditions in the Arctic" as an area of special emphasis, calling for the National Ocean Policy to "address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes." The interim report calls for "better ways to conserve, protect, and sustainably manage Arctic coastal and ocean resources... new collaborations and partnerships to better monitor and assess environmental conditions... improvement of the scientific understanding of the Arctic system and how it is changing in response to climate-induced and other changes." NOAA's strategic Arctic goals were developed to directly support the recommendations identified by the Task Force.

NOAA's Evolving Role in the Arctic:
Providing Critical Science, Services, & Stewardship to the Arctic & Partners

No single region better demonstrates the complex interdependence of communities and changing ecosystem conditions than the Arctic. The breadth and complexity of the cultural, societal, economic, and environmental impacts requires a concerted, systematic, and rapid effort with partners from local to international levels. NOAA provides vital Arctic science, services, and stewardship, including information and products that form a critical foundation for science and management of our trust resources in Arctic oceans and on the coasts–products that are essential for other agencies to succeed in their Arctic missions. However, achieving the Nation's Arctic goals requires strong integrated partnerships at all levels of governance. NOAA is building and continues to advance partnerships with several international, federal, state, and local partners and stakeholders focused on Arctic issues. Interagency and international cooperation should be an element of most of NOAA's Arctic activities and should be included in relevant project plans. Some elements of collaboration have general applications and need to be organized and conducted for the benefit of NOAA as a whole. In this category are participation in interagency working groups such as the Interagency Arctic Research Policy Committee, implementation and development of international agreements, and participation in policy-relevant activities focused on the Arctic.

Given our science, service, and stewardship responsibilities to Arctic residents and to the Nation, NOAA must engage its diverse and unique capabilities to rapidly address the emerging environmental, social, economic, and national security issues in the Arctic. NOAA's scientific capabilities can be deployed to increase our understanding of climate and assess key environmental trends; to predict the ecosystem response to those trends; and to offer the technical expertise needed to develop policy options and planning and management strategies for mitigation and adaptation to the environmental challenges in the Arctic region. NOAA's service capabilities are needed to support safety and security needs for fishing, marine mammal protection, transportation, energy, infrastructure, and mineral exploration in the unique Arctic environment. NOAA's legal and regulatory authorities and operational and international cooperation requirements will set the framework for delivery of our science, services, and stewardship.

Strategic Alignment of NOAA's Priorities

NOAA's Annual Guidance Memorandum, signed August 5, 2009, identified the need to "strengthen Arctic science and service" as one of the agency's five strategic priorities. The other four priorities include: 1) enhance NOAA's climate services and support the establishment of a National Climate Service, 2) support Coastal and Marine Spatial Planning, 3) ensure sustainability of marine fisheries, and 4) sustain satellite-based Earth observations. This Arctic strategy integrates the enhanced capacity provided by implementing NOAA's strategic priorities and positions NOAA to move forward in these areas. Concurrently, it aligns NOAA's Arctic goals to directly support priorities of our federal partners.

NOAA's Arctic Vision

NOAA envisions an Arctic where:

- Conservation, management, and use are based on sound science and support healthy, productive, and resilient communities and ecosystems; and
- The global implications of Arctic change are better understood and predicted.

Guiding Principles

The U.S. and its partners will greatly benefit from enhanced and better coordinated NOAA efforts in the Arctic region. Though NOAA's scientific interests in the Arctic are broad, this strategic framework establishes a limited set of guiding principles that emerged from the strategic planning process. NOAA Arctic activities in the next one to five years will:

1) Provide outcomes critical for other agencies to succeed in fulfilling their responsibilities and support the implementation of the National Ocean Policy,
2) Strive to better understand the linkages between oceans and climate,
3) Advance the implementation of ecosystem-based management and Coastal and Marine Spatial Planning,
4) Concentrate action in the Bering, Chukchi, and Beaufort areas, but be global in scope,
5) Enable, inspire, and engage our partners and stakeholders, both domestic and international,
6) Incorporate the value of traditional and local knowledge,
7) Integrate a coordinated education and outreach program that encompasses formal and informal education and the general public,
8) Incorporate new developments in science and technology, and
9) Anticipate, respond, and adapt to new and emerging issues of importance.

Arctic Goals & Strategy

NOAA's six Arctic goals are both integrated and crosscutting, and are designed to achieve NOAA's Arctic vision. The goals, and initial priorities described within them, were developed based on a set of criteria vetted across NOAA's Line Offices, Staff Offices, and Goal Teams; and derived from the Draft NOAA Strategic Plan for the Arctic. They are intended to support the goals and priorities of our federal and intergovernmental partners and stakeholders.

The goals first provide a foundation for improved research and understanding of the scientific underpinnings, climate changes, and dynamic feedback loops that are needed to support effective stewardship and address national security concerns. Increased scientific understanding and improved service delivery of predictions and forecasts, in concert with increased cooperation and collaboration with national and international partners, will result in more effective management of coastal and ocean resources and resilient and vibrant Arctic communities and economies (Figure 2).

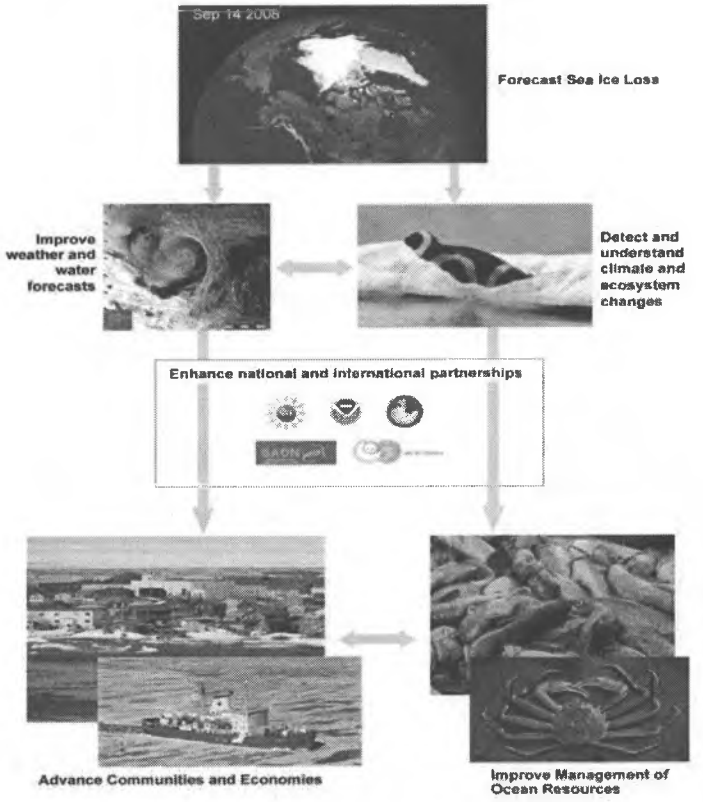


Figure 2. NOAA's Strategic Arctic Goals. This diagram illustrates the alignment and integration of NOAA's Arctic goals.

Goal 1: Forecast Sea Ice

Goal Statement – Accurate, quantitative, daily forecasts to decadal predictions of sea ice are provided to support safe operations and ecosystem stewardship.

Importance: Continued rapid loss of sea ice will be a major driver of large changes across the Arctic (Figure 3). The loss of sea ice affects marine access, regional weather, ecosystem changes, and coastal communities. Food webs are expected to dramatically shift between benthic-focused food webs and pelagic webs as ice cover diminishes. The understanding of ice as a habitat also has implications for oil spill response and damage assessment. As the Arctic Ocean becomes seasonally passable and tourism, oil and gas exploration, and shipping increase, floating sea ice will present a major threat to maritime safety and increase the potential for oil spills in the region.

Projections of a nearly sea ice-free summer by the end of the century, made just three years ago, have been revised recently and now indicate that ice-free summers may occur before mid-century (Figure 4). Arctic change is accelerated by the unique physical properties associated with sea ice loss, which acts to accelerate warming of the Arctic, driven by increasing greenhouse gases in the global atmosphere. Reduction in summer sea ice diminishes reflection

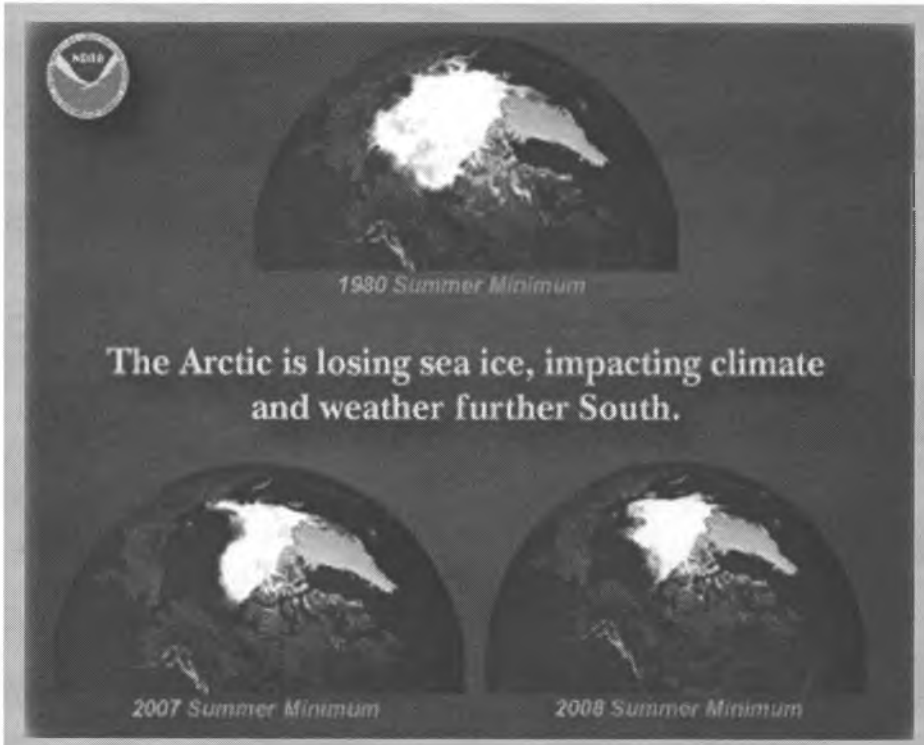


Figure 3. Arctic summer sea-ice cover has decreased over 35 percent over the last 30 years, and the amount of stable long-term multi-year sea ice has decreased by the same amount.

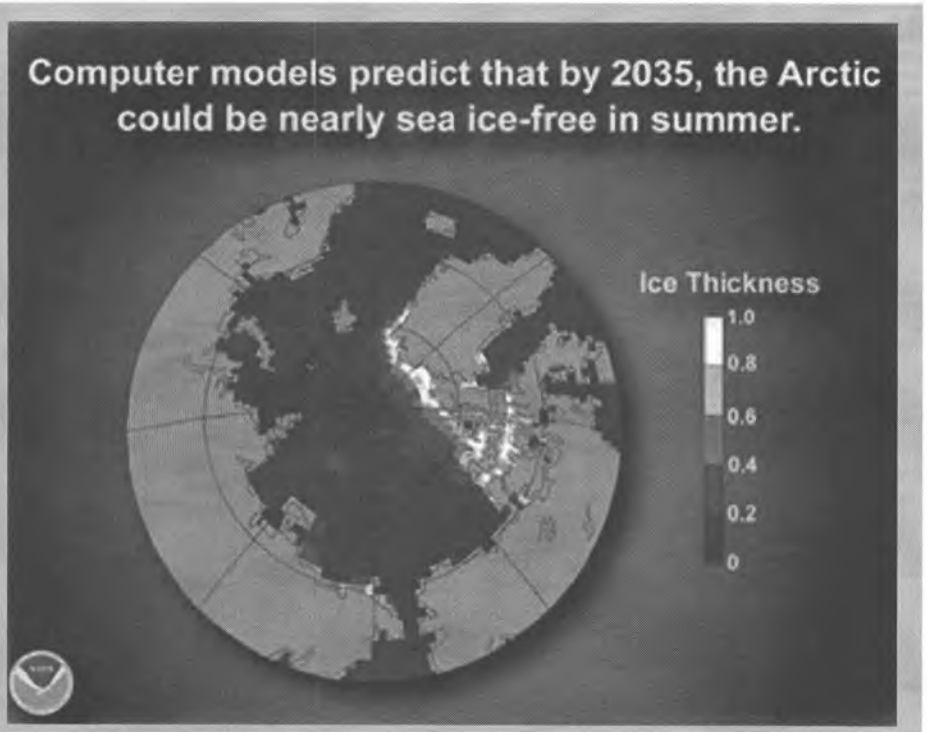


Figure 4. Model projections of sea ice thickness when the Arctic is nearly ice free, in September, within 30 years. Units for sea ice thickness are meters. Figure from Wang and Overland (2009).

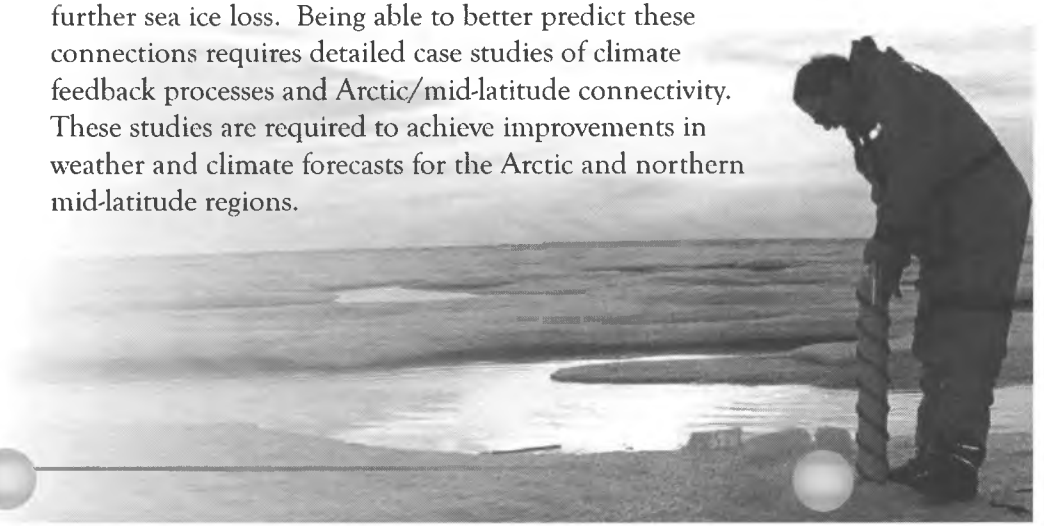
of solar energy and creates additional ocean heat storage in newly formed sea ice-free areas. Further, the additional heat stored in the ocean during summer is given back to the atmosphere the following autumn, causing changes in normal patterns of weather and climate variability with global consequences. The ability to quantitatively forecast Arctic sea ice over varied time scales requires regular observation of Arctic atmospheric and ocean states, circulation, and sea ice characteristics; understanding of the interactions among clouds, radiation, and aerosols; and development of coupled atmosphere-ice-ocean models.

NOAA's current activities: NOAA is currently conducting sea ice analysis and forecasts, evaluation of sea ice projections in Intergovernmental Panel on Climate Change (IPCC) climate models, conducting and analyzing satellite and airborne observations of sea ice freeboard or thickness, improving satellite image analyses, and contributions toward the Arctic buoy program.

Five-year strategy: *Improving daily to weekly sea ice models and forecasts and new seasonal prediction* services will fill a critical gap in marine weather and climate services that will benefit community activities, support the management of protected marine resources, and improve safe operation and navigation through these waters as marine transportation and industry use expands. There is currently no up-to-date sea ice atlas for Alaskan waters, necessary for operational planning. Native communities have noted that not only is the extent and timing of sea ice changing, but its character (floe size, thickness, ridging) is also changing. *Forecast improvements* can be made by enhancing and integrating different types of observations of the atmosphere, sea ice, and ocean, including use of local knowledge, classifying sea ice characteristics, and directly combining data-assimilating sea ice models and climatological information with forecast models. *Seasonal predictions*, particularly the period of open water that defines an extended operations and shipping season, are increasingly in demand. An exploratory Sea Ice Outlook, led by NOAA and the National Science Foundation, in coordination with 20 international contributors, suggests that it is possible to develop seasonal predictions constrained by late spring sea ice conditions and driven by projected weather conditions.

Multi-decadal sea ice projections are required for infrastructure planning, ecosystem stewardship under rapidly changing conditions, and projection of global climate impacts forced by changes first occurring in the Arctic. The most important requirement is to reduce the uncertainty in climate projections forced by anthropogenic gas increases relative to the large natural variability in the Arctic. Current multi-decadal sea ice projections are based on a judicious evaluation of the 24 climate models provided through the IPCC Fourth Assessment Report. NOAA must anticipate a major evaluation of the new model results for application in the Arctic using information that will soon be made available by the IPCC Fifth Assessment Report. Further, special studies using climate and Earth system models need to target Arctic processes. Global models are necessary but not sufficient for regional applications, meaning that development of regional models is also needed.

Retrospective and prospective studies of the linkages between changes in Arctic sea ice and hemispheric weather and climate will lead to new understanding of how these changes affect larger areas. The cold conditions in eastern Asia and the eastern U.S. during winter 2009-2010 highlight the importance of shifts in hemispheric climate patterns to regional weather events, specifically the combination of the two major northern hemisphere patterns of variability—El Nino and the Arctic wind vortex, also known as the Arctic Oscillation. Recent studies support an increased connection between shifts in Arctic climate and increased climate variability in mid-latitudes. Such Arctic/mid-latitude connections can be expected to strengthen over the next decades as the planet experiences further sea ice loss. Being able to better predict these connections requires detailed case studies of climate feedback processes and Arctic/mid-latitude connectivity. These studies are required to achieve improvements in weather and climate forecasts for the Arctic and northern mid-latitude regions.

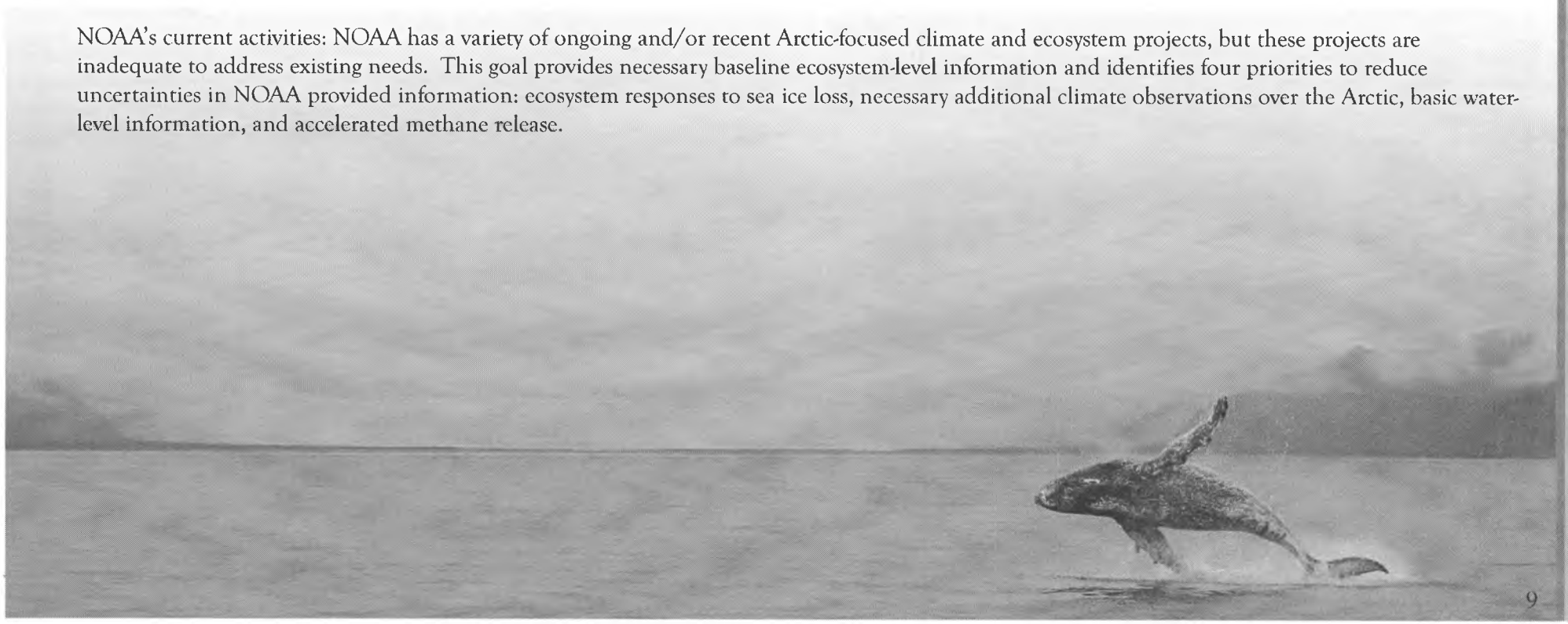


Goal 2: Strengthen Foundational Science to Understand & Detect Arctic Climate & Ecosystem Changes

Goal Statement – Improved baseline observations and understanding of Arctic climate and ecosystems reduces the uncertainty in assessing and predicting impacts caused by a changing Arctic.

Importance: While sea ice extent can be tracked by satellite sensors from year to year, there is much greater uncertainty in tracking the types and magnitudes of social and ecological impacts caused by Arctic climate changes and economic development. The Arctic will continue to provide short-term surprises as ecosystems move toward new and generally unknown states. Previous data and understanding can provide only minor guidance. For example, the response of marine primary production and the impacts on higher levels of the food chain from additional loss of sea ice are basically unknown. Recent data show that a simple conceptual model of a uniform northward shift of ecosystems as the Arctic warms is too simplistic. Other examples of changes in the Arctic are the warming of permafrost, increased coastal erosion, sea level changes, shifts in land and marine transportation patterns, the recent decrease in the pollock stock of the Bering Sea, and changes in land-based human subsistence resources. Monitoring and understanding climate change in the Arctic is important for other socioeconomic applications as well, including sea level and infrastructure protection, transportation, and community resilience. While the International Polar Year initiated a single intensive observational period in the Arctic, most NOAA missions require an enhanced effort to achieve sustained observations.

NOAA's current activities: NOAA has a variety of ongoing and/or recent Arctic-focused climate and ecosystem projects, but these projects are inadequate to address existing needs. This goal provides necessary baseline ecosystem-level information and identifies four priorities to reduce uncertainties in NOAA provided information: ecosystem responses to sea ice loss, necessary additional climate observations over the Arctic, basic water-level information, and accelerated methane release.



High Arctic Biodiversity

In June/July 2005, NOAA organized an international team of 45 scientists from the United States, Canada, Japan, China, and Russia in a collaborative effort to explore the frigid depths of the Canada Basin, one of the deepest parts of the Arctic Ocean. The expedition focused on assessing the diversity of life and the environment in all three major realms of the Arctic—the sea ice, the water column, and the sea floor. For one month, 35 members of the science party and 75 U.S. Coast Guard crewmembers worked together on board the U.S. Coast Guard Cutter Healy to conduct round-the-clock science operations. Scientists examined the hidden world of life in these extreme conditions with the aid of divers, photographic platforms, and a remotely operated vehicle specially designed to operate under ice and at great depth. More traditional techniques like ice coring, plankton nets, and bottom trawls supported these efforts. Expedition results form much of the basis of the January 2010 special issue of the journal Deep Sea Research.

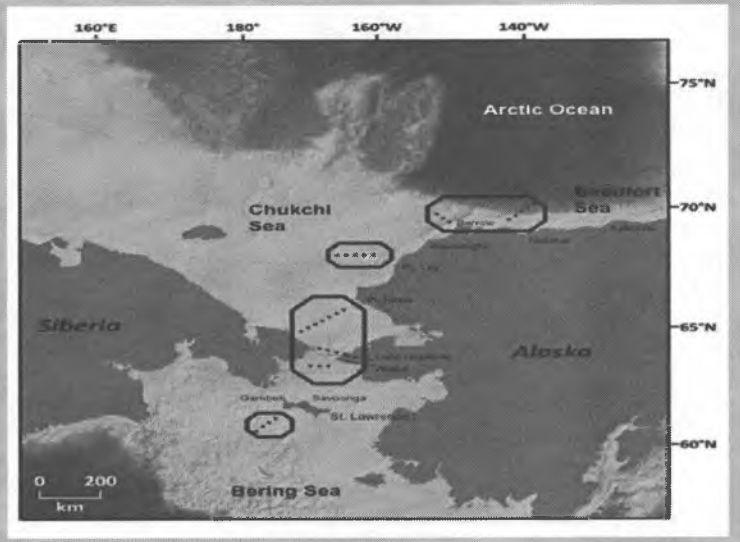


Figure 5. Four possible regional locations of Distributed Biological Observatory transect lines and stations for standard hydrological and biological measurements in the Pacific Arctic sector, including acoustics for marine mammal detection. These stations would include Canadian, Chinese, Japanese, Korean, Russian, and U.S. research vessels, coordinated through the international Pacific Arctic Group, and land-based research from coastal communities using helicopters, small ships, and long-term moorings.

Five-year strategy: An enhanced and integrated set of environmental observations is required to track the new trajectory of Arctic change across land, in the atmosphere, and in the ocean, including physical indicators, biological responses, and social and economic impacts. Rapid organization, interpretation, and dissemination of this information in near real-time is also a necessity, placing it in context with past conditions, natural variability, and model studies. Increased knowledge gained through this process, combined with model forecasts, will further enhance NOAA's capability to project and respond to future change. These enhancements would form the basis for a NOAA Arctic Change Detection System.

Such a system also includes a *marine Distributed Biological Observatory* (DBO) in the U.S. Arctic for consistent monitoring of biophysical responses in four pivotal oceanographic areas along a north-south latitudinal gradient (Figure 5). Each area exhibits high biological productivity, biodiversity, and gradients in ecosystem properties and direct linkages to subsistence-based coastal communities. All areas are projected to experience increased commercial use with the loss of sea ice. The Bering Strait region represents potential conflicts between commercial shipping and resource exploration, subsistence hunting, and management of biological resources. As sea ice retreats, the DBO will track the rate of ecosystem change and sample currently unknown impacts. The DBO was the central recommendation from a NOAA-sponsored workshop in May 2009 on the biological impacts of loss of sea ice. The DBO integrates biological and physical sampling, including both mooring and dedicated repeat ship occupations using a collaborative international network of logistical support. Efforts such as the Russian-American Long-term Census of the Arctic (RUSALCA) should be expanded to improve the exchange of information about near and far-field changes in the Arctic.

The science community was surprised by the rate of loss of summer Arctic sea ice from 2007 through 2009, as well as the magnitude of its impact on the regional and potentially hemispheric ocean and atmosphere. Current observing systems are inadequate to track and understand such changes. New in-situ, airborne, and satellite observing technologies are needed to fill gaps in meteorological and oceanographic fields. While satellites provide vertical profiles of air temperatures, they are less reliable in the lower layers of the Arctic atmosphere. For example, three areas of enhancement can improve analysis products, which in turn are the basis for understanding current Arctic change and improving forecasts. First, *in situ atmospheric profiles* across the Arctic Ocean are needed to stabilize the satellite data in reanalysis products and initial conditions. Second, *increase the number of drifting buoys and long-term moorings*. It is imperative to know upper ocean temperatures at the beginning of the summer melt and fall sea-ice freeze-up seasons to project future sea ice conditions. Long-term biophysical moorings at key locations in the Arctic are essential for tracking influx of heat to the Arctic. Third, NOAA should work to *maintain real-time access to NOAA and other national and international satellites* to fill critical gaps in observations, including the European CryoSat, the Canadian RadarSat, and Indian satellites. In addition, NOAA needs to continue and enhance research on integration of satellite data into regional products and scientific analyses to make the best use of these expensive systems.

Water-level information and forecasts are necessary for coastal community hazard resilience. NOAA is limited in its ability to meet this goal due to insufficient resources and outdated historical data sets. Increased sea-ice-free areas in fall allow a completely new wave and storm surge regime to develop. Deficiencies in information include accurate elevations based on new and updated gravity data and a geodetic framework tied to a new Arctic tide gauge network. Traditional tide gauges have difficulties in freezing and sea ice areas, but these difficulties can be overcome. More effort is needed to conduct circum-Arctic sea level analyses using all in situ and satellite data available from national and international sources.

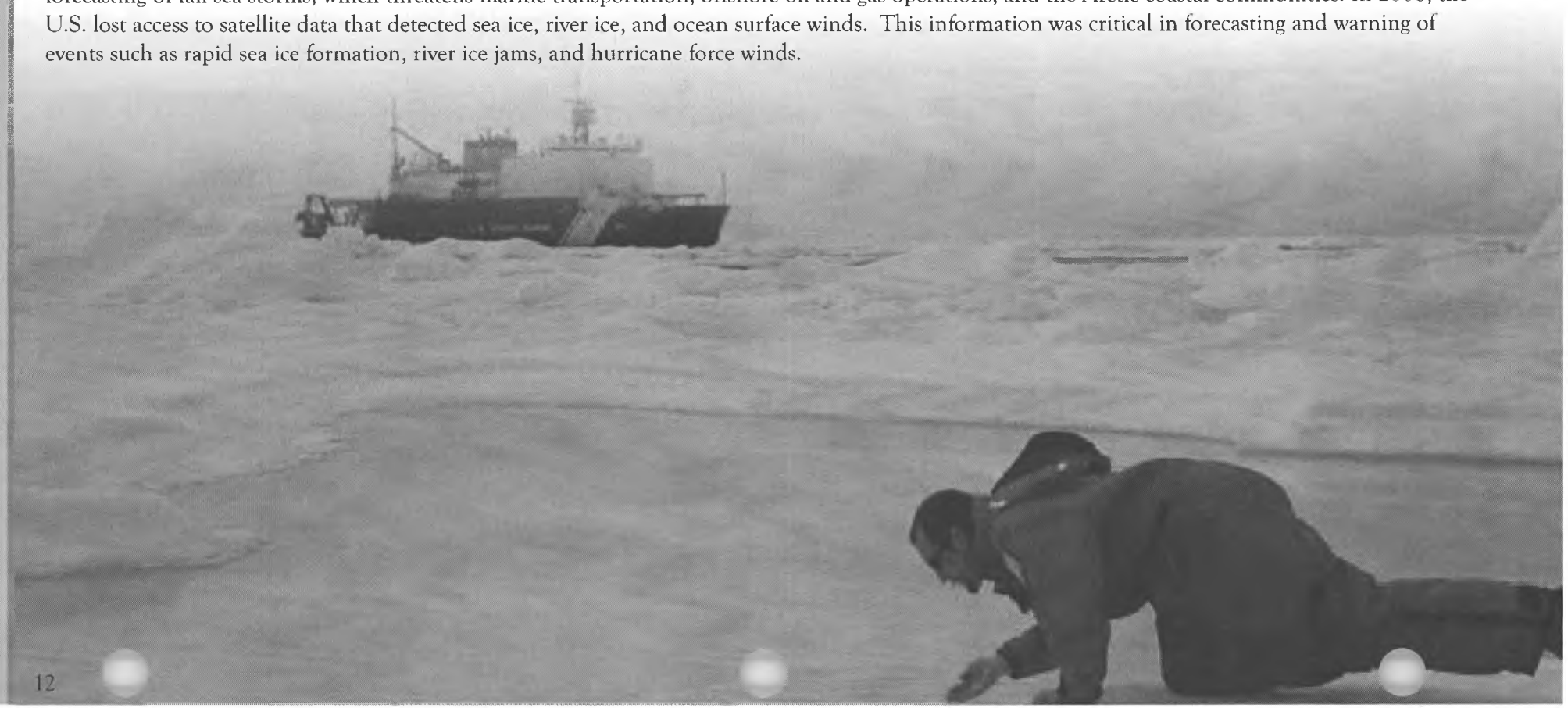
Recent research has shown that methane is being released from thawing permafrost on land and in shallow coastal seas. The amount of methane potentially available for release is very large, but there are no data sets that allow an estimate of the current rate of methane release throughout the Arctic and how this rate may be changing over time. *New synoptic observations over large regions of the Arctic, coupled with modeling and process research* are needed to determine if methane release from Arctic permafrost will be another positive, and powerful, feedback to the global climate system.

Goal 3: Improve Weather and Water Forecasts and Warnings

Goal Statement – Advanced, accurate forecasts and warnings are provided to ensure society can prepare for and respond appropriately to weather-related routine and extreme events.

Importance: Major stakeholders and partners, including the U.S. Coast Guard and the State of Alaska Division of Homeland Security and Emergency Management, require more useful weather and water information for planning and decision making to protect lives, property, and manage the region's many resources. Arctic weather also plays an important role in global weather; understanding this role is essential to improving global forecasts as well.

Arctic populations rely on aviation and marine systems for transportation and access to goods and services. A 2006 study by the National Institute of Occupational Safety and Health reported that the accident rate for commercial pilots in Alaska was five times higher than the national average. Additionally, Alaska's $4 billion fishing industry is one of the most dangerous in the Nation. Improvements in weather and water information will lead to increased safety and efficiency in these important sectors. Environmental observations and studies supporting weather and ice forecasts are highly limited in both geographic scope and frequency. For example, there is inadequate real-time meteorological data in U.S. Arctic waters to support accurate forecasting of fall sea storms, which threatens marine transportation, offshore oil and gas operations, and the Arctic coastal communities. In 2008, the U.S. lost access to satellite data that detected sea ice, river ice, and ocean surface winds. This information was critical in forecasting and warning of events such as rapid sea ice formation, river ice jams, and hurricane force winds.



Climate change is also affecting the Arctic environment, as evidenced by changing precipitation patterns, later freezing and earlier thawing of snow and ice, and changing sea level. People living along rivers and inland waterways face increasing disruption due to more frequent and devastating flooding. Still others face drought, straining municipal water supplies and putting the sustainability of entire businesses and communities at risk. Alaska's strategic location and waterways present both challenges and opportunities in terms of marine transportation, homeland security, and economic development.

NOAA's current activities: NOAA provides forecasts, warnings, and information for surface, marine, and aviation weather interests, with emphasis, when possible, on high-impact events such as extra-tropical storms and polar lows, storm surge and other coastal hazards such as tsunamis, heavy precipitation, floods, droughts, volcanic ash, and space weather. Services are delivered through a number of media from Internet to high frequency radio broadcasts.

Updating Alaska's Precipitation Frequency Estimates

NOAA is using a team of experts, and a set of global best practices, to update the 40-year-old Precipitation Frequency Estimates (PFE) for the State of Alaska. The PFE data are commonly used to reduce the risk of runoff-related loss of life and property and to prevent pollution. The data provide rainfall-related criteria used extensively by the engineering and environmental communities for the design of structures such as sewers and drainage systems, for environmental studies and design, and for sediment control. The criteria are used by the Federal Emergency Management Agency to update National Flood Insurance rate maps and by the Environmental Protection Agency's National Pollution Discharge Elimination System Program to regulate pollution control in streams. Results from climate change investigations in Alaska suggest the seasonality, amount, and type of precipitation are changing in many locations. NOAA uses these criteria for comparison during rainstorms that could produce flash flooding. NOAA expects to complete this task in September 2010.

Five-year strategy: Predictive services are generally not of the same accuracy, resolution (temporal and spatial), and reliability as similar products in mid-latitude regions. Forecasts of weather and water conditions lack detail beyond 60-72 hours and lose reliability considerably thereafter. A primary reason for this discrepancy is the relative coarseness of the observational fields to support meteorological and oceanographic modeling. New in-situ, airborne, and satellite observing technologies are needed to fill gaps in meteorological and oceanographic datasets, with then intent of improving both local and global weather forecasts. NOAA must expand services by addressing greater needs for observations, modeling, and forecasts while incorporating new techniques for ensuring this information leads to the best possible decisions and associated response. Science and technology will need to be leveraged based on advanced numerical models, including ranges of uncertainty. Improved Earth system models will include coupling of atmosphere, ocean, land and ice at local, regional, and global scales.

NOAA *must improve Arctic marine weather, sea ice, and storm surge forecast services* by addressing greater needs for observations, modeling, and forecasts while incorporating new techniques for ensuring this information leads to the best possible decisions and associated response. Improved forecast services will ensure the safety and security of marine transportation, mineral (oil and gas) exploration, and tourism activities, and *protect northern and western Alaska coastal communities from storm surge, inundation, and erosion hazards.* The operational marine weather service infrastructure in the National Weather Service will enable NOAA to provide regular forecasts and on-demand support for the Arctic Ocean to meet the NOAA mandate to protect life and property as well as enhance the economy and fulfill NOAA's obligations under international treaties.

Goal 4: Enhance International & National Partnerships

Goal Statement – National and international partners are engaged to promote cooperation and sharing of data, observational platforms, and intellectual resources to enable more rapid and comprehensive attainment of NOAA's Arctic science and ecosystem-based management goals.

Importance: The Arctic is comprised of the northern regions of eight countries and adjacent marine areas. As the Arctic climate continues its warming trend, sea ice in the Arctic continues to recede and freshwater entering the Arctic from rivers is increasing. These changes in the Arctic environment are likely to impact the globe, making it urgent that NOAA builds on its abilities to observe, understand, predict, and respond to these Arctic changes. Both national and international partnerships are needed to help fill data gaps; improve analyses, models, and forecasts; and apply ecosystem-based management.

NOAA's current activities: NOAA currently cooperates with other governments through broad Science and Technology (S&T) Agreements and NOAA-specific agreements, as well as through international institutions and organizations. S&T Agreements and Memorandums of Understanding with Russia, Norway, Sweden, Finland, Canada, and Denmark support NOAA's work with these Arctic countries in areas such as weather, climate, aviation, and marine observations, forecasts, and services; ecosystem management; fisheries; and ice monitoring. . These agreements allow us to cooperate on sea ice forecasts, as well as better understand and predict changes in the Earth's environment by observing the Arctic atmosphere and cryosphere from manned observatories in places such as Summit, Greenland and Tiksi, Russia.

NOAA is also an active participant in numerous international organizations such as the World Meteorological Organization, International Maritime Organization, International Hydrographic Organization,

Enhance International and National Partnerships: Arctic Council

NOAA has played a key role in major products of the Arctic Council and is now providing leadership on future products. By enhancing and institutionalizing its support for the Council, NOAA can exert stronger leadership on the Council's science-based activities and offer greater support to U.S. Arctic policy goals. The Arctic Council is the only intergovernmental group that focuses solely on the Arctic. By engaging through the Council with the other seven Arctic countries, permanent participants, and the several observer countries, the goals outlined in this plan can be more readily achieved.

and the Arctic Council. NOAA serves in leadership roles in two Arctic Council working groups (Protection of the Arctic Marine Environment and Arctic Monitoring and Assessment Program), while providing expertise to others. Current Arctic Council work includes assessing the effects of pollutants in the Arctic, reviewing the comprehensiveness of governance mechanisms for the Arctic, and understanding the status of biodiversity in Arctic ecosystems.

Five-year strategy: Modeling climate change at the regional and global levels is an enormous task, best accomplished by *sharing data at multiple levels* – with universities and researchers, with other Arctic countries, and with non-Arctic countries possessing satellite and observation capabilities in the Arctic. NOAA must continue and expand these relationships through partnerships and formal bilateral arrangements. Understanding and predicting how ice cover and consistency will change in the Arctic will necessitate cooperation. NOAA should increase both its interagency and international partnerships to increase the accuracy, timeliness, and coverage of its sea ice forecasts – ensuring seamless transitions across jurisdictional boundaries and enhancing safe navigation.

With reduced sea ice comes opportunities for trans-Arctic shipping, increased oil and gas exploration and extraction, tourism, and other uses that increase regional vessel traffic, as well as associated threats such as oil spills, transport of invasive species, and collisions with species or small craft. NOAA, working through the interagency process, should *expand Arctic protection mechanisms* at the international level (e.g., the International Maritime Organization), including developing a mandatory Polar Code, Particularly Sensitive Sea Areas, vessel routing measures and sea lanes (in particular for choke points such as the Bering Strait). NOAA also should increase hydrographic charting and cooperation in the region (e.g., via the International Hydrographic Organization).

These changes in climate and sea ice are also driving changes in marine ecosystems, species abundance, and composition, in ways not yet fully understood. NOAA should *provide leadership and additional resources to support Arctic governance and science organizations*. Specifically, NOAA should support the Arctic Council and its working groups, which monitor and assess biodiversity, climate, and the health of humans and ecosystems and contribute to international approaches to ecosystem and protected area management, and management of shipping. The International Arctic Science Committee and the Pacific Arctic Group identify science priorities across countries and build trusted and lasting relationships among scientists.

The Sustaining Arctic Observing Networks (SAON) activity co-sponsored by the Arctic Council and the International Arctic Science Committee aims to become an effective mechanism for sharing data among the Arctic countries and for identifying critical observing systems that should be maintained for long periods. The success of SAON will make achievement of NOAA Arctic science goals more likely and NOAA should *support development of an effective international SAON process*.

Continued coordination across federal entities, such as that provided by the Interagency Arctic Research Policy Committee, will be needed to implement overarching U.S. Arctic Policy goals, particularly those identified by the U.S. Arctic Policy (NSPD 66/HSPD 25) and the Interagency Ocean Policy Task Force. Scientific research and discovery will proceed in collaboration with the National Science Foundation, and other federal, state and local partners, academia, non-governmental organizations, and private entities. Due to the interconnected nature of Arctic ecosystems, the U.S. will also need to continue to improve collaboration and engagement with other Arctic nations through international mechanisms, such as the Arctic Council and our bilateral relationships, to better understand, observe, research, and manage Arctic resources.

Goal 5: Improve Stewardship & Management of Ocean & Coastal Resources in the Arctic

Goal Statement – Conservation, management, and use of ocean and coastal resources are based on sound science and support healthy, productive, and resilient ecosystems and communities.

Importance: As the Arctic Ocean becomes more accessible with the retreat of sea ice in summer months, cascading consequences must be anticipated. Biophysical and chemical changes in the ocean, combined with increasing human uses will impact the Bering, Chukchi, and Beaufort Seas. Currently commercial harvest of groundfish, shellfish, salmon and other resources, primarily in the Bering Sea, constitute almost 50 percent of marine fish landings in the U.S. Further, these same resources, plus various species of marine mammals, seabirds, and other marine life are critical to the maintenance of the subsistence lifestyle of over 40,000 indigenous people who inhabit small towns and villages on Alaska's Arctic coastline. It is therefore critical to both the U.S. economy and the coastal inhabitants of the U.S. Arctic that NOAA, in cooperation with Federal, state, and local partners and stakeholders, expand its capabilities to understand and predict the full spectrum of changes associated with climate change in the Arctic, with the intended outcome of improving the stewardship of Arctic marine resources.

NOAA's current activities: NOAA currently conducts population assessments and ecological process studies to meet its living marine resource management mandates. However, data in the Arctic are insufficient to make adequate assessments, and it is currently beyond the scope of existing ecosystem models to provide reliable indications of how loss of sea ice, increased ocean acidity, and increasing ocean temperatures will impact key fish and mammal species. NOAA will need to expand aspects of its current Arctic ecosystem research program and the regional Alaska Ocean Observing System, as well as implement better data collection, analyses, and models to provide reliable predictions of the changes coming to marine ecosystems in the U.S. Arctic.

Extended Continental Shelf Mapping
Since 2001, NOAA activities have been critical to U.S. efforts to gather and analyze data to determine the outer limits of its extended continental shelf (ECS) including the Arctic region. The primary goal these efforts is to establish the limits of the areas of seabed beyond 200 miles where the United States can exercise sovereign rights over seabed and sub-seafloor continental shelf natural resources. NOAA is a co-vice chair on the State Department-led interagency task force established in 2007. To date, U.S. data collection efforts have provided a wealth of bathymetric and seismic information. Though beyond the scope of ECS, collecting the baseline ecosystem-level data would enhance the existing information and provide the U.S. with a better understanding of the nature, extent, and economic value of these resources, as well as insights into issues such as climate variability; marine ecosystems; and undiscovered or unconventional energy, biological, and mineral resources.

Five-year strategy: At present, the biggest limiting factor in providing managers with the information they need regarding the impact of climate change on Arctic living marine resources off Alaska is access to survey vessels and aircraft during the ice-free summer months and support for over-wintering sampling tools including autonomous sea gliders, passive acoustic recorders, and satellite-linked tags. Specifically, very few surveys have been conducted to assess the status of living marine resources in the northern Bering, Chukchi, and Beaufort Seas. Additional Arctic surveying capability is proposed in NOAA's Fleet and Aircraft Recapitalization plans, which include state-of-the-art replacements of aging NOAA survey vessels and planes. Additional charters are required to meet capacity shortfalls. Also, resources are needed to conduct ecological process studies on how loss of sea ice, increased acidity, and sea surface temperature warming will change the productivity and composition of Arctic marine resources in waters off Alaska.

Because of fiscal limitations, it is beyond the capability of NOAA to address all of these deficiencies in the next five years. Therefore, in this strategy, NOAA is proposing to expand two existing programs, while *continuing on-going assessment programs on marine mammals, fish, and shellfish*: 1) the Bering-Aleutian Salmon International Survey (BASIS) and the RUSALCA (Figure 6), which are cooperative international research programs in the northern Bering and Chukchi Seas, and 2) NOAA's *ocean acidification* program. The former will provide critical information on the biodiversity of this region and a baseline for assessing how biodiversity will respond to climate change and loss of sea ice. The latter activity will result in greater attention given to the *impact of more corrosive waters on the ecology and life history of key Arctic species* such as king crab. The geographic scope of this proposal is therefore limited to the northern Bering and Chukchi Seas. This is a critical region because of the connectivity of the high Arctic marine ecosystems with the Bering Sea through the Bering Strait. Further, the expansion of existing research programs in this area is a cost-effective way to address critical information needs. Expansion of the existing research program in the Beaufort Sea will be dependent on the availability of funding between 2015 and 2020.

The data produced by the continuation and expansion of these two on-going research programs will provide a subset of the information needed to develop models that will allow resource managers to better assess the risk of action or inaction, as well as the relative benefit of specific actions. Integrated ecosystem assessments and operational ecosystem modeling will ultimately require further investments in human and facility infrastructure in the Arctic (e.g., real-time sea-ice monitoring at the appropriate scale for safe maritime operations). Through conservation, research, and response to environmental threats, NOAA will assist the part of the U.S. that is already impacted by climate change in developing risk-averse strategies to maximize the resilience of marine ecosystems in the Arctic, and develop strategies to mitigate and adapt to adverse impacts.

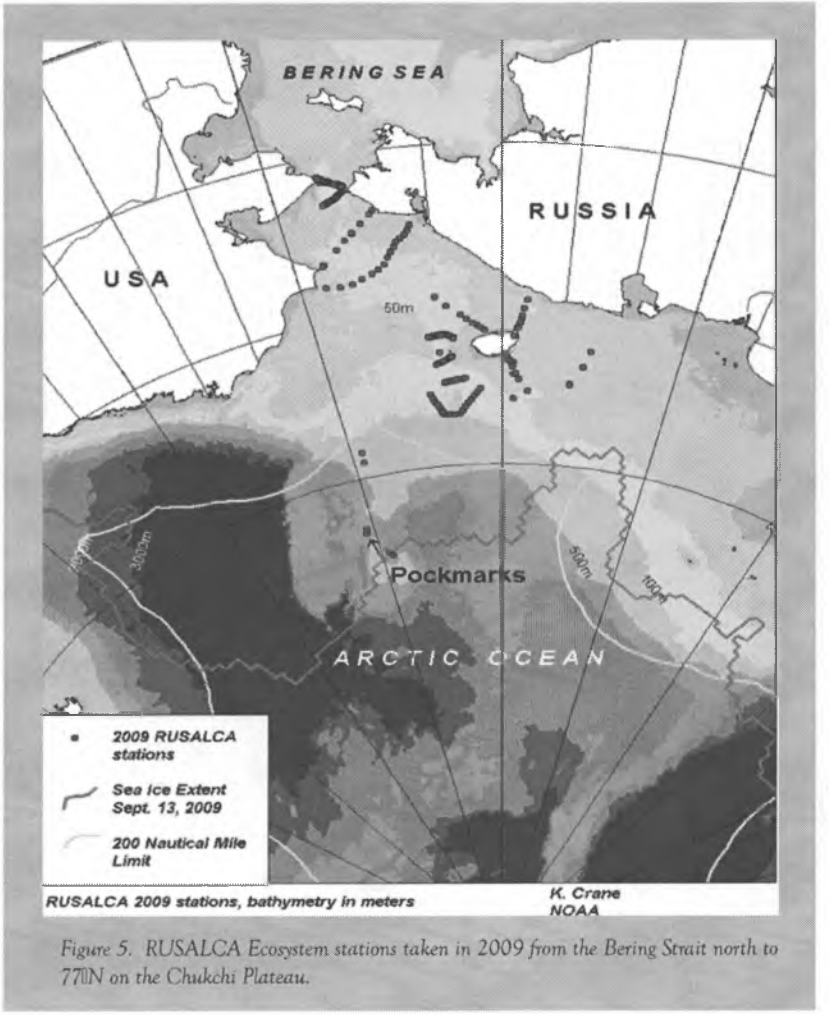


Figure 5. RUSALCA Ecosystem stations taken in 2009 from the Bering Strait north to 77ºN on the Chukchi Plateau.

Goal 6: Advance Resilient & Healthy Arctic Communities & Economies

Goal Statement - Resilient and healthy Arctic communities and economies through improved geospatial infrastructure, safe navigation, oil spill response readiness, and climate change adaption strategies.

Importance: We measure the well-being of our Nation through the health of our communities and economies. The condition of the Arctic can be gauged by the health of the people living and working in this unique environment, and by the impact of increased economic activity on it. Indigenous people have long depended upon the unique characteristics of the Arctic for food, livelihoods, cultural heritage, and protection. However, climate change in the Arctic is altering the foundations of their communities and challenging indigenous ways of life. At the same time, the loss of sea ice creates opportunities for commercial enterprises such as oil and gas development, cruise and cargo shipping, fishing, and other economic sectors. This creates tension between the traditional and the new, and argues for a measured approach to Arctic resource utilization.

As the ice barriers that protect Arctic coastal communities diminish, the State of Alaska and its people must make critical decisions based on threats from stronger storms, increasing erosion, thawing permafrost, changing animal migration patterns, and sea level changes. Shorter freeze periods and weak ice impact transportation and can result in loss of life. The potential economic effects of these changes in the Arctic are also enormous, as retreating sea ice opens access to economic development. Oil companies are investing in exploration, private interests are anticipating an open Arctic trade route, and pressure is increasing on our defense and security assets to maintain a presence in the region in a "response-ready state" because of the increased risks.

NOAA's current activities: NOAA has a variety of mandates relating to resilient communities and economies. The agency has the U.S. government lead for hydrographic surveys, nautical charts, and the National Spatial Reference System. NOAA is also responsible for administering the Coastal Zone Management Program. During oil spills, NOAA is legally responsible for providing scientific support to the U.S. Coast Guard and conducting natural resource damage assessments following those incidents. In addition, people who live in, work in, and visit the Arctic rely on NOAA and the Search and Rescue Satellite System to rescue them in an emergency.

Environmental preparedness, response, and recovery: NOAA and the University of New Hampshire's Coastal Response Research Center are partnering to expand Environmental Response Management Application (ERMA) coverage to one or two key areas of concern in the Chukchi and Beaufort Seas. The demonstration will show how the ERMA tool can benefit Arctic stakeholders, including coastal communities, Alaska Native villages, the State of Alaska, NOAA, Federal agencies, and industry. ERMA is a web-based map tool designed to assist both emergency responders and environmental resource managers who deal with incidents that may adversely impact the environment. The data within ERMA also assist in resource management decisions regarding hazardous waste site evaluations and restoration planning. ERMA includes human use and human dimension data components and, for the Arctic, will include sea-ice conditions. Federal, State and Tribal governments would be able to use this information and the ERMA interface to address not only oil spill planning and response, but also to access sea-ice/shoreline erosion information.

The Arctic is severely deficient in many of the capabilities that NOAA extends to the rest of the Nation. The region currently has virtually no geospatial infrastructure for accurate positioning and elevations; sparse tide, current, and water-level prediction coverage; obsolete shoreline and hydrographic data; poor nautical charts; insufficient weather and ice forecast coverage; inadequate oil spill response capacity; and poor understanding of baseline conditions for existing ecosystems. There are large gaps in the information that NOAA does have, illustrated by empty white space on nautical charts of the region and limited capabilities for modeling spills in ice conditions. Most Arctic waters that are charted were surveyed with obsolete technology, some dating back to the 1800s, before the region was part of the United States. Most of the shoreline along Alaska's northern and western coasts has not been mapped since 1960, if ever, and confidence in the nautical charts of the region is extremely low.

Five-year strategy: NOAA can make the highest positive impact to Arctic communities and sustainable economic growth by providing products and services for safe navigation and security, oil spill response readiness, post-incident resource restoration efforts, and climate change adaptation strategies.

The Arctic region needs accurate land and tidal elevations to build flood protections, harden infrastructure, ensure safe and efficient marine transportation, model storm surge, and monitor sea levels. Good weather and navigation tools, building the capacity to respond to spills when they occur, and research to improve Arctic spill response and restoration capabilities are essential. Arctic communities also need a reliable source for information on climate in Alaska to support decisions on moving communities and other adaptive strategies. By building on the capabilities noted in other strategic priorities such as marine weather, sea ice forecasts, and increased observing capacity, NOAA can act to support navigation safety, maritime security, and environmental protection from oil spills and other hazardous events. NOAA's geospatial framework, products, and services will also provide the foundation for all other NOAA activities in the Arctic, including effective climate adaptation, community resilience, coastal resource, and marine spatial planning strategies in the region.

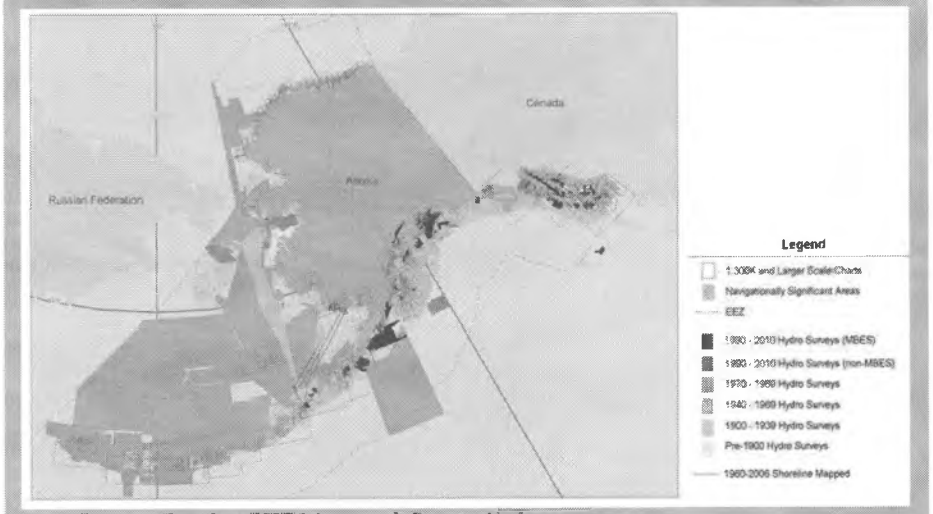


Figure 7. **Age and quality of NOAA nautical charts** *in Alaska.*

Figure 8. NOAA Arctic hydrographic survey priorities (2010 – 2014)

Overhauling the Arctic Geospatial Framework of geodetic control and water levels will correct meters-level positioning errors and enable centimeter-level measurements to support such critical needs as marine transportation, sea level rise monitoring, understanding of erosion and permafrost thaw impacts to infrastructure, oil/gas resource exploration, and storm surge modeling. *Delivering scientific support for Arctic pollution response* such as contingency plans, place-based drills and community workshops, and spill trajectory modeling to decision makers will help to reduce risk of accident and injury to protected resources and ecosystems as commercial vessel traffic in and through the Arctic increases. *Surveying and mapping Arctic waters and shoreline* for accurate coastal maps and nautical charts will benefit navigation and national security, sea level change impact assessments, and habitat characterizations (Figure 8). NOAA will work with partners to prioritize and survey likely shipping lanes in the North Bering and Chukchi Seas and around coastal communities. This effort will help address the Bering Strait chokepoint in particular, and reduce the risk of accidents and environmental impacts in Arctic waters more broadly.

Finally, by working with local, State and Federal health agencies such as the Alaska Native Tribal Health Consortium and the Centers for Disease Control, NOAA will *support coastal communities with adaptive strategies and planning tools* and contribute to the understanding of how the changing climate is affecting health and welfare. NOAA will assist Arctic communities on this issue by leading the development of a regional climate service partnership. This climate center will serve as a one-stop shop for information on climate in Alaska. NOAA will also work with other agencies, the State, and tribal entities to implement coastal and marine spatial planning to improve the management and coordination of human activities in the coastal zone and U.S. Exclusive Economic Zone.

Conclusion & Next Steps

As the Nation's only Arctic state, Alaska and its communities are the first to be impacted by climate change. Observations have shown that Alaska has warmed at over twice the rate of the rest of the Nation. The average annual temperatures in Alaska have increased by 3.4 degrees Fahrenheit and the winter time average temperatures have increased by 6.3 degrees. This means Alaska is already experiencing early snow melt, changes in sea ice, wide-spread glacial retreat, and permafrost thawing.

The Arctic is a particularly vulnerable system, which is prone to rapid change. It is also a primary driver for global weather patterns. Initial predictions from global climate change models underestimated the rate at which the Arctic would lose sea ice. This has led to an underestimate of global warming. Understanding global climate change and providing reliable predictions regarding changes in worldwide weather patterns will require an improved understanding of the impacts of Arctic climate change.

NOAA has diverse capabilities that can and should be brought to bear on the emerging environmental, economic, and national security issues in the Arctic. NOAA envisions an Arctic where:

- Conservation, management, and use are based on sound science and support healthy, productive, and resilient communities and ecosystems; and
- The global implications of Arctic change are understood and predicted.

In support of this vision and in order to fulfill NOAA's missions and responsibilities that are critical for other agencies to succeed in fulfilling their responsibilities, NOAA intends to undertake the following four steps:

Step 1 – In the next five years, implement, through a NOAA five-year Arctic Action Plan, actions to achieve the six primary goals that are identified and described in this document in support of the Arctic vision.

1) Accurate, quantitative, daily forecasts to decadal predictions of sea ice are provided to support safe operations and ecosystem stewardship,
2) Improved baseline observations and understanding of Arctic climate and ecosystems reduces the uncertainty in assessing and predicting impacts caused by a changing Arctic,
3) Advanced, accurate forecasts and warnings are provided to ensure society can prepare for and respond appropriately to weather-related routine and extreme events,
4) National and international partners are engaged to promote cooperation and sharing of data, observational platforms, and intellectual resources to enable more rapid and comprehensive attainment

of NOAA's Arctic science and ecosystem-based management goals,

5) Conservation, management, and use of ocean and coastal resources are based on sound science and support healthy, productive, and resilient ecosystems and communities, and
6) Resilient and viable Arctic communities and economies through improved geospatial infrastructure, safe navigation, oil spill response readiness, and climate change adaption strategies.

Step 2 – In order to accomplish these goals, coordination across all NOAA Line and Staff Offices and collaboration with local, regional, federal, academic, and non-governmental organizational partnerships will be required.

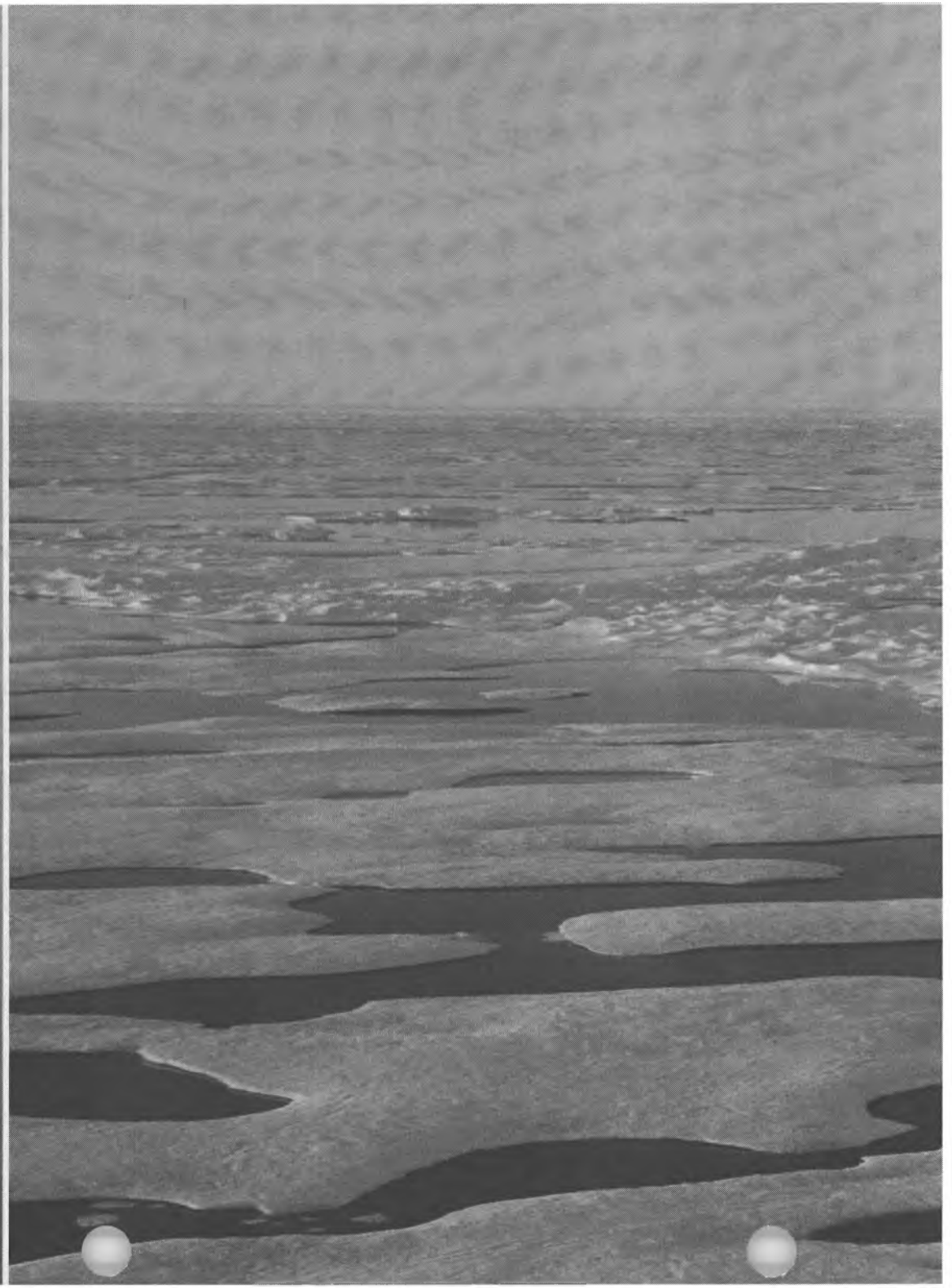
Step 3 – Develop an engagement strategy to reach internal and external employees, partners, and stakeholders. As a starting point, establish a single point of contact within NOAA Senior Executive Leadership that is accountable for implementation of this strategy.

Step 4 – Include the formalization of a detailed budget strategy as part of the NOAA Arctic Action Plan. NOAA is committed to enhancing its current involvement in research and management programs in the Arctic, and anticipates initial investment of $10 million towards the implementation of this strategic plan, recognizing that additional funds will be needed to achieve these goals.

No single region better exemplifies the complex interdependence of communities and changing ecosystem conditions than the Arctic. The breadth and complexity of the cultural, societal, economic, and environmental impacts requires a concerted, systematic and rapid effort with partners from international to local levels. NOAA's scientific capabilities can be deployed to increase understanding of climate and other key environmental trends, to predict the ecosystem response to those trends, and to offer the technical expertise needed to develop policy options and management strategies for mitigation and adaptation to the environmental challenges in the Arctic region. NOAA's service capabilities are needed to support safety and security needs for fishing, marine mammal protection, transportation, energy, infrastructure, and mineral exploration in the unique Arctic environment. The choices we make today can have pivotal impacts on the future state of the Arctic.

UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE AND ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - NOAA

JANE LUBCHENCO, PH.D.



10.

Arctic Report Card

Arctic Report Card: *Update for 2009*

Tracking recent environmental changes

Warming of the Arctic continues to be widespread, and in some cases, dramatic. Linkages between air, land, sea, and biology are evident.

Sea Ice: Multi-year ice is going away

Melting multi-year sea ice in the Arctic Ocean
Credit: Kitty Mecklenburg

Atmosphere	Ocean
Sea Ice	Greenland
Biology	Land

Red boxes: Consistent evidence of warming.
Yellow boxes: Many indications of warming.

Atmosphere
Large scale wind patterns impacted by loss of summer sea ice

Sea Ice
Multi-year sea ice is being replaced by first year sea ice

Ocean
Upper ocean remains warm and less salty

Land
Increased runoff in Siberia, less snow in North America

Greenland
Ice sheet loss continues

Biology
High Arctic species impacted by loss of sea ice

October 2009

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Citing an essay (example):
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Authors and Affiliations

I. Ashik, Arctic and Antarctic Research Institute, St. Petersburg, Russia

L.-S. Bai, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio

R. Benson, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio

U. S. Bhatt, Geophysical Institute, University of Alaska–Fairbanks, Fairbanks, Alaska

I. Bhattacharya, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio

J. E. Box, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio

D. H. Bromwich, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio

R. Brown, Climate Research Division, Environment Canada

J. Cappelen, Danish Meteorological Institute, Copenhagen, Denmark

E. Carmack, Institute of Ocean Sciences, Sidney, Canada

B. Collen, Institute of Zoology, Zoological Society of London, Regent's Park, London, UK

J. E. Comiso, NASA Goddard Space Flight Center, Greenbelt, Maryland

D. Decker, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio

C. Derksen, Climate Research Division, Environment Canada

N. DiGirolamo, Science Systems Applications Inc. and NASA Goddard Space Flight Center, Greenbelt, Maryland

D. Drozdov, Earth Cryosphere Institute, Tumen, Russia

B. Ebbinge, Alterra, Wageningen

H. E. Epstein, University of Virginia, Charlottesville, Virginia

X. Fettweis, Department of Geography, University of Liège, Liège, Belgium

I. Frolov, Arctic and Antarctic Research Institute, St. Petersburg, Russia

T. Gaston, Environment Canada, National Wildlife Research Centre, Carleton University, Ottawa, Canada K1A 0H3

G. Gilchrist, Environment Canada, National Wildlife Research Centre, Carleton University, Ottawa, Canada K1A 0H3

M.J. Gill, Environment Canada, Circumpolar Biodiversity Monitoring Program Office, Whitehorse, Yukon, CA

D. Hall, NASA Goddard Space Flight Center, Greenbelt, Maryland

E. Hanna, Department of Geography, University of Sheffield, England

G. J. Jia, Chinese Academy of Sciences, Institute for Atmospheric Physics, Beijing, China

A. Kholodov, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK

R. Krishfield, Woods Hole Oceanographic Institute, Woods Hole, MA

J. Loh, Institute of Zoology, Zoological Society of London, Regent's Park, London, UK

M.J.J.E. Loonen, University of Groningen, Arctic Centre

G. Malkova, Earth Cryosphere Institute, Tumen, Russia

S. Marchenko, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK

F. McLaughlin, Institute of Ocean Sciences, Sidney, Canada

M. McPhee, McPhee Research Company, Naches, Washington

L. McRae, Institute of Zoology, Zoological Society of London, Regent's Park, London, UK

W. Meier, CIRES/NSIDC, University of Colorado, Boulder, Colorado

J. Morison, Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle, WA

T. Mote, Department of Geography, University of Georgia, Atlanta, Georgia

S. V. Nghiem, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

N. Oberman, MIREKO, Syktivkar, Russia

J. Overland, NOAA, Pacific Marine Environmental Laboratory, Seattle, WA

D. K. Perovich, ERDC-Cold Regions Research and Engineering Laboratory, Hanover, NH

J. Pinzon, NASA Goddard Space Flight Center, Greenbelt, Maryland

I. Polyakov, International Arctic Research Center, Fairbanks, Alaska

A. Proshutinsky, Woods Hole Oceanographic Institute, Woods Hole, MA

M. K. Raynolds, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, Alaska

J.D. Reist, Freshwater Institute, Fisheries and Oceans Canada, Winnipeg, MB

J. Richter-Menge, ERDC-Cold Regions Research and Engineering Laboratory, Hanover, NH

V. Romanovsky, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK

D. Russell, Scientist Emeritus, Canadian Wildlife Service, Environment Canada, Yukon, Canada

C.D. Sawatzky, Freshwater Institute, Fisheries and Oceans Canada, Winnipeg, MB

M. Sharp, Department of Earth and Atmospheric Sciences, University of Alberta

A. Shiklomanov, University of New Hampshire, Durham, NH

K. Shimada, Institute of Observational Research for Global Change, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan

M. Simpkins, NOAA Fisheries Service

V. Sokolov, Arctic and Antarctic Research Institute, St. Petersburg, Russia

M. Steele, Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle, WA

M. Tedesco, Department of Earth and Atmospheric Sciences, City College of New York, New York, New York

M.-L. Timmermans, Woods Hole Oceanographic Institute, Woods Hole, MA

J. Toole, Woods Hole Oceanographic Institute, Woods Hole, MA

C.J. Tucker, NASA Goddard Space Flight Center, Greenbelt, Maryland

R. van de Wal, Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht, The Netherlands

M. van den Broeke, Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht, The Netherlands

D. A. Walker, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, Alaska

J. Walsh, International Arctic Research Center, Fairbanks, AK

L. Wang, Climate Research Division, Environment Canada

M. Wang, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA

T. Weingartner, Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, Alaska

G. Wolken, Department of Earth and Atmospheric Sciences, University of Alberta

R. Woodgate, Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle, WA

C. Zöckler, UNEP World Conservation Monitoring Centre, Cambridge, UK

Atmosphere

J. Overland[1], M. Wang[2], and J. Walsh [3]

[1]NOAA, Pacific Marine Environmental Laboratory, Seattle, WA
[2]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA
[3]International Arctic Research Center, Fairbanks, AK

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Summary

It is apparent that the heating of the ocean in areas of extreme summer sea ice loss is directly impacting surface air temperatures over the Arctic Ocean, where surface air temperature anomalies reached an unprecedented +4°C during October through December 2008. There is evidence that the effect of higher air temperatures in the lower Arctic atmosphere is contributing to changes in the atmospheric circulation in both the Arctic and northern mid-latitudes.

The annual mean Arctic temperature for the year 2008 was the fourth warmest year for land areas since 1990 (Figure A1). This continued the 21st century positive Arctic-wide surface air temperature (SAT) anomalies of greater than 1.0° C, relative to the 1961–1990 reference period. The mean annual temperature for 2008 was cooler than 2007, coinciding with cooler global and Pacific temperatures (Hansen, 2009). The outlook is for increased temperatures, because there are currently (October 2009) El Nino conditions which are expected to continue through winter 2009–2010.

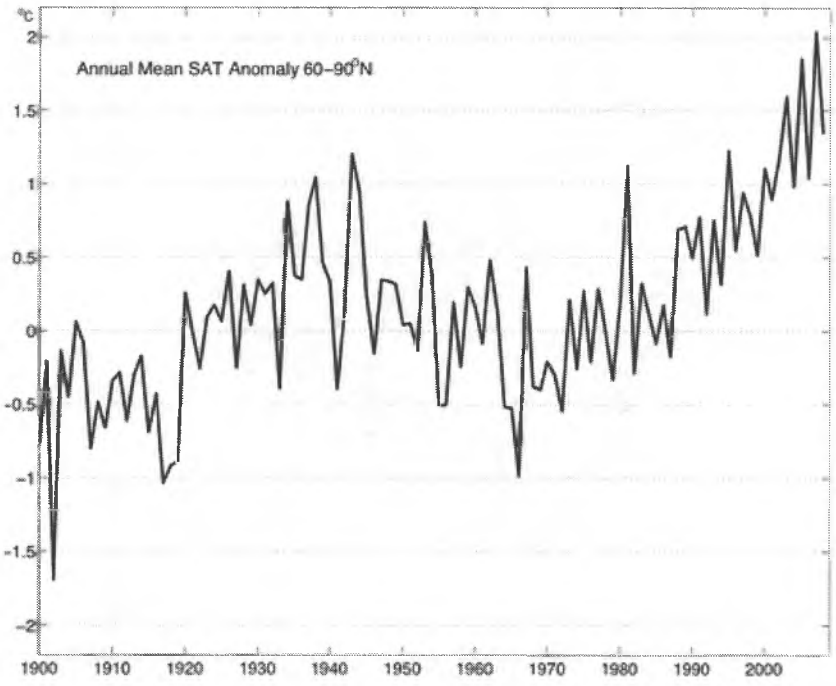

Figure A.1. Arctic-wide annual averaged surface air temperature anomalies (60°–90°N) based on land stations north of 60°N relative to the 1961–90 mean. From the CRUTEM 3v dataset, (available online at www.cru.uea.ac.uk/cru/data/temperature/ . Note this curve does not include marine observations.

During October through December 2008 SAT anomalies remained above an unprecedented +4° C across the central Arctic (Fig. A2(A)). This is linked to summer sea ice conditions. The summer of 2008 ended with nearly the same extreme minimum sea ice extent as in 2007, characterized by extensive areas of open water (see sea ice section). This condition allows extra heat to be absorbed by the ocean from longwave and solar radiation throughout the summer season, which is then released back to the atmosphere in the following autumn (Serreze et al., 2009). We expect similar warm fall temperatures over the Arctic in 2009, as in 2007 and 2008.

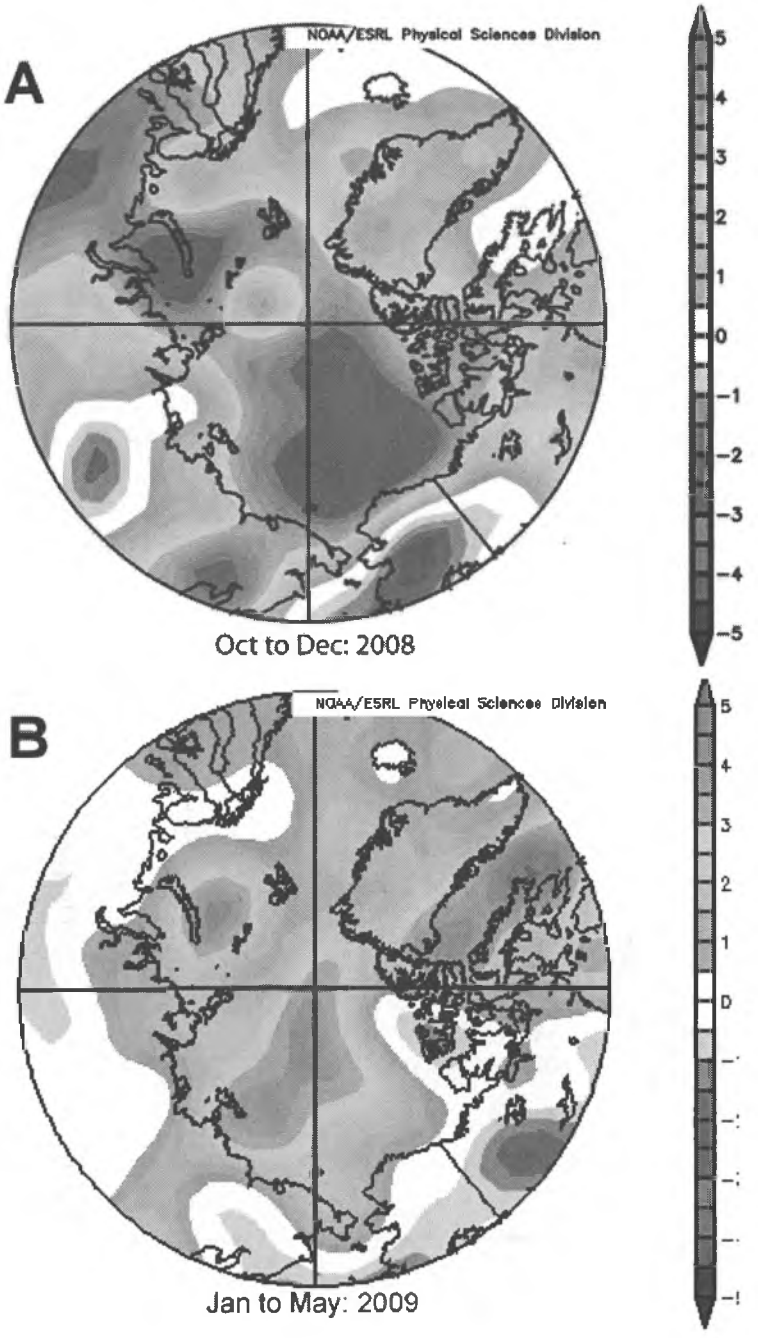

Figure A.2. Near surface air temperature anomalies for (A, top) October through December 2008 and (B, bottom) January–May 2009. Anomalies are relative to 1968–1996 mean. Data are from the NCEP – NCAR reanalysis through the NOAA /Earth Systems Research Laboratory, generated online at www.cdc.noaa.gov .

Similar to the previous years of the 21st century, in 2009 the spatial extent of positive SAT anomalies in winter and spring of greater than +1°C was nearly Arctic-wide (Figure A2 (B)), in contrast with more regional patterns in the 20th century (Chapman and Walsh, 2007). The exception was the Bering Sea/southwestern Alaska which experienced a fourth consecutive cold or average winter associated with weaker winds and colder temperatures in the North Pacific.

There is evidence that, by creating a new major surface heat source, the recent extreme loss of summer sea ice extent is having a direct feedback effect on the general atmospheric circulation into the winter season (Francis et al., 2009). Fall air temperature anomalies of greater than +1.0° C were observed well up into the atmosphere (Figure 3A), when averaged over 2003–2008 relative to a 1968–1996 base period. The higher temperatures in the lower troposphere decrease the atmospheric air density and raise the height of upper-air-constant-pressure levels over the Arctic Ocean (Figure 3B). These increased heights north of 75 °N weaken the normal north-to-south pressure gradient that drives the normal west-to-east airflow in the upper troposphere. In this sense, the effect of higher air temperatures in the lower Arctic atmosphere is contributing to changes in the atmospheric circulation in both the Arctic and northern mid-latitudes. For example, Honda et al. (2009) suggest a remote connection between loss of Arctic sea ice and colder temperatures over eastern Asia.

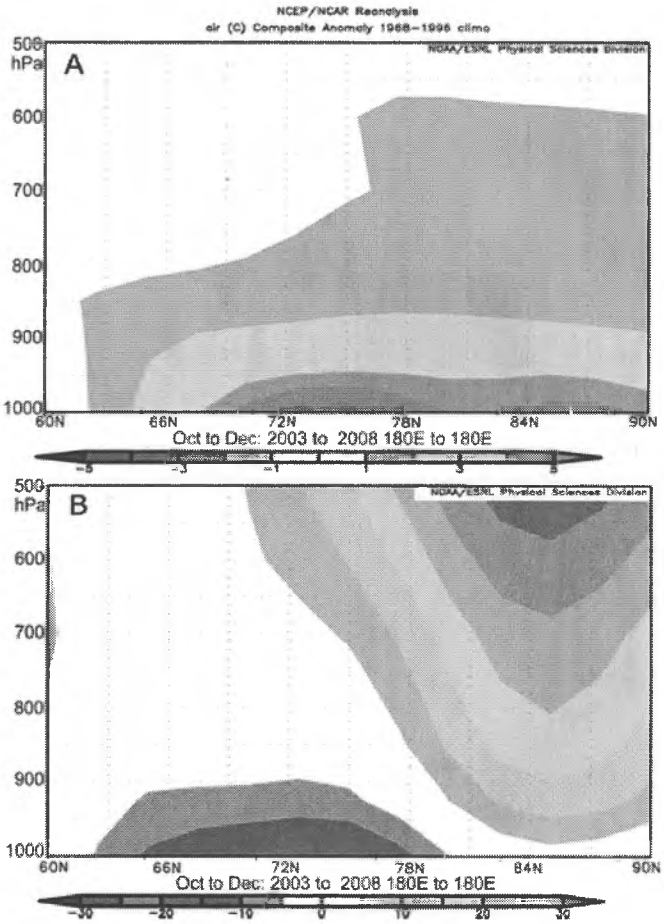

Figure A.3. Vertical cross section from 60° to 90° N along 180° longitude averaged for October–December 2003 through 2008 (years for which summertime sea ice extent fell to extremely low values) for (A) air temperature, and (B) geopotential height. Data are from the NCEP – NCAR reanalysis available online at www.cdc.noaa.gov.

The climate of the Arctic is influenced by repeating patterns of sea level pressure that can either dominate during individual months or represent the overall atmospheric circulation flow for an entire season. The main climate pattern for the Arctic is known as the Arctic Oscillation (AO) with anomalous winds that blow counter-clockwise around the pole when the pattern is in its positive phase. A second wind pattern has been more prevalent in the 21st century and is known as the Arctic Dipole (AD) pattern (Wu et al., 2006; Overland et al., 2008). The AD pattern has anomalous high pressure on the North American side of the Arctic and low SLP on the Eurasian side. This implies winds blowing more from south to north, compared to the AO, and increasing transport of heat into the central Arctic Ocean. The AD pattern occurred in all summer months of 2007 and helped support the major 2007 summer reduction in sea ice extent (Overland et al., 2008). Fall 2008 and winter/spring 2009 showed a return of the AO pattern, but also considerable month to month variability in the presence of these various climate patterns.

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Sea Ice Cover

D. Perovich[1], R. Kwok[2], W. Meier[3], S. Nghiem[2], J. Richter-Menge[1]

[1]ERDC-Cold Regions Research and Engineering Laboratory, Hanover, NH
[2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA
[3]CIRES/NSIDC, University of Colorado, Boulder, Colorado

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New! Monthly Sea Ice Outlook from SEARCH/Arcus

Summary

One of the most dramatic signals of the general Arctic-wide warming trend in recent years is the continued significant reduction in the extent of the summer sea ice cover and the decrease in the amount of relatively older, thicker ice. The extent of the 2009 summer sea ice cover was the third lowest value of the satellite record (beginning in 1979) and >25% below the 1979–2000 average.

Sea ice extent

Sea ice extent is the primary parameter for summarizing the state of the Arctic sea ice cover. Microwave satellites have routinely and accurately monitored the extent since 1979. There are two periods that define the annual cycle and thus are of particular interest: March, at the end of winter when the ice is at its maximum extent, and September, when it reaches its annual minimum. Maps of ice coverage in March 2009 and September 2009 are presented in Figure S1, with the magenta line denoting the median ice extent for the period 1979–2000.

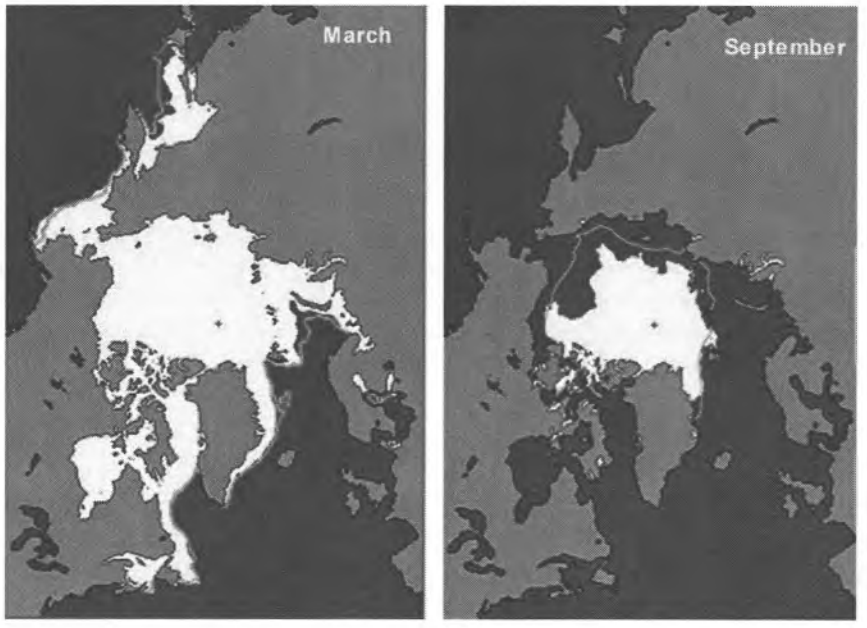

Figure S1. Sea ice extent in March 2009 (left) and September 2009 (right), illustrating the respective winter maximum and summer minimum extents. The magenta line indicates the median maximum and minimum extent of the ice cover, for the period 1979–2000. [Figures from the National Snow and Ice Data Center Sea Ice Index: nsidc.org/data/ seaice_index.]

On September 12, 2009 sea ice extent reached a 2009 minimum of 5.1 million km^2. The 2009 summer minimum is the third-lowest recorded since 1979. It was 0.6 million km^2 greater than 2008 and 1.0 million km^2 above the record low in 2007. Surface air temperatures through the 2009 summer were relatively cooler, particularly in the Chukchi and Beaufort seas. Winds in 2009 also tended to disperse the ice pack over a larger region. While the 2009 minimum was an increase over the two previous years, it was still 1.6 million km^2 below the 1979 to 2000 average minimum. The March 2009 ice extent was 15.2 million km^2, the same as in 2008 and only 4% less that the 1979–2000 average of 15.8 million km^2.

The time series of the anomalies in sea ice extent in March and September for the period 1979–2009 are plotted in Figure S2. The anomalies are computed with respect to the average from 1979 to 2000. The large interannual variability in September ice extent is evident. Both winter and summer ice extent exhibit a negative trend, with values of -2.5 % per decade for March and -8.9 % per decade for September over the period 1979–2009.

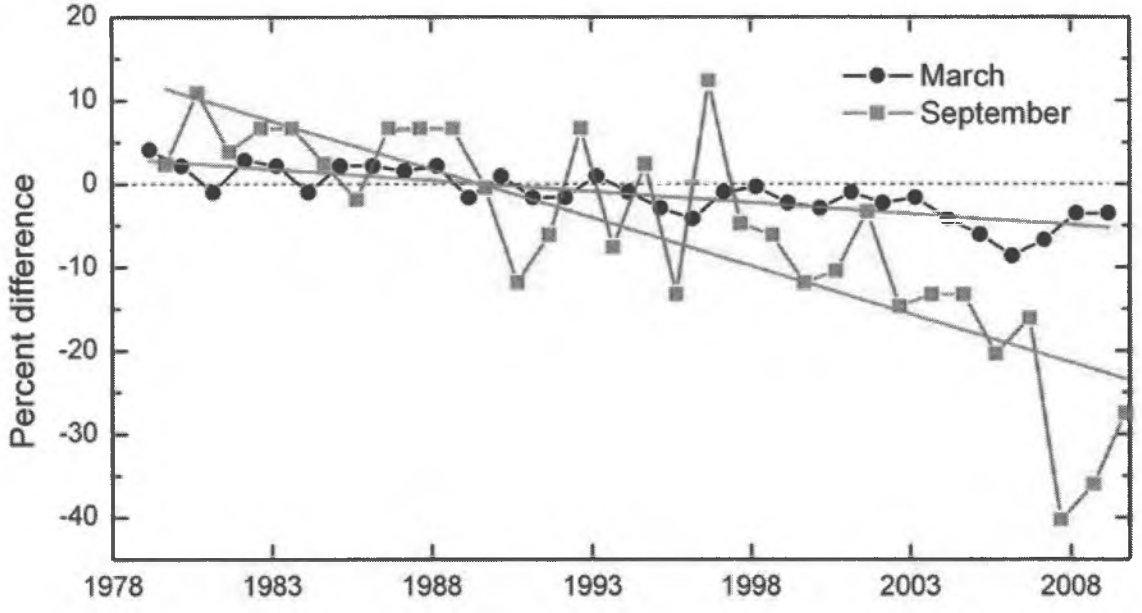

Figure S2. Time series of the percent difference in ice extent in March (the month of ice extent maximum) and September (the month of ice extent minimum) relative to the mean values for the period 1979–2000. Based on a least squares linear regression for the period 1979-2009, the rate of decrease for the March and September ice extents is –2.5% and –8.9% per decade, respectively.

Sea ice age and thickness

The age of the ice is another key descriptor of the state of the sea ice cover, since older ice tends to be thicker and more resilient than younger ice. A simple two-stage approach classifies sea ice into first year and multiyear ice. First-year is ice that has not yet survived a summer melt season, while multi-year ice has survived at least one summer and can be several years old. Satellite derived maps of ice age for March of 2007, 2008, and 2009 are presented in Figure S3.

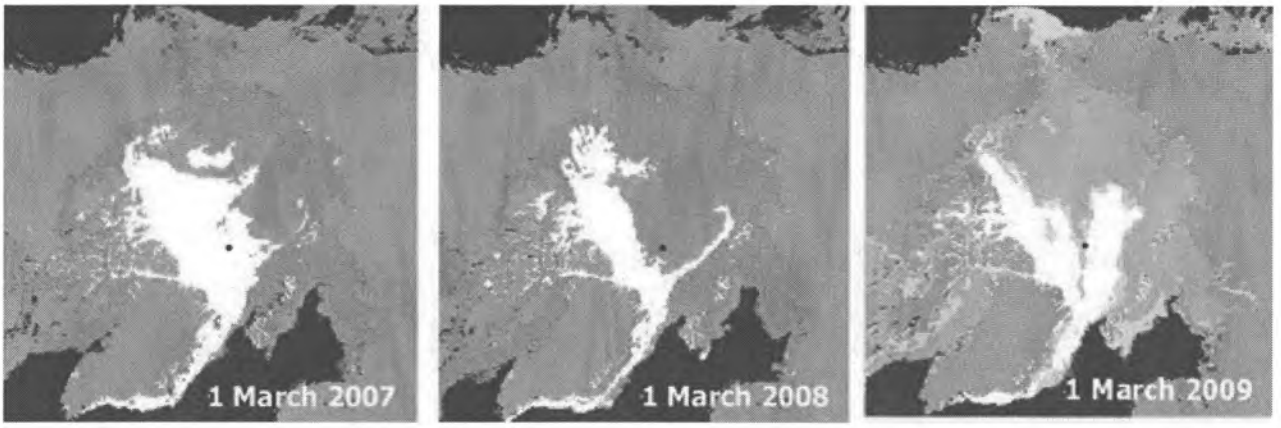

Figure S3. Arctic sea ice distribution in March of 2007, 2008, and 2009. Multiyear ice is in white, mixed ice aqua, first-year ice teal, and ice with melting surface red. Dark blue is for open water and brown for land. From a combination of AVHRR and SSM/I satellite observations and results from drifting ice buoys. (courtesy of Son Nghiem)

In the past decade, the extent of multiyear sea ice rapidly reduced at a rate of 1.5×10^6 km^2 per decade, triple the reduction rate during the three previous decades (1970–2000). Springtime multiyear ice extent was the lowest in 2008 in the QuikSCAT data record since 2000. QuikSCAT results in March 2009 showed a multiyear ice extent of 3.0 ± 0.2 million km^2. This was 0.3 million km^2 larger than the multiyear ice extent on the same date in 2008, even though the total sea ice extent was similar in the spring of 2008 and 2009. While the multiyear ice extent was similar in March 2008 and 2009, its distribution was quite different. More specifically, in 2008 there was a significant amount of multiyear ice the Beaufort Sea and in 2009 there was a large amount of multiyear ice the central Arctic Ocean.

Recent estimates of Arctic Ocean sea ice thickness from satellite altimetry show a remarkable overall thinning of ~0.6 m in ice thickness between 2004 and 2008 (Figure. S4a). In contrast, the average thickness of the thinner first-year ice in mid-winter (~2 m), did not exhibit a downward trend. Seasonal ice is an important component covered more than two-thirds of the Arctic Ocean in 2008. The total multiyear ice volume in the winter experienced a net loss of more than 40% in the four years since 2005 while the first year ice cover gained volume due to increased overall coverage of the Arctic Ocean. The declines in total volume and average thickness (black line in Figure S4a) are explained almost entirely by thinning and loss of multiyear sea ice due to melting and ice export. These changes have resulted in seasonal ice becoming the dominant Arctic sea ice type, both in terms of area coverage and of volume.

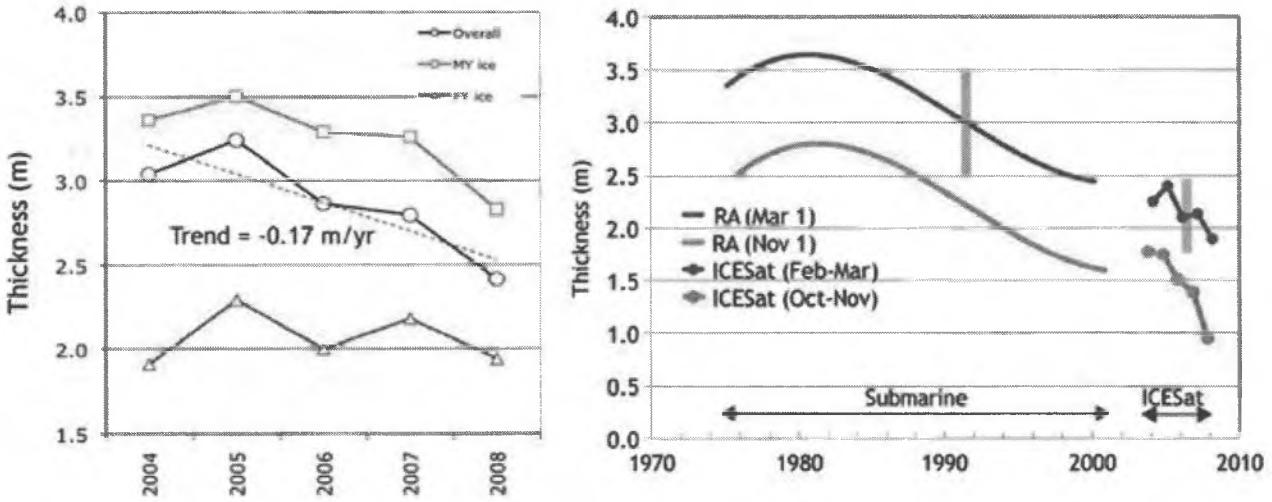

Figure S4. (a) Winter Arctic Ocean sea ice thickness from ICESat (2004–2008). The black line shows the average thickness of the ice cover while the red and blue lines show the average thickness in regions with predominantly multiyear and first-year ice, respectively. b) Interannual changes in winter and summer ice thickness from the submarine and ICESat campaigns within the data release area spanning a period of more than 30 years. The data release area covers approximately 38% of the Arctic Ocean. Blue error bars show the uncertainties in the submarine and ICESat data sets. (after Kwok et al., 2009 and Kwok and Rothrock, 2009)

The recent satellite estimates were compared with the longer historical record of declassified sonar measurements from US Navy submarines (Figure S4b). Within the submarine data release area (covering ~38% of the Arctic Ocean), the overall mean winter thickness of 3.6 m in 1980 can be compared to a 1.9 m mean during the last winter of the ICESat record—a decrease of 1.7 m in thickness. This combined submarine and satellite record shows a long-term trend of sea ice thinning over submarine and ICESat records that span three decades. The contribution of the increasing fraction of first year ice to the long term thickness trend remains to be determined.

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Ocean

A. Proshutinsky[1], R. Krishfield[1], M. Steele[2], I. Polyakov[3], I. Ashik[4], M. McPhee[5], J. Morison[2], M.-L. Timmermans[1], J. Toole[1], V. Sokolov[4], I. Frolov[4], E. Carmack[6], F. McLaughlin[6], K. Shimada[7], R. Woodgate[2], and T. Weingartner[8]

[1]Woods Hole Oceanographic Institute, Woods Hole, MA
[2]Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle, WA
[3] International Arctic Research Center, Fairbanks, Alaska
[4]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[5]McPhee Research Company, Naches, Washington
[6]Institute of Ocean Sciences, Sidney, Canada
[7]Institute of Observational Research for Global Change, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan
[8]Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, Alaska

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Summary

In 2008, there was an unprecedented amount of fresh water in the surface layer of the Arctic Ocean. The source of the fresh water was melting sea ice. The heating of the ocean in areas of extreme summer sea ice loss (for instance, summer surface water temperatures in the Beaufort Sea were more than 3°C above average) was contributing to record high surface air temperatures in the fall (October through December) over the Arctic Ocean.

Circulation

In 2008, the ocean surface circulation regime in the central Arctic was anticyclonic (clockwise) in winter and summer (Fig. O.1). The intensity of motion was weaker than observed in 2007, consistent with changes in the observed sea level atmospheric pressure patterns (see section 5b). In winter the major flow stream removed sea ice from the Kara and Laptev Seas, while in the summer sea ice from the Canada Basin was transported toward the Fram Strait. Data from satellites and drifting buoys (Proshutinsky et al. 2009) indicate that the entire period of 1997–2008 has been characterized by a relatively stable anticyclonic ocean surface circulation regime. This circulation pattern was the result of a higher sea level atmospheric pressure over the Arctic Ocean, relative to the 1948–2008 mean, and the prevalence of anticyclonic winds. These conditions have significantly influenced the sea ice cover, oceanic currents, and ocean freshwater and heat content.

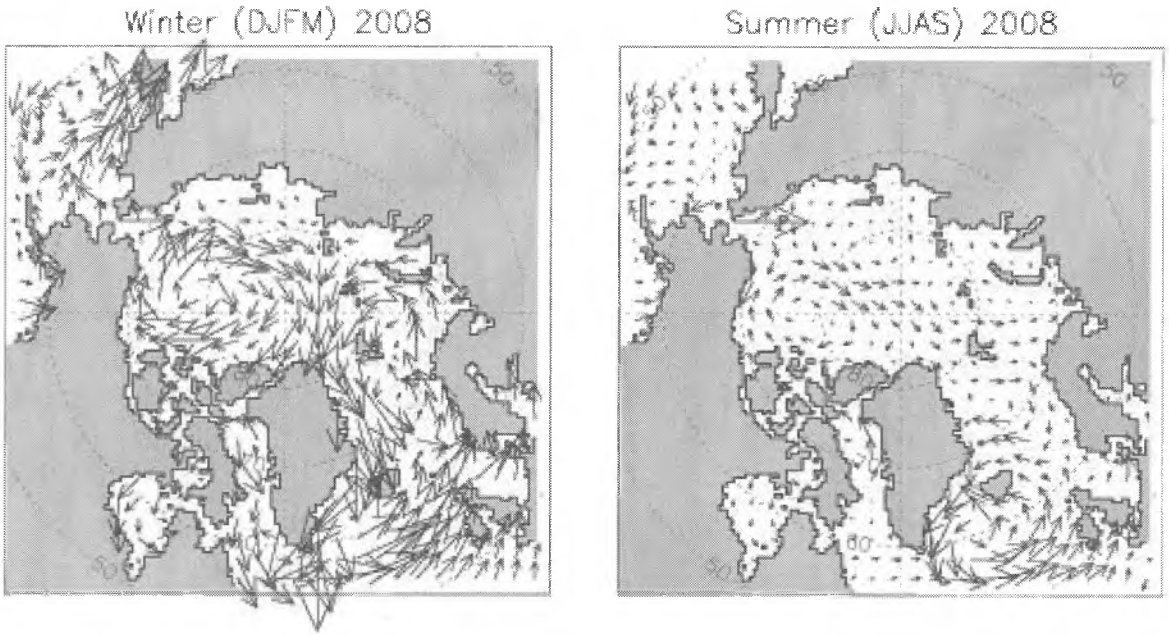

Figure O.1. Simulated circulation patterns of the upper-ocean wind-driven circulation in (left) winter and (right) summer in 2008. Both patterns are identified as anticyclonic (clockwise). The intensity of anticyclonic circulation in summer 2008 has reduced relative to 2007 (see Proshutinsky and Johnson 1997 for details).

Water temperature and salinity

Upper-ocean temperatures in summer 2008 were not quite as high as in the record-breaking summer of 2007. Although the position of the September ice edge did not change significantly in 2008 relative to 2007, the timing of ice retreat was different. Early ice retreat from the Beaufort Sea in 2008 led to anomalously high sea surface temperatures that exceeded even those in 2007 in this region (Fig. O.2). However, ice retreat in the Chukchi and east Siberian Seas occurred relatively late in the summer, leading to near-normal or only slightly above-normal ocean warming (Fig. O.2). This difference illustrates that the warming of the upper ocean is dependent not only on the position of the September ice edge but also on the time history of the ice cover over the summer. More specifically, ocean surface warming depends on the time history of atmospheric heat input to the sea surface, which depends both on atmospheric conditions (winds, clouds) and on the presence of the ice cover that acts to block this heat input (Steele et al. 2009).

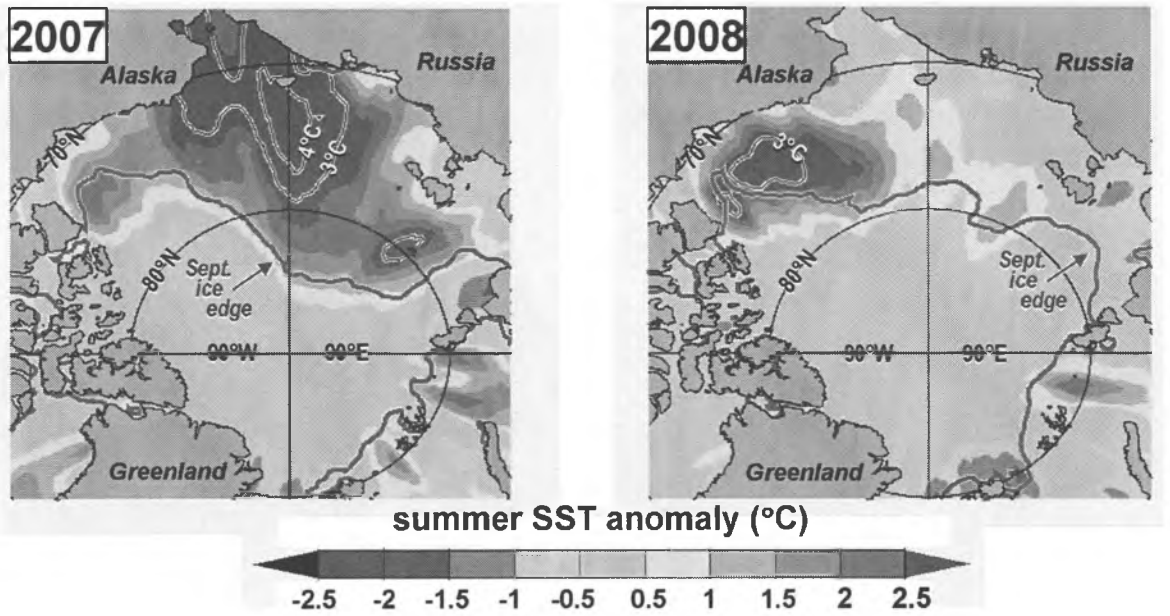

Figure O.2. Satellite-derived summer (JAS) SST anomalies (Reynolds et al. 2002) in (left) 2007 and (right) 2008, relative to the summer mean over 1982–2006. Also shown is the Sep mean ice edge (thick blue line).

Changes in the AWCT varied regionally in 2008, reflecting temporal pulses in the Atlantic water flow volume, temperature, and salinity in the Fram Strait. The Atlantic water propagates cyclonically (counterclockwise) along the Arctic Ocean continental slope, entering the Arctic Ocean via the Fram Strait west of Spitsbergen and leaving the Arctic via the Fram Strait east of Greenland. Observations at a NABOS (http://nabos.iarc.uaf.edu/) mooring in the vicinity of Spitsbergen (Fig. O.3) along the entry point of the AWCT showed that the monthly mean AWCT at 260 m reached a maximum of ~3.8°C in November–December 2006. Subsequently, the temperature at this location has declined or cooled, reaching ~2.8°C in 2008. Observations at sections crossing the continental slope in the vicinity of Severnaya Zemlya also revealed cooling of AWCT by approximately 0.5°C (Fig. O.3). This cooling signal has not reached central parts of the Arctic Ocean and the Beaufort Gyre of the Canada Basin (Proshutinsky et al. 2009). In the Beaufort Gyre region, the AWCT in 2008 was 0.80°–0.90°C, which is 0.10°C above AWCT observed in 2007 and 0.50°C above AWCT from pre-1990s climatology. In spring of 2008, data collected at the NPEO (http:// psc.apl.washington.edu/northpole/index.html) indicate that the AWCT increased to nearly 1.4°C, which is about 0.1°C higher than observed in a 2007 survey and about 0.7°C higher than pre-1990s climatology.

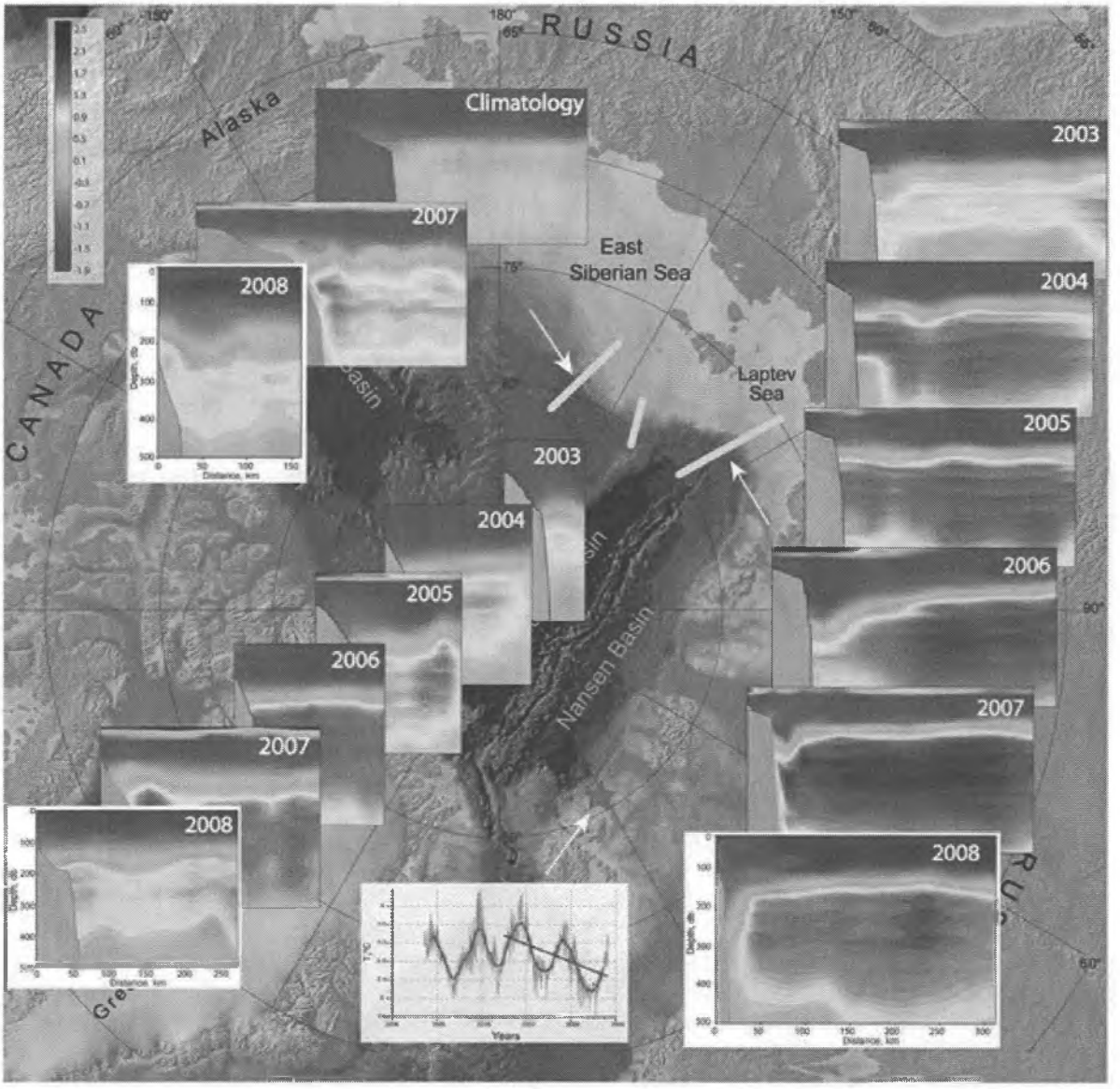

Figure O.3. Temporal (°C) and spatial variability of the AWCT. Locations of sections are depicted by yellow thick lines. Mooring location north of Spitsbergen is shown by a red star. There is a decline of Atlantic water temperature at 260 m at mooring locations with a rate of 0.5°C per year starting at the end of 2006. Some cooling in 2008 is also observed at the sections crossing the continental slope in the vicinity of Severnaya Zemlya and in the east Siberian Sea (Polyakov et al. 2009, manuscript submitted to Geophys. Res. Lett.).

Summer 2008 ship-based hydrographic surveys (Ashik, Sokolov, Frolov, and Polyakov 2008, personal communications) in different regions of the Arctic Ocean showed a continued freshening of the upper 20-m ocean layer, similar to 2007. In the 25–75-m layer, some salinification was observed in the central regions of Amundsen and Makarov Basins, while along the continental slope the water salinity remained unchanged relative to salinities observed in 2007. There was also some freshening of the deeper water layers in the Beaufort Gyre in 2008, as the surface freshening in this region was accompanied by Ekman pumping (Proshutinsky et al. 2009).

Data collected as part of the BGOS (www.whoi.edu/beaufortgyre/index.html) show that in 2000–08 the total freshwater summer content in the Beaufort Gyre has significantly increased relative to

climatology of the 1970s (Arctic Climatology Project 1997, 1998; Fig. O.4). In 2008, the center of the freshwater maximum remained shifted toward Canada as in 2007 but significantly intensified relative to 2007 (Fig. O.4). As a result, the northwest part of the region is much saltier and the southeast region of the Beaufort Gyre is much fresher than in 2006–07 and, also, compared to 30 years ago. At some stations in the southeast of the Canada Basin the FWC reached the maximum observed value, increasing by as much as 11 m, which is 60% above climatology values. The freshening extends northward through the Canada and Makarov Basins to the Lomonosov Ridge (not shown). On the Eurasian side of the Lomonosov Ridge, the FWC anomaly is negative (water salinity was increased relative to climatology) with minimum FWC values of about -4 m (McPhee et al. 2009). The Beaufort Gyre heat content is significantly elevated relative to 1970s climatology (Arctic Climatology Project 1997, 1998; Fig. O.4), but no significant changes relative to 2007 heat content were registered by the BGOS in 2008.

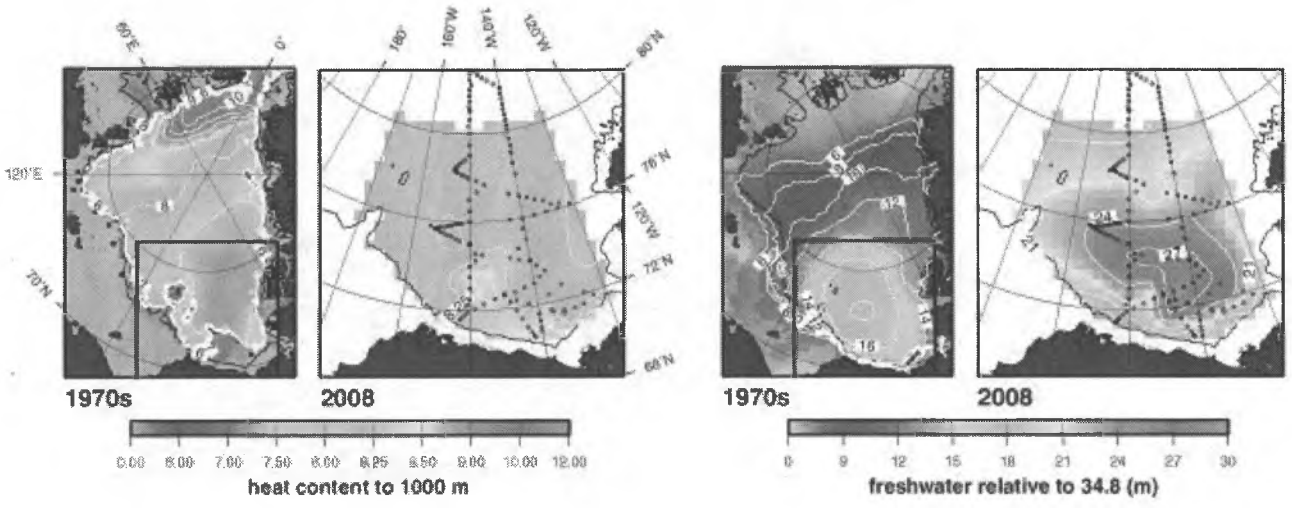

Figure O.4. (left) Summer heat (1×10^{10} J m^{-2}) and (right) freshwater (m) content. Panels 1 and 3 show heat and freshwater content in the Arctic Ocean based on 1970s climatology (Arctic Climatology Project 1997, 1998). Panels 2 and 4 show heat and freshwater content in the Beaufort Gyre in 2008 based on hydrographic survey (black dots depict locations of hydrographic stations). For reference, this region is outlined in black in panels 1 and 3. The heat content is calculated relatively to water temperature freezing point in the upper 1000-m ocean layer. The freshwater content is calculated relative to a reference salinity of 34.8.

The Bering Strait is an important gateway to the Arctic Ocean. Preliminary observations from a mooring site, established and maintained since 1990 (Woodgate et al. 2006), suggest the 2007 annual mean transport through the Bering Strait is around 1 Sv (1 Sv = 10^6 m^3 s^{-1}), greater than 2006 but comparable with previous high years, such as 2004. The same is true of the freshwater flux through the strait. The heat flux, being largely determined by the total volume flux, is also high, but in this case it appears to be somewhat higher than the 2004 values.

Sea Level

Figure O5 shows SL time series from nine coastal stations in the Siberian Seas, having representative records for the period of 1954–2008 (Arctic and Antarctic Research Institute data archives). For the nine stations, the rate for 1954–89, after the GIA, was 1.94 ± 0.47 mm yr^{-1}. This compares to an estimated rate of 1.85 ± 0.43 mm yr^{-1} along the Arctic coastlines over the same period, based on 40 arctic coastal stations (Proshutinsky et al. 2004). Addition of 1990–2008 data

increases the estimated rate of SL rise for the nine stations in the Siberian seas, beginning in 1954, to 2.68 ± 0.45 mm yr^{-1} (after correction for GIA).

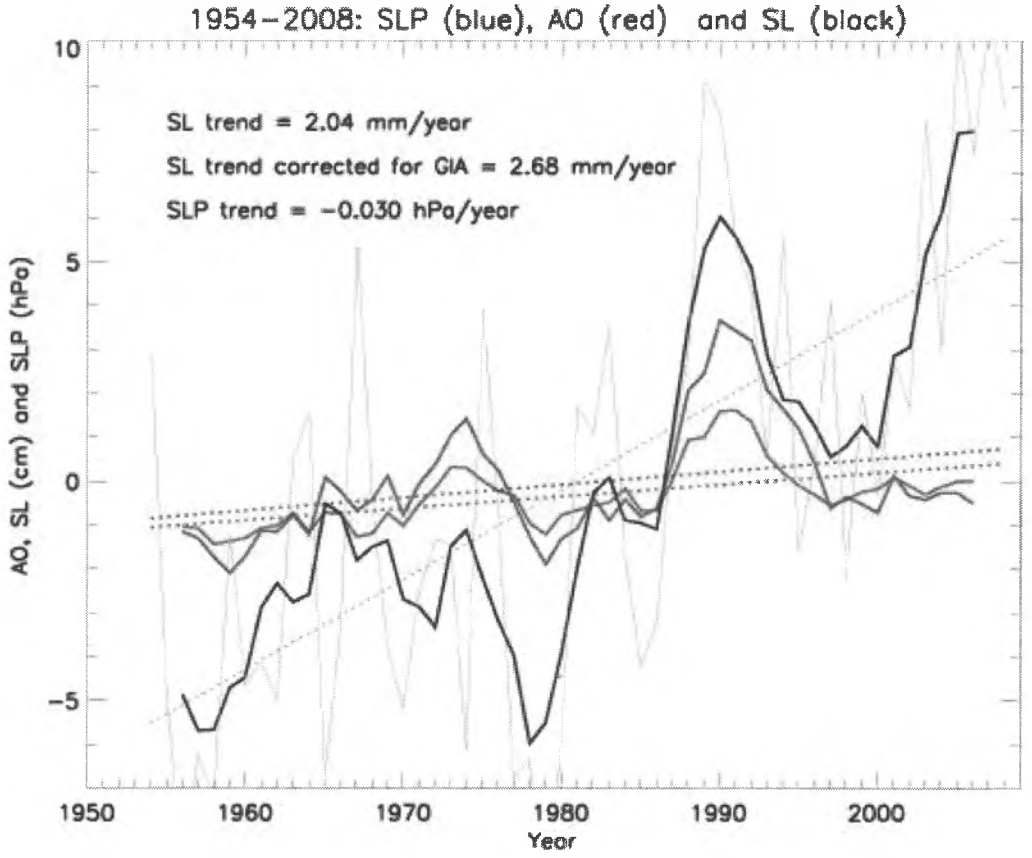

Figure O.5. The 5-yr running mean time series: annual mean sea level at nine tide gauge stations located along the Kara, Laptev, east Siberian, and Chukchi Seas' coastlines (black line). The red line is the anomalies of the annual mean AO Index multiplied by 3. The dark blue line is the sea surface atmospheric pressure at the North Pole (from NCAR–NCECEP reanalysis data) multiplied by -1. Light blue line depicts annual sea level variability.

Until 1996, SL correlates relatively well with the times series of the AO Index and sea level atmospheric pressure at the North Pole (Fig. O5). In contrast, from 1997 to 2008 the SL has generally increased, despite the more or less stable behavior of AO and SLP. Possible reasons for the rapidly rising sea level are ocean expansion, due to heating and freshening of the Arctic Ocean, and increased rates of the Greenland ice sheet melt (see Greenland essay).

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Land

J. Richter-Menge, Topic Editor

ERDC-Cold Regions Research and Engineering Laboratory, Hanover, NH

September 3, 2009

Summary

Observations of land-based changes in the Arctic cover a wide spectrum, including variations and trends in vegetation, permafrost, river discharge, snow cover, and mountain glaciers and ice caps. In general, these observations present further evidence of the impact of a general, Arctic-wide warming trend that is accompanied by high variability from year to year and region to region. For instance, the 2007/08 and 2008/09 snow cover seasons marked a continuation of the trend towards shorter snow seasons due to earlier spring melt, which has been observed during the last two decades following a rapid reduction in snow cover duration that occurred in the 1980's. Despite this overall trend, there was evidence of considerable annual and regional variability. The Arctic 2008 spring melt exhibited close to normal conditions over Eurasia, but the earliest snow cover disappearance in the period of record (1966–present) over North America. In 2008/09, the Arctic snow cover was slightly deeper than average in many areas, and the onset of snow melt was near normal or slightly later than normal across large regions of the Arctic, yet the melt intensity was sufficient to again produce an earlier than usual disappearance of snow.

Other observations reveal that there has been a general increase in land-surface temperatures and in permafrost temperatures during the last several decades throughout the Arctic region. New permafrost data from Russia show striking similarity to observations made in Alaska, with permafrost temperature typically increased by 1 to 2°C in the last 30 to 35 years. Significant losses in the mass of ice sheets and the area of ice shelves continued, with several fjords on the northern coast of Ellesmere Island being ice-free for the first time in 3000–5500 years. There continues to be a general increase of freshwater input to the Arctic Ocean from major rivers in Eurasia and North America.

Illustrating the connectivity between various elements of the Arctic system, direct observations confirm model predictions that the affects of the retreating sea ice influence the temperature and vegetation of adjacent lands. Temporal analyses generally show that, within a specific region, periods of lower sea-ice concentration are correlated with warmer land-surface temperatures and an increase in the amount of live green vegetation in the summer.

Vegetation

D. A. Walker[1], U. S. Bhatt[2], M. K. Raynolds[1], J. E. Comiso[3], H. E. Epstein[4], G. J. Jia[5], J. Pinzon[3], C. J. Tucker[3]

[1] Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, Alaska
[2] U.S., Geophysical Institute, University of Alaska–Fairbanks, Fairbanks, Alaska
[3] NASA Goddard Space Flight Center, Greenbelt, Maryland
[4] University of Virginia, Charlottesville, Virginia
[5] Chinese Academy of Sciences, Institute for Atmospheric Physics, Beijing, China

October 19, 2009

There continues to be evidence of widespread changes in vegetation in northern latitudes, primarily determined from trends in terrestrial greenness as detected by the Normalized Difference Vegetation Index (NDVI) derived from the NOAA AVHRR satellites (Myneni et al. 1997; Zhou et al. 2001; Lucht et al. 2002; Jia et al. 2003; Goetz et al. 2005; Bunn et al. 2007). Changes in land cover, vegetation density, and other factors are reflected in NDVI. Overall, increasing NDVI is consistent with warming soil and air temperatures, earlier snow melt, and the expansion of shrubs and tree line to the north.

In coastal regions, models have predicted that the retreating sea ice should affect the temperature and ecosystems of adjacent lands (e.g., Lawrence et al., 2008). Time series of sea-ice area, land temperatures, and an index of photosynthetic activity (the annual maximum NDVI or MaxNDVI) were investigated for trends and variability during the period 1982–2008 along the coastlines of 14 Arctic seas. Temporal analyses of these regional time series (not shown) consistently indicate that higher land-surface temperatures and higher NDVI values correspond to below-average sea-ice concentration (Bhatt et al., 2008, 2009).

The trend analysis shows that summer sea ice within 50 km of the coast declined in all regions, with a decrease of 25% for the northern hemisphere as a whole (Fig. 1, blue bars). The largest declines were along the northern Beringia region, including the E. Siberia (-47%), W. Chukchi (-46%), and E. Chukchi (-44%) seas. This portion of the Arctic saw large areas of summer ice retreat in 2005, 2007, and 2008.

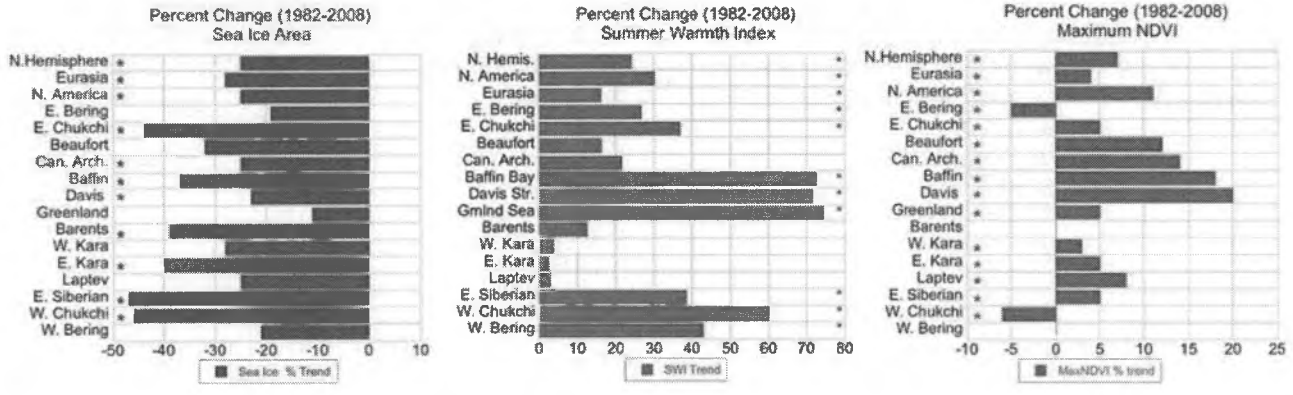

Figure 1. Blue bars: Percentage change in sea-ice area in late spring (when the long-term mean 50% concentration is reached) during 1982–2008 along the 50-km-seaward coastal margin in each of the major seas of the Arctic using 25-km resolution SSMI passive microwave Bootstrap sea-ice concentration data (Comiso and Nishio, 2008). Red bars: Percentage change in the summer land-

surface temperature landward of each sea for the entire tundra domain as measured by the summer warmth index (SWI = sum of the monthly mean temperatures above freezing, °C mo) based on AVHRR surface-temperature data (Comiso, 2003). Green bars: Percentage change in greenness for the full tundra area in the vicinity of each Arctic sea as measured by the annual maximum Normalized Difference Vegetation Index (MaxNDVI) based on revised biweekly GIMMS NDVI (Tucker et al., 2001). Asterisks denote significant trends at $p < 0.05$.

Summer tundra land temperatures as measured by the summer warmth index (sum of the monthly mean temperatures that are above freezing) increased 24% for the northern hemisphere as a whole (Fig. 1, red bars). The North America Arctic tundra experienced a 30% increase in summer land temperatures while Eurasia experienced a 16% increase. Large increases in summer warmth occurred in the vicinity of the W. Chukchi (60%) and W. Bering (43%) seas and near Davis Strait (72%), Greenland Sea (75%) and Baffin Bay (73%). Weak warming occurred along the northern coast of Russia (Laptev Sea, E. Kara Sea and W. Kara Sea).

Photosynthetic activity was determined using the MaxNDVI derived from Global Inventory Modeling and Mapping Studies (GIMMS) data set. The NDVI is an index of the photosynthetic activity that is derived from earth's reflectance in the visible and near infrared portions of the spectrum. MaxNDVI over the tundra region increased 7% for the Arctic as a whole (Fig. 1, green bars), but was variable. Larger percentage increases occurred in North America (11%) than in Eurasia (4%). The largest percentage increases were in the North American High Arctic in the vicinity of Davis Strait (20%), Baffin Bay (18%), and the Canadian Archipelago (14%) and in the Beaufort Sea (12%). Declines or no trend occurred in the Bering-Chukchi region (W. Chukchi -6%, E. Bering -5% and W. Bering 0%). The NDVI changes observed in coastal regions are in general agreement with strong increases in NDVI noted previously in the North American Arctic (Jia et al., 2003; Goetz et al., 2005; Verbyla, 2008; Raynolds et al., 2008) and with ground observations from the same regions (Tape et al., 2006; Walker et al., 2008; Epstein et al., 2008), but the new information from the High Arctic of Canada and Greenland points to previously overlooked major changes to plant productivity occurring in this region. Because of the currently low productivity in these coldest areas of the Arctic, small increases in photosynthetic activity are likely to lead to major changes in biodiversity and total plant biomass.

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Permafrost

V. Romanovsky[1], N. Oberman[2], D. Drozdov [3], G. Malkova [3], A. Kholodov[1], and S. Marchenko[1]

[1]Geophyiscal Institute, University of Alaska Fairbanks, Fairbanks, AK
[2] MIREKO, Syktivkar, Russia
[3] Earth Cryosphere Institute, Tumen, Russia

October 7, 2009

Observations show a general increase in permafrost temperatures during the last several decades in Alaska (Romanovsky et al., 2002; Romanovsky et al., 2007; Osterkamp, 2008), northwest Canada (Couture et al., 2003; Smith et al., 2005), Siberia (Oberman and Mazhitova, 2001; Oberman, 2008; Drozdov et al., 2008; Romanovsky et al., 2008), and Northern Europe (Isaksen et al., 2000; Harris and Haeberli, 2003). Most of the permafrost observatories in Alaska show a substantial warming during the last 20 years. The detailed characteristic of the warming varies between locations, but is typically from 0.5 to 2°C at the depth of zero seasonal temperature variations in permafrost (Osterkamp, 2008). It is worth noting that permafrost temperature has been relatively stable on the North Slope of Alaska during 2000–2008.

Permafrost temperature has increased by 1 to 2°C in northern Russia during the last 30 to 35 years (Figure P1). This observed increase is very similar in magnitude and timing to what has been observed in Alaska. Also, a common feature for Alaskan and Russian sites is more significant warming in relatively cold permafrost than in warm permafrost. This fact may be explained by a partial melting of constituent ice within a substantial portion of warm permafrost (upper 20–25 meters) with temperatures in this portion still below 0°C. This partial ice melting slows down the rate of permafrost warming as the temperature of permafrost approaches 0°C (Romanovsky, 2007). An especially noticeable permafrost temperature increase in the Russian Arctic was observed during the last two years. The mean annual permafrost temperature at 15-m depth increased by more than 0.3°C in the Tiksi area and by 0.25°C at 10-m depth in the European North of Russia.

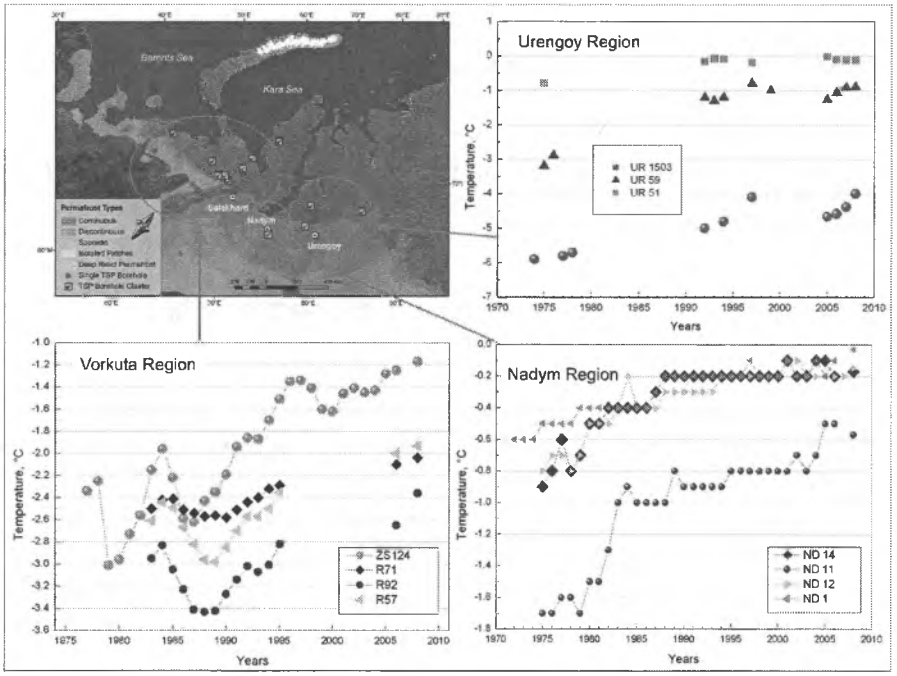

Figure P1. Left above: Location of the long-term MIREKO and the Earth Cryosphere Institute permafrost observatories in northern Russia. Left below: Changes in permafrost temperatures at 15-m depth during the last 20 to 25 years at selected stations in the Vorkuta region (updated from Oberman, 2008). Right: Changes in permafrost temperatures at 10-m depth during the last 35 years at selected stations in the Urengoy (above) and Nadym (below) regions (updated from Romanovsky et al., 2008).

The last 30-years warming in permafrost temperatures have resulted in thawing of permafrost in areas of discontinuous permafrost in Russia. Most of observed long-term thawing has occurred in the Vorkuta and Nadym research areas (Oberman, 2008). At one of the locations, the upper boundary of permafrost lowered to 8.6 m in 30 years. It lowered even more, to almost 16 m, in an area where a newly developed talik (a volume or layer of all-year-round unfrozen soil above or within the permafrost) coalesced with an already-existing lateral talik. The average increase in depth of the permafrost table in the Vorkuta and Nadym regions in Russia ranged from 0.6 to 6.7 m depending on the geographical location, ice content, lithological characteristics of sediments, hydrological, hydrogeological, and other factors.

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River Discharge

A. Shiklomanov

University of New Hampshire, Durham, NH

August 27, 2009

A general increase of river discharge to the Arctic Ocean from Eurasia was observed over the period 1936–2007, with a rate of annual change (defined from the linear trend) of 2.7 ± 0.5 km^3/year (Fig. R1). The most pronounced positive (increasing) trend for the six largest Eurasian rivers is observed during the last 21 years (1987–2007), at a rate of 11.8 km^3/year. The rate of discharge has continued to increase in the 21st century. The mean 2000–2007 discharge was 171 km^3 higher (10%) than the long-term average over the period 1936–1999. A new historical maximum for Eurasian river discharge to the Arctic Ocean was observed in 2007, reaching 2250 km^3/year or 30% higher than the long-term mean discharge from 1936–1999, reported in Peterson et al. (2002).

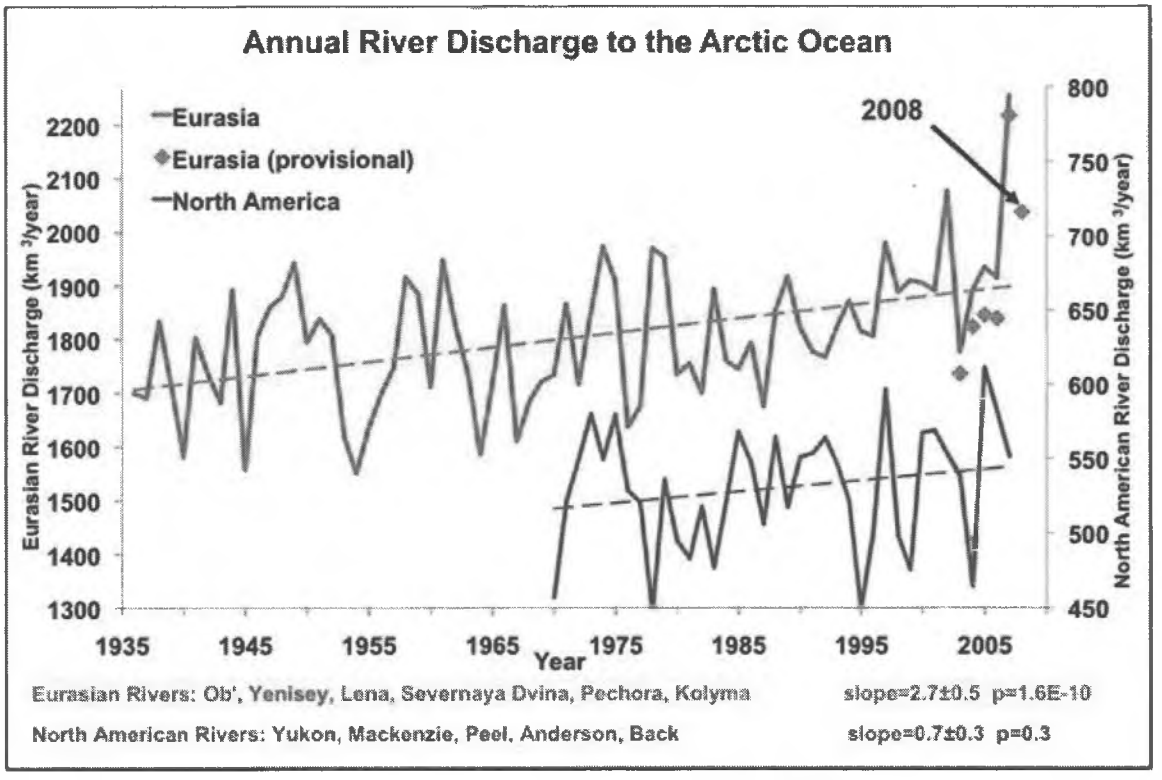

Figure R1. Total annual river discharge to the Arctic Ocean from the six largest rivers in the Eurasian Arctic for the observational period 1936–2007 (updated from Peterson et al., 2002) (red line) and from the five large North American pan-Arctic rivers over 1973–2006 (blue line). The least squares linear trend lines are shown as dashed lines. Provisional estimates of annual discharge for the six major Eurasian Arctic rivers based on near real time data from http://RIMS.unh.edu are shown as red diamonds.

The mean annual discharge to the ocean over 2000–2007 from the 5 large North American Arctic rivers based on data from the Environment Canada and USGS was about 6% (31 km^3) greater than the long-term mean from 1973–1999. The river discharge during 2007 was higher than the

long-term mean and, taking into account that this year had extremely high fresh water discharge from Greenland (Mernild et al., 2009), we can estimate that 2007 showed record high total freshwater input to the Arctic Ocean from the terrestrial land surface.

Official river discharge data are usually processed and published with some delay, the longest delay often being associated with rivers in cold regions that are ice covered for extended periods (Shiklomanov et al. 2006). To provide for more timely detection and diagnosis of changing conditions, a method to estimate near-real time river discharge from the most important Russian monitoring sites, based on provisional stage measurements and river ice data, has been developed in cooperation with the Arctic and Antarctic Research Institute (AARI) (http://RIMS.unh.edu). The provisional estimates over 2003–2007 show a tendency to underestimate the annual observed values within an error of 5% of the officially released data (Figure R1). The preliminary estimate of annual river discharge to the Arctic Ocean from the major Russian rivers in 2008 was significantly greater than the long-term mean but lower than the historical maximum observed in 2007. The North American annual river discharge to the Arctic Ocean in 2008 was probably close to or slightly higher than the long-term mean. However, this estimate is much less reliable due to gaps in near real time discharge data for major North American rivers.

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Terrestrial Snow

C. Derksen, R. Brown, and L. Wang

Climate Research Division, Environment Canada

October 7, 2009

Overview

Northern hemisphere terrestrial snow cover exhibits a high degree of intra- and inter-seasonal variability in spatial extent, covering up to 47 million km^2 in winter, and receding to as low as 4 million km^2 in summer. Across the Arctic and sub-Arctic, snow cover is a defining characteristic of the environment, covering the landscape for up to 9 months of the year. Unlike liquid precipitation, snowfall is stored on the land surface, redistributed by wind, and metamorphosed by various physical processes before the spring melt period. For a comprehensive perspective on terrestrial snow it is necessary to consider snow cover extent (SCE: the area covered by snow), snow cover duration (SCD: how long snow is on the ground), snow water equivalent (SWE: the amount of liquid water stored in the form of snow), and snow melt timing/duration (when and for how long the snow melts).

Various satellite and ground-based measurements are available to characterize these parameters across the northern hemisphere, and assess the 2007/08 and 2008/09 snow seasons relative to the historical record. Seasonal SCD departures (difference from the 1988–2007average) were computed from the NOAA snow extent data record maintained at Rutgers University (http://climate.rutgers.edu/snowcover/). SWE is more difficult to monitor than SCD due to high spatial variability, a sparse surface observation network across the Arctic, and uncertainties in satellite datasets. The Canadian Meteorological Centre (CMC) has produced a daily global snow depth analysis (~35 km resolution) since 1998 by combining the available ground observations with a snow model (Brasnett, 1999). The main snow melt onset date across the pan-Arctic land mass was derived from satellite scatterometer measurements via QuikSCAT, using the algorithm of Wang et al. (2008).

2007/08

The 2007/08 snow season was characterized by a shorter than average snow cover season over the central Canadian Arctic, most of Europe, and eastern Siberia, with a longer than average snow season in central China and the mid-latitudes of North America (Figure S1a). Time series of fall and spring SCD anomalies (departures divided by the standard deviation over the 1988–2007 period to give an indication of relative magnitude) across the North American and Eurasian sectors of the Arctic (north of 60N) are illustrated in Figure S1b. In fall, the 2007/08 snow cover season was close to the 1988–2007 average in both regions while in spring, the North American Arctic had the earliest disappearance of snow since the start of the NOAA record which dates to 1966.

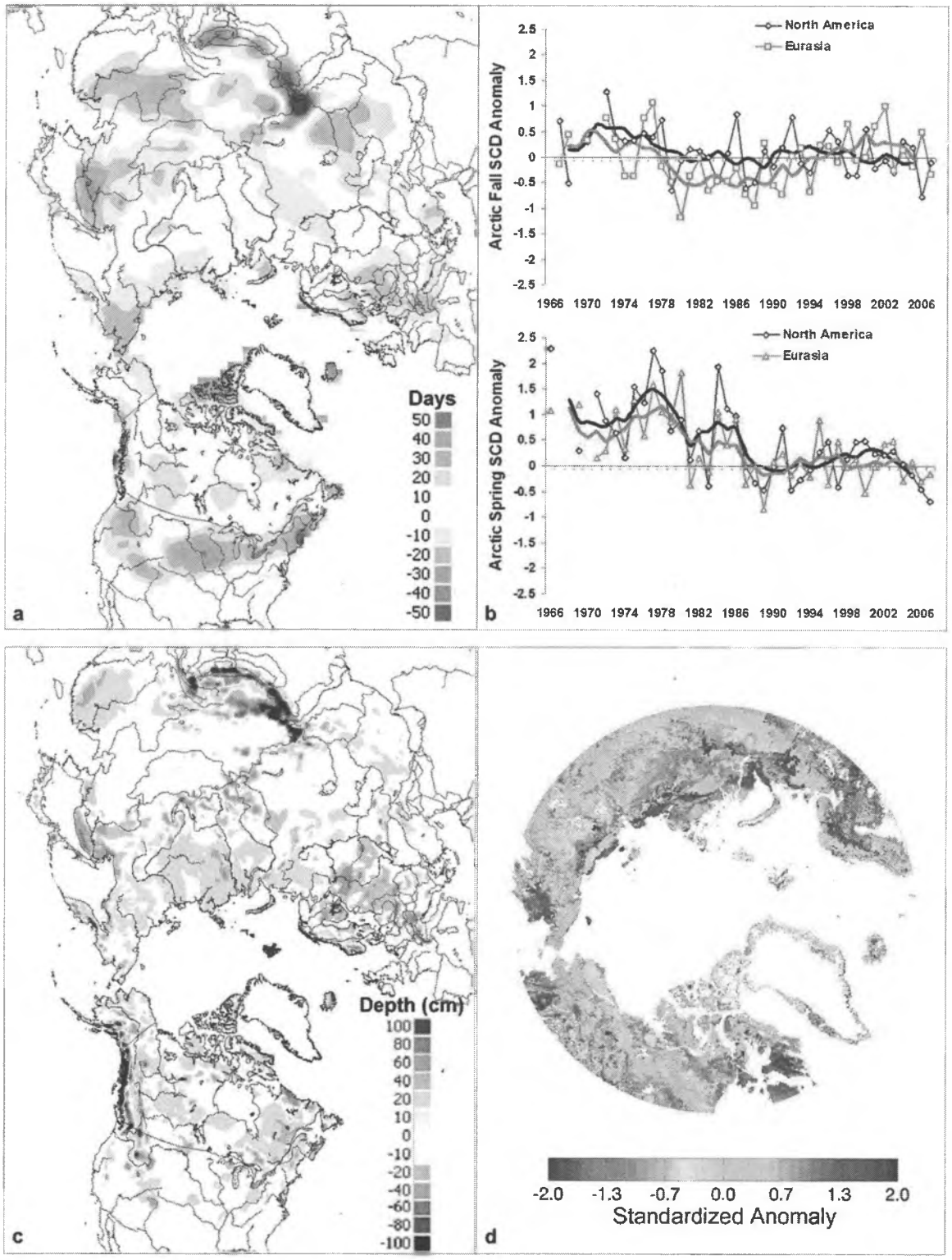

Figure S1. (a) Snow cover duration (SCD) departures (with respect to 1988–2007) for the 2007/08 snow year and (b) Arctic seasonal SCD anomaly time series (with respect to 1988–2007) from the NOAA record for the first (fall) and second (spring) halves of the snow season. Solid lines denote 5-yr moving average. (c) Maximum seasonal snow depth anomaly for 2007/08 (with respect to 1998/99–2007/08) from the CMC snow depth analysis. (d) Terrestrial snow melt onset anomalies (with respect to 2000–2008) from QuikSCAT data derived using the algorithm of Wang et al. (2008).

Maximum seasonal snow depth anomalies for 2007/08 determined from the CMC analysis are shown in Figure S1c. Below-average snow accumulation occurred across the Himalayas, Europe and northern China; above-average snow depth occurred across central North America and Siberia.

The main snow melt onset date for 2008, relative to the 9-year QuikSCAT record (2000 to 2008), confirms regional early melt onset over the North American Arctic that matches the unusually early dates of snow disappearance identified in the NOAA record (Figure S1d).

2008/09

As for the 2008/09 snow season, there was a shorter than normal snow cover season across a large portion of eastern Siberia, with strong negative anomalies in the North American sector confined to the Canadian Arctic Islands (Figure S2a). When separated for fall and spring, and averaged regionally, negative SCD anomalies were evident across Eurasia in the fall, and the entire Arctic in spring (Figure S2b). The 2009 spring Arctic snow season can therefore be characterized as shorter than normal due primarily to an early disappearance of snow cover in spring.

The shorter than average snow season in 2008/09 occurred in spite of slightly deeper than average snow depth in many parts of the Arctic (Figure S2c). Snow melt onset anomalies from QuikSCAT observations show that the initial timing of snow melt was near normal, or slightly later than normal across large regions of western Siberia, northern Europe, and the Canadian tundra (Figure S2d). Collectively, these datasets suggest that although melt was initiated near the average time, it was of sufficient intensity to rapidly remove the snowpack across large regions of the Arctic.

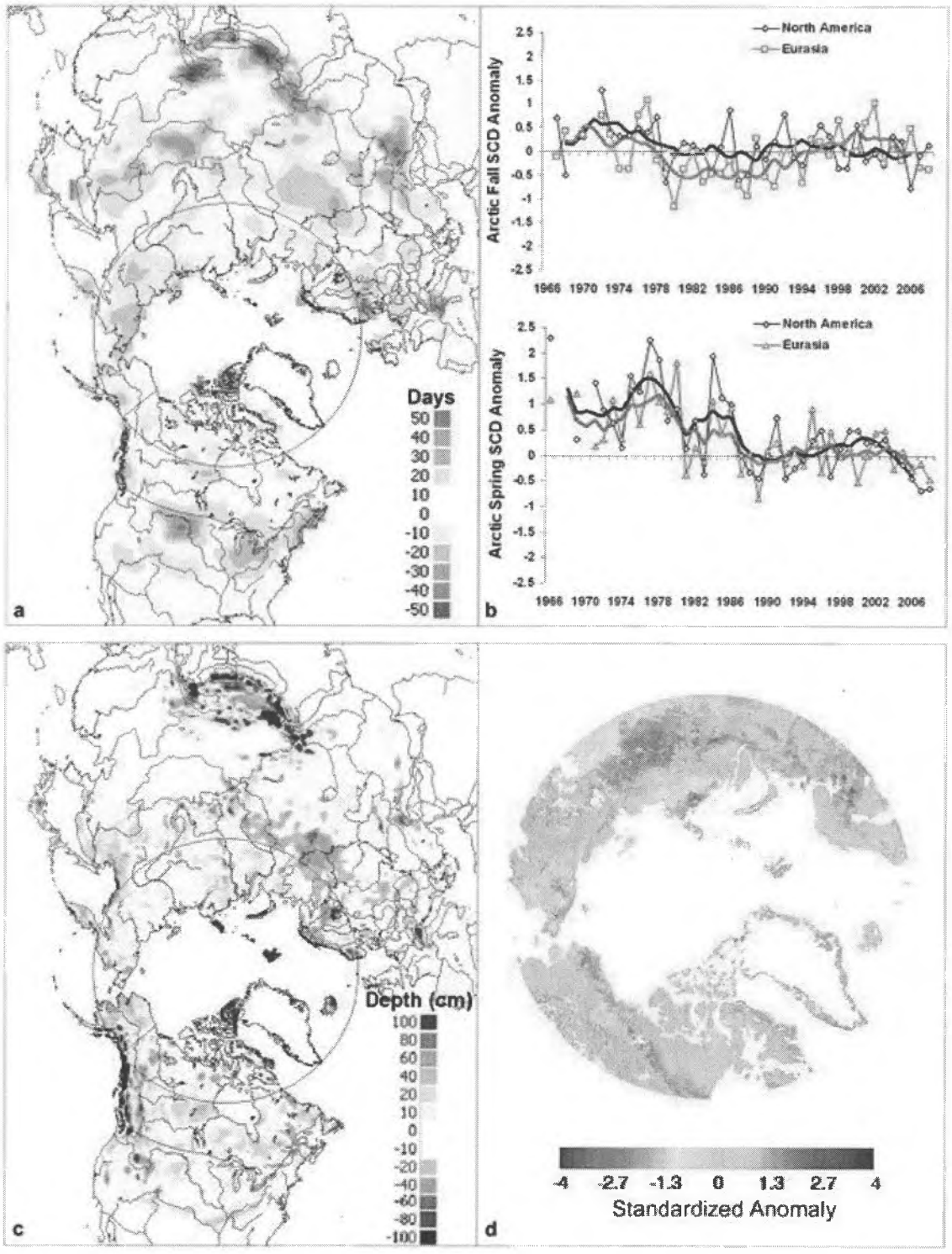

Figure S2. (a) Snow cover duration (SCD) departures (with respect to 1988–2007) for the 2008/09 snow year and (b) Arctic seasonal SCD anomaly time series (with respect to 1988–2007) from the NOAA record for the first (fall) and second (spring) halves of the snow season. Solid lines denote 5-yr moving average. (c) Maximum seasonal snow depth anomaly for 2008/09 (with respect to 1998/99–2007/08) from the CMC snow depth analysis. (d) Terrestrial snow melt onset anomalies (with respect to 2000–2009) from QuikSCAT data derived using the algorithm of Wang et al. (2008).

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Glaciers outside Greenland

M. Sharp and G. Wolken

Department of Earth and Atmospheric Sciences, University of Alberta

August 26, 2009

Glacier shrinkage is a major contributor to global sea level change, and mountain glaciers and ice caps may account for up to 60% of the total glacier contribution to sea level rise since the 1990's (Meier et al., 2007; Cazenave et al., 2009). Since the Arctic (including Alaska) contains nearly 50% of the total global mountain glacier and ice cap area, it has accounted for a large fraction of this contribution (50–60% in the 1961–2004 period) (Kaser et al., 2006).

Surface mass balance (annual net balance and its summer/winter components) measures how climate affects the health of Arctic glaciers. Measurements of this quantity on Arctic glaciers and ice caps suggest accelerating rates of mass loss since the early 1990's (Kaser et al., 2006). As most 2007–8 measurements are not yet available, we report results for the 2006–2007 balance year (Svalbard: 4 glaciers, Iceland: 6, Alaska:3, Arctic Canada:4). Annual surface balances were negative for 14 glaciers, positive for 2 (1 each in Iceland and Alaska) and zero for one (in Svalbard) (WGMS, 2009). The 2006–2007 annual surface balances were among the five most negative balances in the > 40-year long records from the four Canadian Arctic sites. These results suggest a continuation of the longer term trend of overall mass loss.

Summer (JJA 2008) 700 hPa air temperature and winter (September 2007–May 2008) precipitation data from the NCEP/NCAR Reanalysis serve as climatic indices for regions centered over each of the Arctic's major glaciated regions (excluding Greenland). Correlations between the 1948–2008 NCEP summer temperature series from 16 discrete regions form 4 groups (Alaska, Arctic Canada, Iceland, and the Eurasian Arctic). Measurements from glaciers in these regions suggest that inter-annual variability in the annual net balance arises primarily from variability in the summer balance (Arctic Canada), the winter balance (southern Alaska, Iceland) or both (Eurasian Arctic, with greater influence from the summer balance). The climatic indices therefore suggest that the annual mass balance was likely extremely negative in Arctic Canada, due to unusually warm summer air temperatures, and positive in Alaska due to strong positive winter precipitation anomalies (confirmed by GRACE satellite gravimetry; pers. comm. from S. Luthcke, 2009). Annual balance was likely near zero or slightly positive in the Eurasian Arctic (relatively cool summers and generally high winter precipitation) and negative in Iceland (warmer than average summer temperatures and below average winter precipitation).

Melt onset and freeze-up dates and 2008 melt season duration were determined from temporal backscatter variations measured by QuikScat's SeaWinds scatterometer (Table G1; Figure G1). In Arctic Canada, melt duration anomalies (relative to 2000–2004 climatology) on the N Ellesmere, Agassiz, and Axel Heiberg ice caps ranged from +17.6 to +22.5 days, largely due to late freeze-up (Table 1). Here, summer 2008 was the longest melt season in the 2000–2008 record. Melt duration anomalies were also strongly positive on northern Prince of Wales Icefield and Severnaya Zemlya, and positive in the southern Queen Elizabeth Islands and Baffin Island (Arctic Canada), Franz Josef Land, and Iceland. The melt season in southwest Alaska was the shortest in the nine-year record, with strongly negative melt duration anomalies, mostly due to early freeze-up.

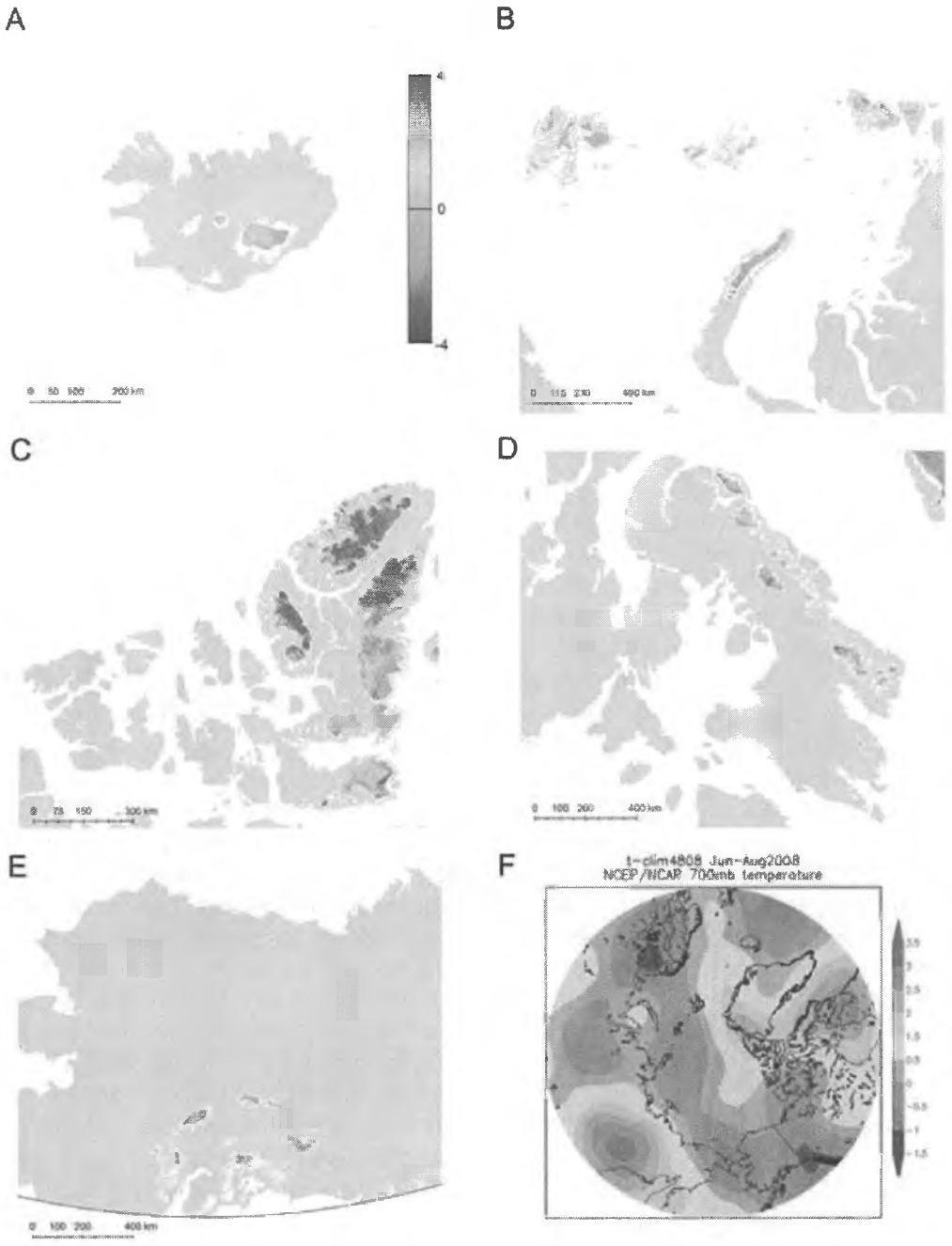

Figure G1. 2008 standardised melt duration anomalies derived from QuikScat for glaciers and ice caps in (a) Iceland, (b) the Eurasian Arctic, (c) the Queen Elizabeth Islands, (d) Baffin and Bylot Islands, and (e) Alaska. (f) Anomalies in JJA 2008 mean air temperature (degrees Celsius) at 700 hPa relative to 1948–2008 climatology from the NCEP/NCAR Reanalysis.

Table G1. Melt onset and freeze-up dates

Region	Sub-Region	Latitude (N)	Longitude (E)	JJA 700 hPa T Anomaly	2008 Rank	Sep-May Ppt Anomaly	2008 Rank	Melt Onset Anomaly	Freeze-up Anomaly	Melt Duration Anomaly
				(deg C)	(/60)	(mm)	(/60)	days	days	days
Arctic Canada	N. Ellesmere Island	80.6–83.1	267.7–294.1	2	4	12.3	10	-1.8	9.8	19.3
	Axel Heiberg Island	78.4–80.6	265.5–271.5	1.67	5	0	30	-2.9	11.4	17.6
	Agassiz Ice Cap	79.2–81.1	278.9–290.4	2.11	3	-9.2	44	5.4	24.0	22.5
	Prince of Wales Icefield	77.3–79.1	278–284.9	1.77	7	-11.4	42	2.1	7.8	10.2
	Sydkap	76.5–77.1	270.7–275.8	1.53	6	-58.5	59	3.0	3.8	1.4
	Manson Icefield	76.2–77.2	278.7–282.1	1.71	7	-62.5	56	6.4	5.7	0.0
	Devon Ice Cap	74.5–75.8	273.4–280.3	1.47	6	-8	33	0.8	-0.8	5.8
	North Baffin	68–74	278–295	1.97	2	12.4	17	-26.9	-14.4	4.9
	South Baffin	65–68	290–300	2.39	1	5.9	25	-2.8	-1.6	-1.1
Eurasian Arctic	Severnaya Zemlya	76.25–81.25	88.75–111.25	-0.36	41	38.9	17	-0.2	13.4	10.6
	Novaya Zemlya	68.75–78.75	48.75–71.25	0.29	24	78	6	21.5	-5.3	-4.2
	Franz Josef Land	80–83	45–65	-0.77	46	110	3	8.4	-2.4	6.1
	Svalbard	76.25–81.25	8.75–31.25	0.13	31	58.5	7	-6.6	-2.8	-0.8
	Iceland	63–66	338–346	0.13	27	-29.3	46	-4.2	-14.4	6.5
Alaska	SW Alaska	60–65	210–220	-0.33	40	117.4	14	3.5	-15.6	-17.7
	SE Alaska	55–60	220–230	-0.91	50	237	5	*	*	*

The total ice shelf area in Arctic Canada decreased by 23% in summer 2008 (Mueller et al., 2008). The Markham ice shelf disappeared completely and the Serson ice shelf lost 60% of its area. 90% of Arctic ice shelf area has been lost in the past century. Several fjords on the north coast of Ellesmere Island are now ice-free for the first time in 3000–5500 years (England et al., 2008).

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Greenland

J. E. Box[1], L.-S. Bai[1], R. Benson[1], I. Bhattacharya[1], D. H. Bromwich[1], J. Cappelen[2], D. Decker[1], N. DiGirolamo[3], X. Fettweis[4], D. Hall[5], E. Hanna[6], T. Mote[7], M. Tedesco[8], R. van de Wal[9], and M. van den Broeke[9]

[1]Byrd Polar Research Center, The Ohio State University, Columbus, Ohio
[2]Danish Meteorological Institute, Copenhagen, Denmark
[3]Science Systems Applications Inc. and NASA Goddard Space Flight Center, Greenbelt, Maryland
[4]Department of Geography, University of Liège, Liège, Belgium
[5]NASA Goddard Space Flight Center, Greenbelt, Maryland
[6]Department of Geography, University of Sheffield, England
[7]Department of Geography, University of Georgia, Atlanta, Georgia
[8]Department of Earth and Atmospheric Sciences, City College of New York, New York, New York
[9]Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht, The Netherlands

October 19, 2009

Summary

An abnormally cold winter across the southern half of Greenland led to substantially higher west coast sea ice thickness and concentration. Even so, record-setting summer temperatures around Greenland, combined with an intense melt season (particularly across the northern ice sheet), led the 2008 Greenland climate to be marked by continued ice sheet mass deficit and marine-terminating ice disintegration.

Regional surface temperatures

Temperature anomalies were mixed and exhibited seasonal variability (Fig. 5.17). Annual mean temperatures for the whole ice sheet were +0.9°C, but were not abnormal, given a rank of 23 of 51 years over the 1958–2008 period (Box et al. 2006). Persistent warm anomalies were evident over the northern ice sheet in all seasons. Temperatures were abnormally cold over the southern ice sheet in winter. Coastal meteorological stations around Greenland with a consistent 51-yr period (1958–2008) (Cappelen 2009) indicate a record-setting warm summer in 2008. The Upernavik (Nuuk) summer temperature was the warmest (second warmest) on record since 1873, respectively.

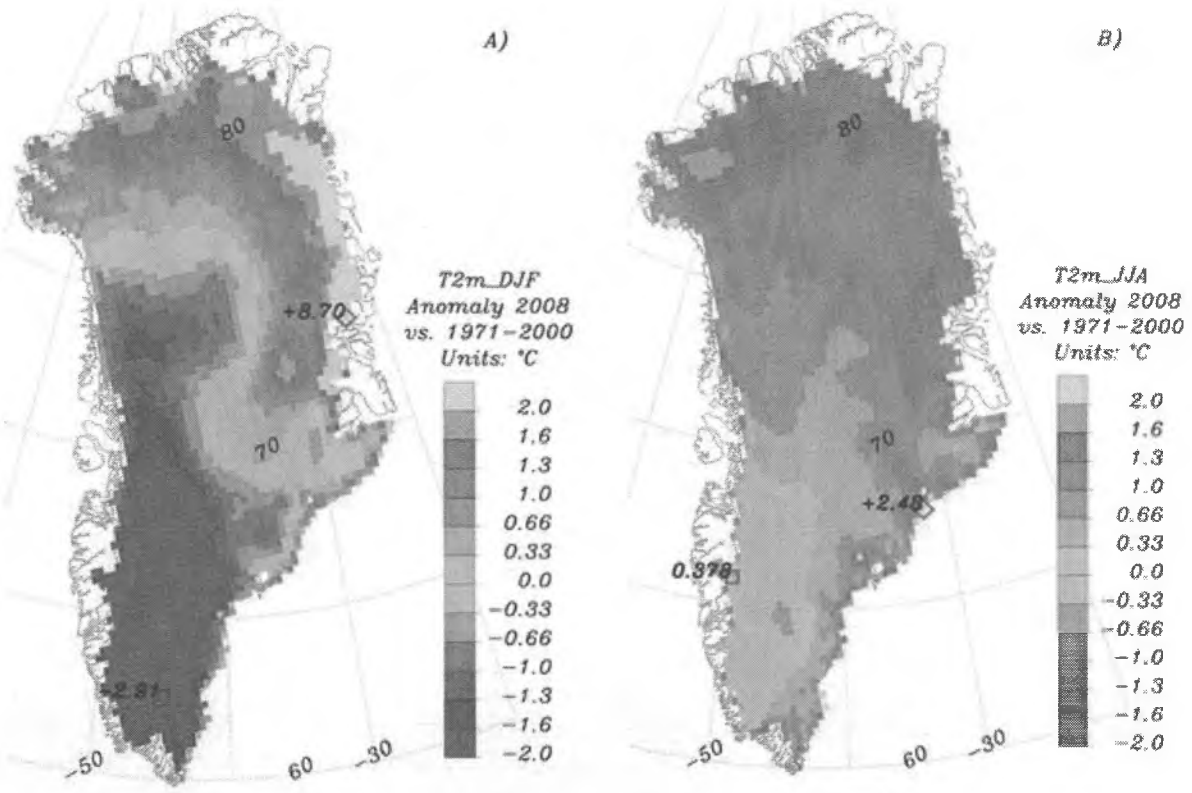

Figure G1. (a) winter and (b) summer near-surface (2 m) air temperature anomalies with respect to the 1971–2000 base period, simulated by Polar MM5 after Box et al. (2006).

Table G1. 2008 Summer 700-hPa temperature and winter precipitation anomalies (relative to 1948–2008 NCEP reanalysis means) for glaciated regions of the Arctic (excluding Greenland). Inferred sign of surface mass balance is based on comparison of historical mass balance records for each region with NCECEP reanalysis temperature and precipitation anomalies. Anomalies in melt duration and the timing of melt onset and freeze-up (relative to 2000–04 climatology) derived from QuikSCAT data. For timing, negative anomalies indicate an earlier-than-normal date.

Region	Sub-region	Latitude (°N)	Longitude (°E)	JJA 700-hPa T Anomaly	2008 Rank	Sep–May Ppt Anomaly	2008 Rank	Inferred Surface Balance	Melt Onset Anomaly	Freeze-up Anomaly	Melt Duration Anomaly
				(°C)	(N = 60)	(mm)	(N = 60)		days	days	days
Arctic Canda	North Ellesmere Island	80.6–83.1	267.7–294.1	2	4	12.3	10	—	-1.8	9.8	19.3
	Axel Heiberg Island	78.4–80.6	265.5–271.5	1.67	5	0	30	--	-2.9	11.4	17.6
	Agassiz Ice Cap	79.2–81.1	278.9–290.4	2.11	3	-9.2	44	--	5.4	24.0	22.5
	Prince of Wales Icefield	77.3–79.1	278–284.9	1.77	7	-11.4	42	--	2.1	7.8	10.2
	Sydkap	76.5–77.1	20.7–275.8	1.53	6	-58.5	59	--	3.0	3.8	1.4
	Manson Icefield	76.2–77.2	278.7–282.1	1.71	7	-62.5	56	--	6.4	5.8	0.0
	Devon Ice Cap	74.5–75.8	273.4–280.3	1.47	6	-8	33	--	0.8	-0.8	5.8
	North Baffin	68–74	278–295	1.97	2	12.4	17	--	-26.9	-14.4	4.9
	South Baffin	65–68	290–300	2.39	1	5.9	25	--	-2.8	-1.6	-1.1
Eurasian Arctic	Severnaya Zemlya	76.25–81.25	88.75–111.25	-0.36	41	38.9	17	+	-0.2	13.4	10.6
	Novaya Zemlya	68.75–78.75	48.75–71.25	0.29	24	78	6	+	21.5	-5.3	-4.2
	Franz Josef Land	80–83	45–65	-0.77	46	110	3	++	8.4	-2.4	6.1
	Svalbard	76.25–81.25	8.75–31.25	0.13	31	58.5	7	+	-6.6	-2.8	-0.8
Iceland		63–66	338–346	0.13	27	-29.3	46	-	-4.2	-14.4	6.5
Alaska	SW Alaska	60–65	210–220	-0.33	40	117.4	14	+	3.5	-15.6	-17.7
	SE Alaska	55–60	220–230	-0.91	50	237	5	++	*	*	*

Upper-air temperatures

Upper-air sounding data available from the Integrated Global Radiosonde Archive (Durre et al. 2006) indicate a continued pattern of lower tropospheric warming and lower stratospheric cooling

1964-onward (Box and Cohen 2006). Lower tropospheric warm anomalies in all seasons, particularly in spring along western Greenland, were accompanied by relatively small midtropospheric cool anomalies. Winter tropopause temperatures (200 hPa) were above normal. Lower stratospheric (above 100 hPa) temperatures were lower than normal.

Surface melt extent and duration

Passive (SMMR and SSM/I, 1979–2008) and active (QuikSCAT, 2000–08) microwave remote sensing (Bhattacharya et al. 2009, submitted to Geophys. Res. Lett.; Liu et al. 2005) indicate abnormally high melt duration over the north and northeast ice sheet and along the east and west coasts above Greenland's most productive three outlet glaciers in terms of ice discharge into the sea: Kangerlussuaq; Helheim; and Jakobshavn (Fig.G2). Lower-than-normal melt duration is evident over much of the upper elevations of the ice sheet. New records of the number of melting days were observed over the northern ice sheet, where melting lasted up to 18 days longer than previous maximum values. Anomalies near the west coast are characterized by melting up to 5–10 days longer than the average (Tedesco et al. 2008).

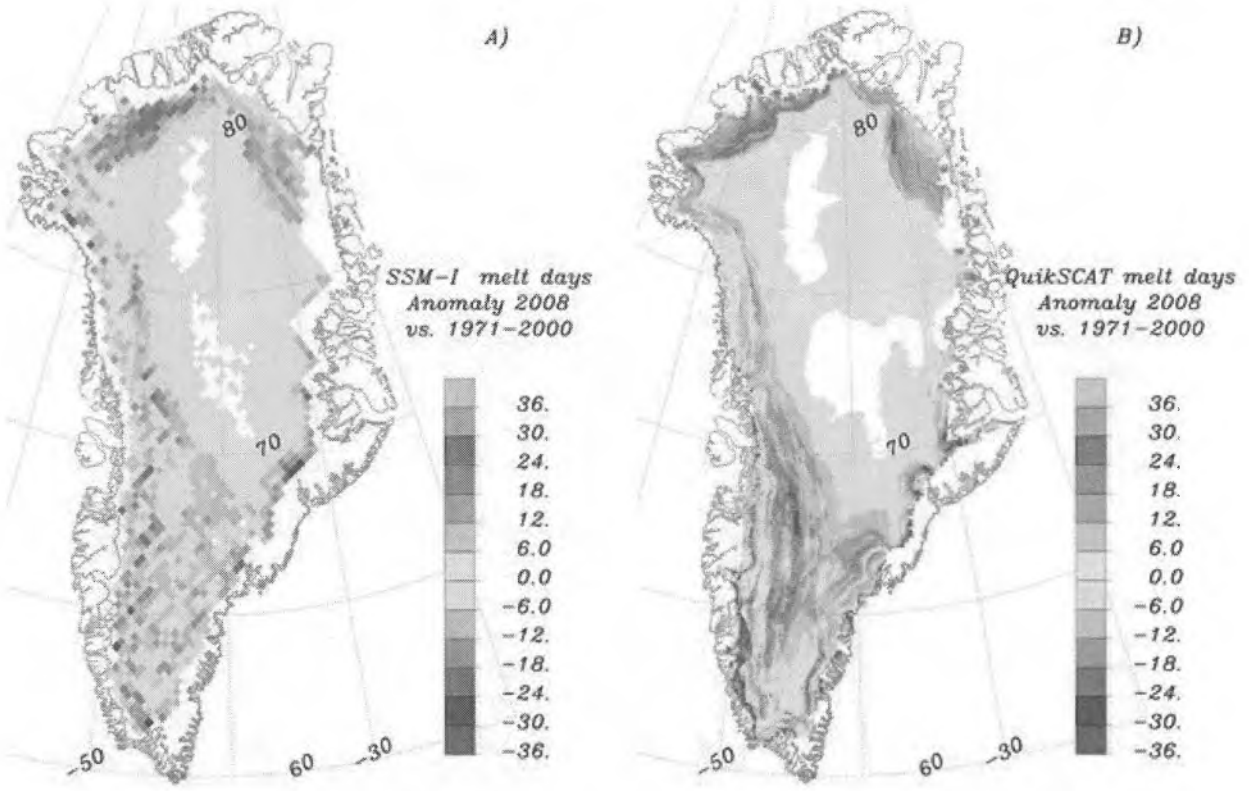

Figure G2. 2008 Greenland ice sheet surface melt duration anomalies relative to the 1989–2008 base period based on (a) SSM/I and (b) QuikSCAT (2000–08 base period), after Bhattacharya et al. (2009, submitted to Geophys. Res. Lett.).

The average daily melt extent, after Mote and Anderson (1995) and Mote (2007), for 2008 was 424,000 km^2, about 2.4% greater than the 1989–2008 average of 414,000 km^2, representing the lowest average melt extent since 2001. Significantly more melt occurred in 2008 in the northeast (45.6% greater than the 1989–2008 average) and northwest (29.7%), but less occurred in the two east-central regions (−16.8% and −25.4%) and in the southeast (−21.1%). Melt extent in 2008 was also above the 1979–2007 average. The trend in the total area of melt during 1979–2008 is approximately +15,900 km^2 yr^{-1} and is significant at the 95% confidence interval ($p < 0.01$).

Precipitation anomalies

Annual PT anomalies in 2008, determined using Polar MM5 data assimilation modeling (Bromwich et al. 2001; Cassano et al. 2001; Box et al. 2006), were positive (negative) up to 750 mm (−250 mm) over the eastern (western) ice sheet, respectively. More PT than normal occurred in isolated areas in extreme southeast, east, north, and northwestern Greenland. The overall anomaly indicated approximately 41 Gt more PT than normal for the 1971–2000 standard normal period.

Surface albedo

Melt season (day 92–274) surface albedo anomalies, derived using the Liang et al. (2005) algorithm applied to daily cloud-free MODIS imagery, indicate a lower surface albedo around the ablation zone (except the east ice sheet) (Fig. G3) resulting from the combined effect of the positive summer surface melt intensity anomaly and, in most areas, less winter snow coverage. A positive albedo anomaly is evident for the ice sheet accumulation zone and is consistent with above-average solid precipitation and/or less-than-normal melting/snow grain metamorphism.

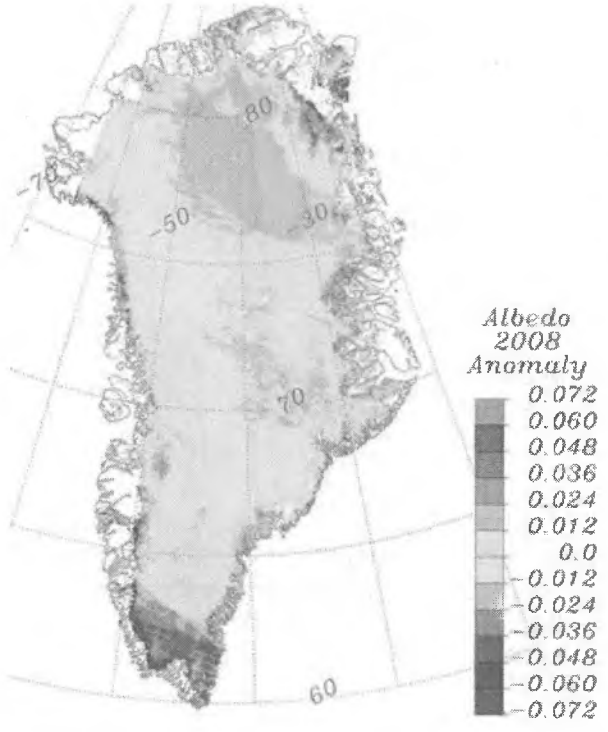

Figure G3. Surface albedo anomaly Jun–Jul 2008 relative to a Jun–Jul 2000–08 base period.

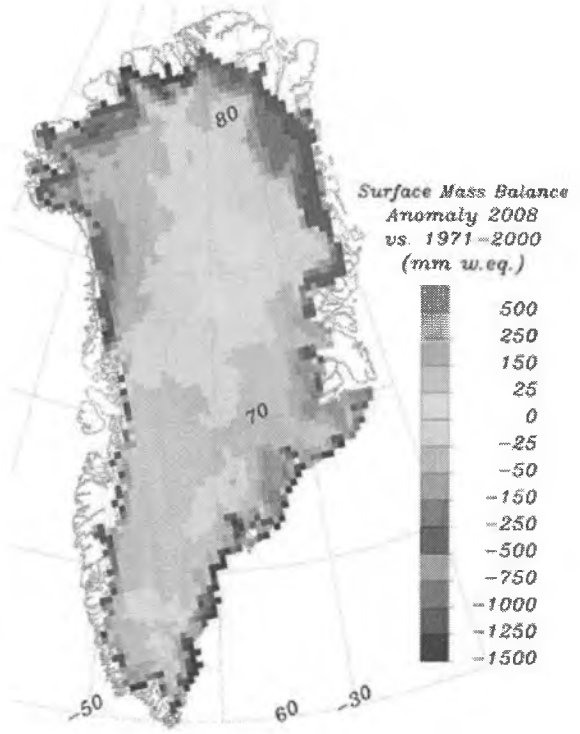

Figure G4. 2008 surface mass balance anomalies with respect to the 1971–2000 base period, simulated by Polar MM5 after Box et al. (2006).

Surface mass balance

Polar MM5 climate data assimilation model runs spanning 51 years (1958–2008), calibrated by independent in situ ice-core observations (Bales et al. 2001; Mosley-Thompson et al. 2001; Hanna et al. 2006) and ablation stakes (van de Wal et al. 2006), indicate that 2008 total precipitation and net snow accumulation was slightly (6%–8%) above normal (Table G2). In accordance with a +0.9°C 2008 annual mean surface temperature anomaly, the fraction of precipitation that fell as

rain instead of snow, surface meltwater production, and meltwater runoff were 142%–186% of the 1971–2000 mean. Consequently, and despite 6%–9% (39–50 Gt) more snow accumulation than normal, the surface net mass balance was substantially (145 Gt) below normal. 2008 surface mass balance ranked ninth-least positive out of 51 years (1958–2008).

Table G2. Greenland ice sheet surface mass balance parameters: 2008 departures from 1971–2000 average (adapted from Box et al. 2006). Estimates by Hanna et al. (2008) are included for comparison.

	Box			Hanna		
	Mean (1971–2000)	% of normal	2008 Anomaly (Gt)	Mean (1971–2000)	% of normal	2008 Anomaly (Gt)
Total Precipitation	710.7	105%	38.5	624.16	108%	52
Liquid Precipitation	16.8	142%	7.1	27.01	147%	13
Surface Water Vapor Flux	66.7	100%	−0.2	40.59	74%	−11
Blowing Snow Sumblimation	39.6	99%	−0.3			
Snow Accumulation	604.5	106%	39.0	556.56	109%	50
Meltwater Volume	330.1	159%	194.1	333.95	133%	110
Meltwater Runoff	214.9	186%	184.3	277.91	142%	116
Surface Mass Balance	389.6	63%	−145.3	305.66	83%	−53
Mean T	−19.0		0.9	−21.4		1.1
AAR	0.920	0.905%	−0.087	0.859	0.933%	−0.007

Surface mass balance anomalies indicate a pattern of increased marginal melting with noteworthy departures in excess of 1-m water equivalence per year from normal across the northern ice sheet (Fig.G4). The pattern of steepening mass balance profile is consistent with observations from satellite altimetry (Zwally et al. 2005) and airborne altimetry (Krabill et al. 2000); satellite gravity retrievals (e.g., Luthcke et al. 2006); and climate projections (Solomon et al. 2007).

Marine-terminating glacier area changes

Daily surveys of Greenland ice sheet marine terminating outlet glaciers from cloud-free MODIS imagery (http://bprc.osu.edu/MODIS/) indicate that the 34 widest glaciers collectively lost 106.4 km^2 of marine-terminating ice between the end of summer 2008 and the end of summer 2009 (Figure G4). This is equivalent to an area 20% larger than Manhattan Island (87.5 km^2), New York. The largest individual glacier losses are observed at: Humboldt (-37 km^2); Zachariae Isstrom (-31 km^2); and Midgard (-16 km^2). The 2000–2009 rate (106 km^2) has been linear (R = −0.98) despite the fact that a few individual glaciers exhibit erratic annual net ice area changes. The cumulative area change from end-of-summer 2000 to 2009 is −990 km^2, an area 11.3 times that of Manhattan Island.

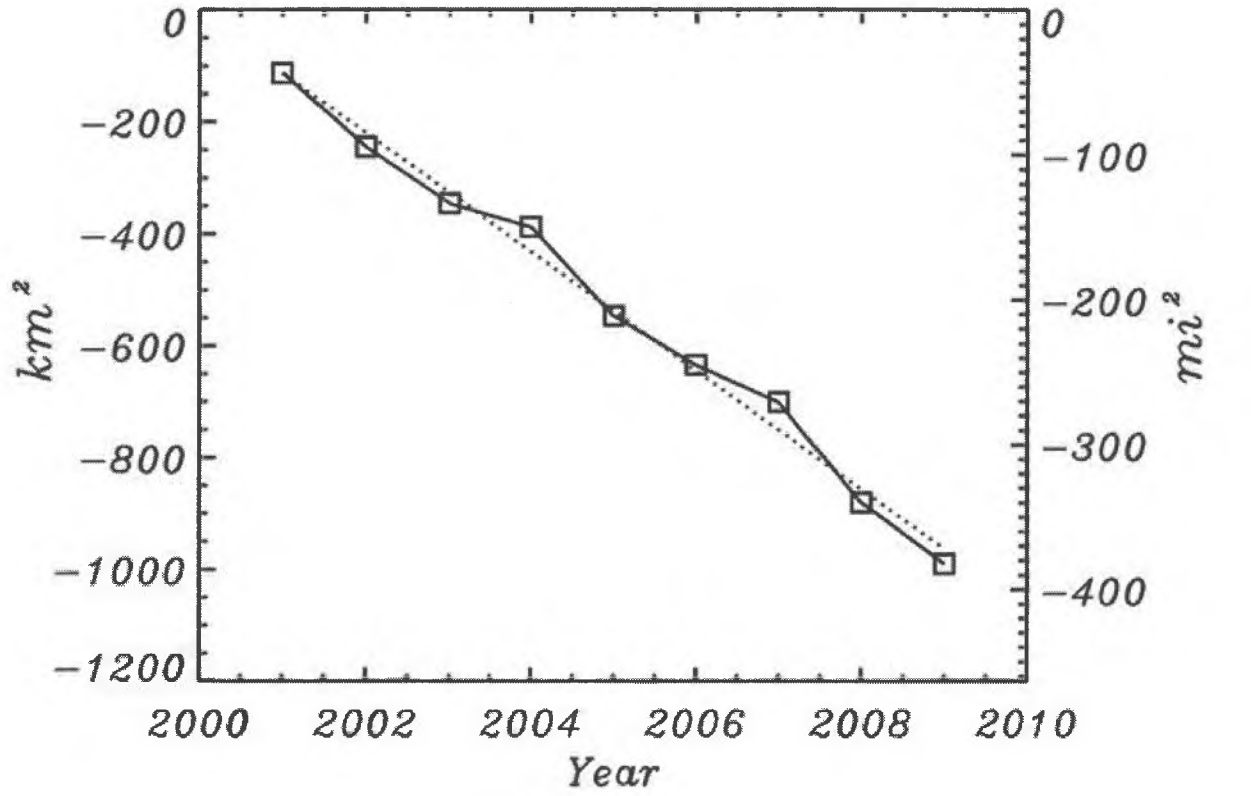

Figure G4. Cumulative annual area changes for 34 of the widest Greenland ice sheet marine-terminating outlets.

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Biology

Michael J. Gill, Topic Editor

Chair, Circumpolar Biodiversity Monitoring Program, Environment Canada, Whitehorse, Yukon CA

October 16, 2009

Summary

Broad-scale changes to Arctic wildlife populations and ecosystems illustrate the sensitivity of these systems to changing conditions, both natural and human-induced. Recent research and monitoring has shown close correlations between ocean temperatures and ecosystem states (e.g. Bering Sea fisheries) and population abundance (e.g. Murres). Also, in some instances, largely synchronous, pan-Arctic periods of abundance and scarcity suggest large-scale mechanisms (e.g. continental climate oscillations) are important determinants of population trajectories for some species. Recent examples of these close connections are the declines in wild caribou and reindeer herds across the Arctic, which are thought to be part of a long-term natural cycle. The strong linkages between arctic ecosystems and physical conditions are cause for concern as the Arctic is experiencing and expected to continue to experience rapid and wide-scale changes in temperatures and associated conditions (e.g. sea ice extent, permafrost). Broad changes in wildlife abundance and distributions are expected, with some early evidence of these changes already emerging (e.g. sea-ice dependent marine mammals such as walrus and polar bears). However, our current understanding of the response of arctic wildlife and ecosystems to both natural and human-induced change is limited. More coordinated research and monitoring is required to provide an accurate picture as to how these systems may be responding to a changing Arctic.

State of Wild Reindeer Herds

D. Russell

Scientist Emeritus, Canadian Wildlife Service, Environment Canada, Yukon, Canada

October 19, 2009

Summary

Rangifer (wild reindeer and caribou) herds across the circumpolar north have long been characterized by periods of abundance and periods of scarcity. Recent population estimates indicate we may be entering a period of declining numbers. Populations that have been increasing at a steady rate since the early to mid 1970's are either showing signs of peaking or beginning to decline. Figure R1 shows the current status of selected *Rangifer,* the major migratory herds and herds being monitored as part of the CARMA Network (see note on CARMA at bottom of this article). In 2009, a number of population counts were made available, which illustrates the diversity of trends across the arctic.

- On the Alaskan coastal plain the Teshekpuk Lake Herd (TLH) and the Central Arctic Herd (CAH) continued to increase by 5–7% per year. Counted in 2008 the TLH numbered 64,000 up from 45,000 in 2002. The CAH in 2008 were estimated at 67,000 up from 32,000 in 2002.
- In the Central barrens attempts to count the Beverly herd failed because only a few hundred breeding females could be found on the traditional calving grounds. The Beverly herd was last counted in 1994 when the population was estimated at 276,000 animals.
- The Bathurst Caribou herd was counted in 2009 and, although an estimate is not finalized, biologists believe the count will be less than 50,000 animals down from a population peak of over 470,000 in 1986.
- Across the north a number of herds were counted in 2009 or are scheduled to be counted in 2010 in an effort to more closely monitor the apparent declines that are occurring.

Most feel the general declines that the north is experiencing are part of a natural cycle. However during this population scarcity many are concerned that the increased threats of climate change, increased industrial expansion in the north and the increased sophistication and mobility of harvesters will require more careful monitoring and analysis of population response. The CircumArctic *Rangifer* Monitoring and Assessment (CARMA) Network (http://www.rangifer.net/carma/) was formed in response for a need to cooperate and coordinate monitoring efforts across the north. The Network is taking advantage of the International Polar Year initiative to increase its monitoring and assessment activities.

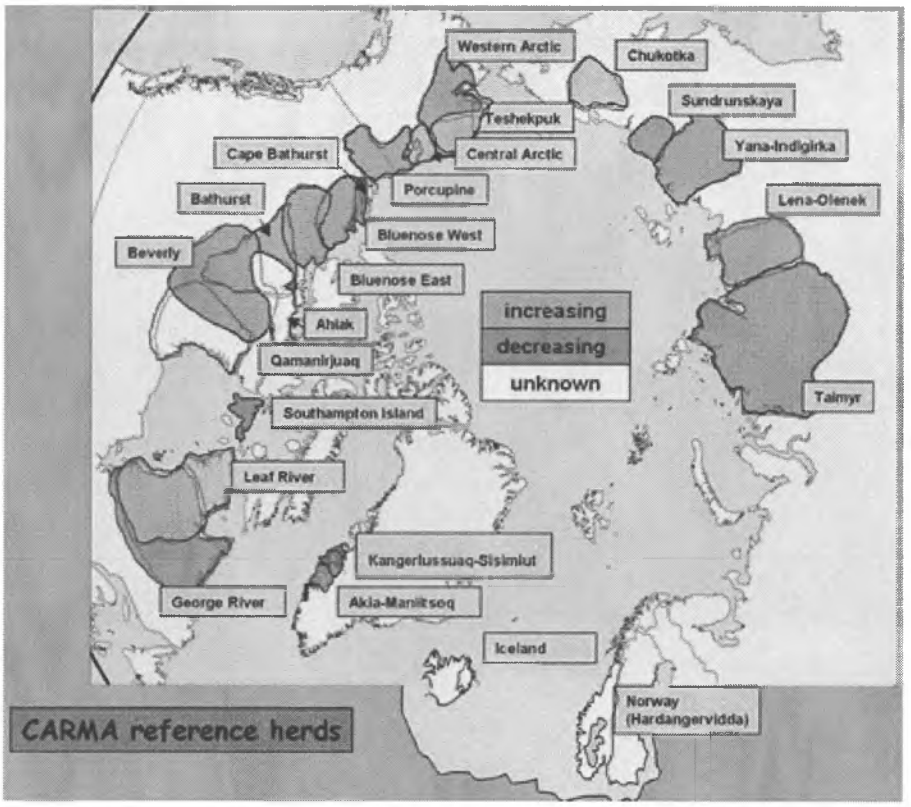

Figure R1. Current status of the main migratory herds across the circumpolar north.

Additional Information

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Marine Mammals

M. Simpkins

NOAA Fisheries Service

October 19, 2009

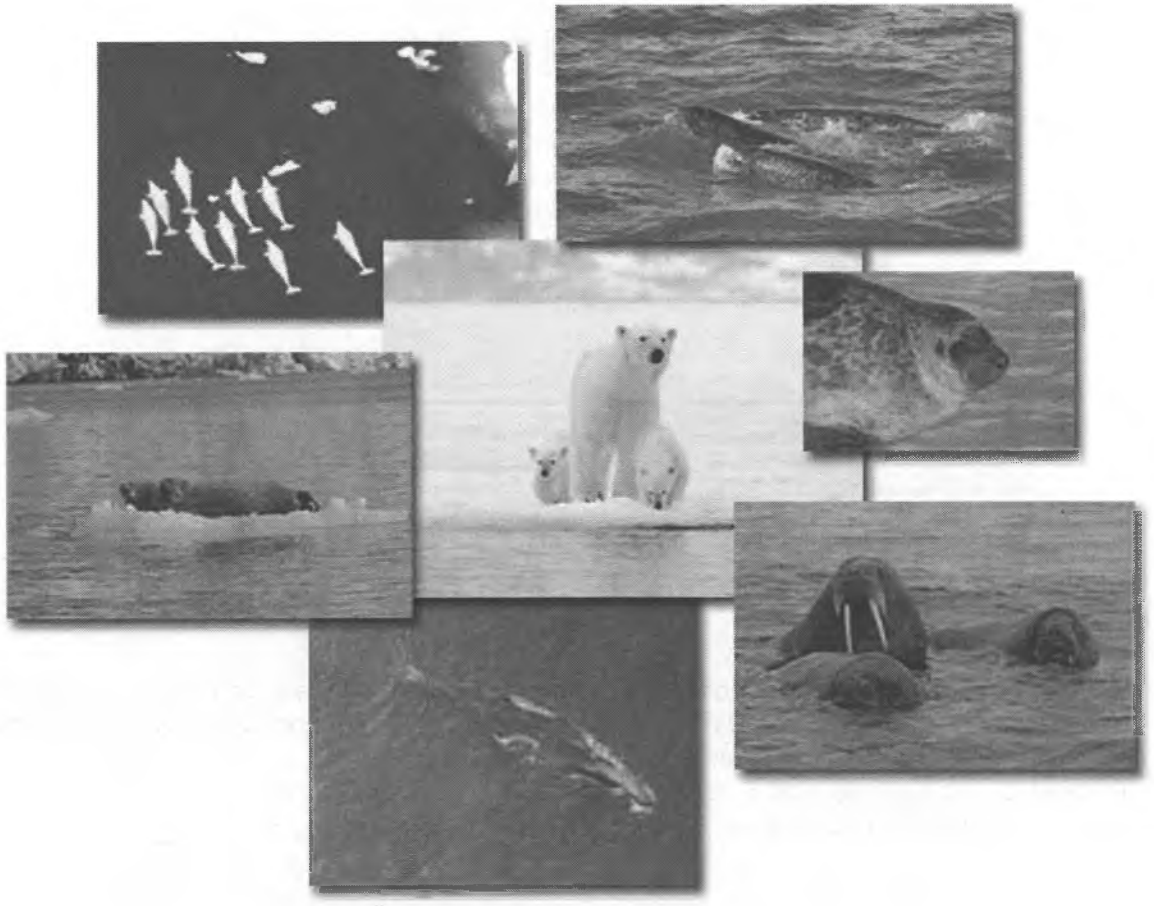

Figure M1. Marine mammals found in the Arctic. Clockwise from the upper left: Beluga whales, Narwhal, Ringed seal, Walrus, Bowhead whale, Bearded Seal, and center, Polar Bear.

A variety of marine mammals can be found in the Arctic at least seasonally. Seven species are present in the Arctic year-round and are often associated with sea ice—bowhead whale, beluga whale, narwhal, ringed seal, bearded seal, walrus, and polar bear. All seven of these species are important top predators within Arctic marine ecosystems. As such they may serve as sentinels of Arctic climate change, with changes in their status reflecting ecosystem-wide perturbations[1]. Table M1 summarizes current knowledge regarding the abundance and trends of these species. Unfortunately, abundance estimates are not available for one or more populations of most species, and trends are unknown for even more populations. Further, some of the available estimates are based on data from the 1990s or earlier and, therefore, are out of date. It is clear, even from this limited information, that several populations of Arctic marine mammals are quite small (e.g., Ungava Bay and Cook Inlet belugas, Lake Saimaa ringed seals, and several stocks of polar bears each have 400 or fewer animals), and this raises concerns about the potential impact of

catastrophes such as oil spills or disease outbreaks. Also, all species with sufficient data exhibit mixed population trends, with some populations of each species increasing while others are stable or declining. The available data are not sufficient for an analysis of trends by region (e.g., to highlight regions within which populations of several species are all increasing or all declining). However, it is likely that species within a region will exhibit different trends because they occupy very different ecological niches, ranging from the bowhead whale that filters zooplankton out of the water to the polar bear that hunts seals on the sea ice (Table M2).

A comprehensive assessment of the status of Arctic marine mammals must consider current population demography and dynamics as well as the resistance or resilience of each species to current and projected threats. Arctic marine mammals appear to be in a tenuous position—they are adapted to life in seas that are at least seasonally ice-covered, and the extent of summer ice cover is rapidly diminishing[41]. These species are long-lived and reproduce slowly and, although they have persisted through ice ages and interglacial periods in the past, it is unclear how quickly they can adapt to rapid changes in habitat. The impacts of reduced sea ice vary depending on the ecological relationship between each species and sea ice[41] (Table M2). A recent special publication of Ecological Applications provides a comprehensive review of the likely impacts of climate change on Arctic marine mammals[42], and other reviews discuss impacts of climate change on marine mammals broadly at a global scale[43] and in more detail for the North Atlantic Arctic[44].

Although assessment of future impacts is by its very nature speculative, currently observed impacts on polar bears and walruses indicate that Arctic marine mammals will almost certainly be affected by the predicted changes in Arctic marine ecosystems [45]. Reduced sea ice has already been implicated in lower body condition and reduced survival of polar bears in western Hudson Bay, and similar impacts are likely elsewhere as sea ice breaks up earlier and bears are forced to fast on shore longer [46,47]. The record sea ice retreat of 2007 caused Pacific walruses to haul out along the shores of Alaska and Russia in unusually large numbers and in new locations [48]. The immediate impact of this redistribution was an increase in trampling deaths as walruses on shore stampeded in response to terrestrial disturbances [48]. Over the long-term, walruses could deplete nearshore benthic resources if they are forced to use land haul-out sites exclusively in the future. Similar shifts in the seasonal distribution of all Arctic marine mammals are likely. For example, species that are strongly tied to sea ice habitats, such as the polar bear and ringed seal, may be limited in the future to areas with sea ice refugia (e.g., summer sea ice is predicted to persist longer in the Canadian Arctic Archipelago than elsewhere), whereas sub-Arctic or migratory species may be able to access areas where sea ice had previously excluded them[41]. Further, species or populations that either migrate with the sea ice edge or make forays to the ice edge from coastal areas may have to travel farther and expend more energy as the summer sea ice edge retreats farther from the coast and from the location of the winter ice edge [49,50].

In addition to the more obvious impacts that changes in the distribution and quality of habitat will have on the distribution of Arctic marine mammals, early spring rains could cause ringed seal lairs to collapse, exposing their pups to hypothermia and increased predation by polar bears and arctic foxes [51], and it has been suggested that increased variability in sea ice and weather conditions could result in more frequent ice entrapments of narwhals and belugas [52,53]. Further, changes in the seasonality of ice retreat could result in changes in the timing and location of phytoplankton blooms (e.g., associated with the melting ice edge or in open water following ice retreat), which in turn could influence both the total amount of primary production and the allocation of that production among pelagic and benthic food webs [39]. Of course, in addition to environmental impacts, reduced sea ice will make the Arctic more accessible for some species (e.g., gray whales[1]) and for human activities, some of which could impact marine mammals (e.g., oil spills, habitat alteration, prey removals, contaminants, and ship strikes). Also, all of these species are harvested for subsistence, with varying degrees of regulation among populations and regions.

Given the threats (both observed and predicted) facing marine mammals, there is justifiable cause for concern regarding populations that are small or declining, as well as those for which information is insufficient. Expanded and accelerated research and monitoring efforts will be necessary to detect changes in the status of Arctic marine mammal populations and to identify the causes of those changes in time to allow developing problems to be addressed [54,55,56].

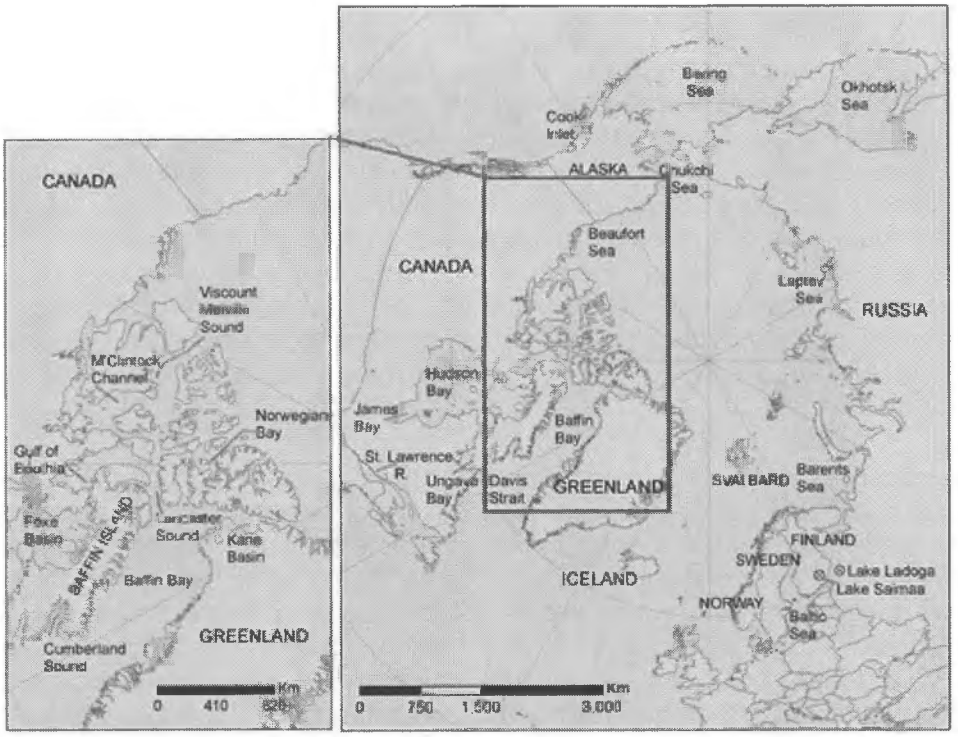

Figure M2. Map of the Arctic with place names referred to in the text or in Table M1.

Table M1. Current abundance and trends of Arctic marine mammal species. Information on abundance, trends, and most recent data (year) are summarized by biological stock, except for ringed seals, bearded seals, and walruses, whose stock structure is unknown (see table footnotes). Figure M2 indicates the locations of place names referred to here. Citation numbers refer to literature cited.

Species	Stock	Abundance	Year	Trend	Citation(s)
Bowhead whale	Bering-Chukchi-Beaufort Seas	10,500	2001	increasing	2
	E. Canada-W. Greenland	6,300	2002–2004	increasing	3,4
	Spitsbergen	unknown	—	unknown	5
	Okhotsk Sea	<400	1979	unknown	5
Beluga whale	Cook Inlet	380	2007	stable	6
	Eastern Bering Sea	18,100	2000	unknown	7
	Bristol Bay	3,300	2005	increasing	6
	Eastern Chukchi Sea	3,700	1989–1991	unknown	6
	Eastern Beaufort Sea	39,300	1992	unknown	6
	Foxe Basin	1,000	1983	unknown	8
	Western Hudson Bay	57,300	2004	unknown	9
	Southern Hudson Bay	1,300	1987	unknown	10
	James Bay	4,000	2004	unknown	11
	St. Lawrence River	1,200	2005	stable	12

	Eastern Hudson Bay	4,300	2004	declining	13
	Ungava Bay	<50	2007	unknown	14
	Cumberland Sound	1,500	1999	increasing	15
	E. High Arctic-Baffin Bay	21,200	1996	stable	16
	West Greenland	7,900	1998–1999	unknown	17
	3 stocks in Okhotsk Sea	18–20,000	1987	unknown	18
	11 additional stocks	unknown	—	unknown	
Narwhal	Canadian High Arctic	>60,000	2002–2004	unknown	19
	Northern Hudson Bay	3,500	2000	unknown	20
	West Greenland	2,000	1998–999	unknown	21,22
	East Greenland	>1,000	1980–1984	unknown	21,23
Ringed seal[a]	Arctic subspecies	~2.5 million	1970s	unknown	24
	Baltic Sea subspecies	5,000–8,000	1990s	mixed	25
	Lake Saimaa subspecies	280	2005	increasing	26
	Lake Ladoga subspecies	3,000–5,000	2001	unknown	27
	Okhotsk Sea subspecies	>800,000	1971	unknown	24
Bearded seal[b]	Bering-Chukchi Seas	250–300,000	1970s	unknown	28
	Canadian waters	190,000	1958–1979	unknown	29
	Atlantic and Russian Arctic	unknown	—	unknown	
	Okhotsk Sea	200–250,000	1968–1969	unknown	28
Walrus[c]	Bering-Chukchi Seas	~201,000	1990	unknown	30
	Atlantic subspecies	18–20,000	2006	mixed	31,32,33,34
	Laptev Sea	4,000–5,000	1982	unknown	35
	Other regions	unknown	—	unknown	
Polar bear[d]	Chukchi Sea	2,000	1993	unknown	36
	Southern Beaufort Sea	1,500	2006	declining	36
	Northern Beaufort Sea	1,200	1986	stable	36
	Viscount Melville Sound	220	1992	increasing	36
	McClintock Channel	280	2000	increasing	36
	Norwegian Bay	190	1998	declining	36
	Lancaster Sound	2,500	1998	stable	36
	Gulf of Boothia	1,500	2000	stable	36
	Foxe Basin	2,200	1994	stable	36
	Western Hudson Bay	940	2004	declining	36
	Southern Hudson Bay	1,000	1988	stable	36
	Baffin Bay	2,100	1998	declining	36
	Davis Strait	1,700	2004	unknown	36
	Kane Basin	160	1998	declining	36
	Barents Sea	2,700	2004	unknown	37
	Laptev Sea	4,000–5,000	1993	unknown	36
	3 other stocks	unknown	—	unknown	

[a] Ringed seal stock structure unknown; information summarized for five recognized subspecies.
[b] Bearded seal stock structure unknown; information summarized for geographic regions.
[c] Walrus stock structure unknown; information summarized for Atlantic subspecies and geographic regions for Pacific subspecies.
[d] Recent analysis of genetic, ecological and life history data from Canadian polar bears suggests that their stock structure may need to be revised [38].

Table M2. Key Arctic marine mammal species ecology		
Species	**Primary Diet** [39]	**Relationship with Sea Ice Habitat** [40]
Bowhead whale	Zooplankton (filter feeder)	Forage in productive marginal ice zone
Beluga whale	Diverse fishes and invertebrates	Refuge from predation? Access ice-associated prey
Narwhal	Ice-associated and benthic fishes (deep diver)	Forage in areas of very dense ice
Ringed seal	Diverse fishes and invertebrates	Resting and nursing platform Access ice-associated prey
Bearded seal	Benthic invertebrates	Resting and nursing platform Access to benthic foraging grounds
Walrus	Benthic invertebrates	Resting and nursing platform Access to benthic foraging grounds
Polar bear	Seals (primarily ringed) and other marine mammals	Hunting platform

Acknowledgments

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Bowhead: Julie Mocklin, National Marine Mammal Lab, AFSC, NMFS, NOAA
Beluga: Laura Morse, National Marine Mammal Lab, AFSC, NMFS, NOAA
Narwhal: Kristin Laidre, University of Washington
Ringed seal: Brendan P. Kelly, University of Alaska Southeast
Bearded seal: Ian Stirling, Environment Canada
Walrus: Ian Stirling, Environment Canada
Polar bear: Ian Stirling, Environment Canada
Collage created by Tracey Nakamura, NOAA/PMEL

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Murres

T. Gaston, G. Gilchrist

Environment Canada, National Wildlife Research Centre, Carleton University, Ottawa, Canada K1A 0H3

September 9 , 2009

Introduction

The two species of murres (N. America)/guillemots (Europe), *Uria lomvia* (Thick-billed Murre) and *U. aalge* (Common Murre), both have circumpolar distributions, the former breeding in Arctic and Subarctic regions, from northern Norway, Iceland, Newfoundland and the Aleutian Islands to the High Arctic, while the latter is predominantly a Subarctic and Boreal species breeding from California, the Gulf of St. Lawrence and northern Spain to the northern Bering Sea, Labrador and Bjornoya (Bear Island). In winter, *U. lomvia* occurs mostly in Arctic waters, while *U. aalge*, although overlapping extensively with *U. lomvia*, is found predominantly in subarctic and temperate waters (Figs 1 and 2). They are among the most abundant seabirds in the northern hemisphere, with both species exceeding 10 million adults (Gaston and Jones 1998).

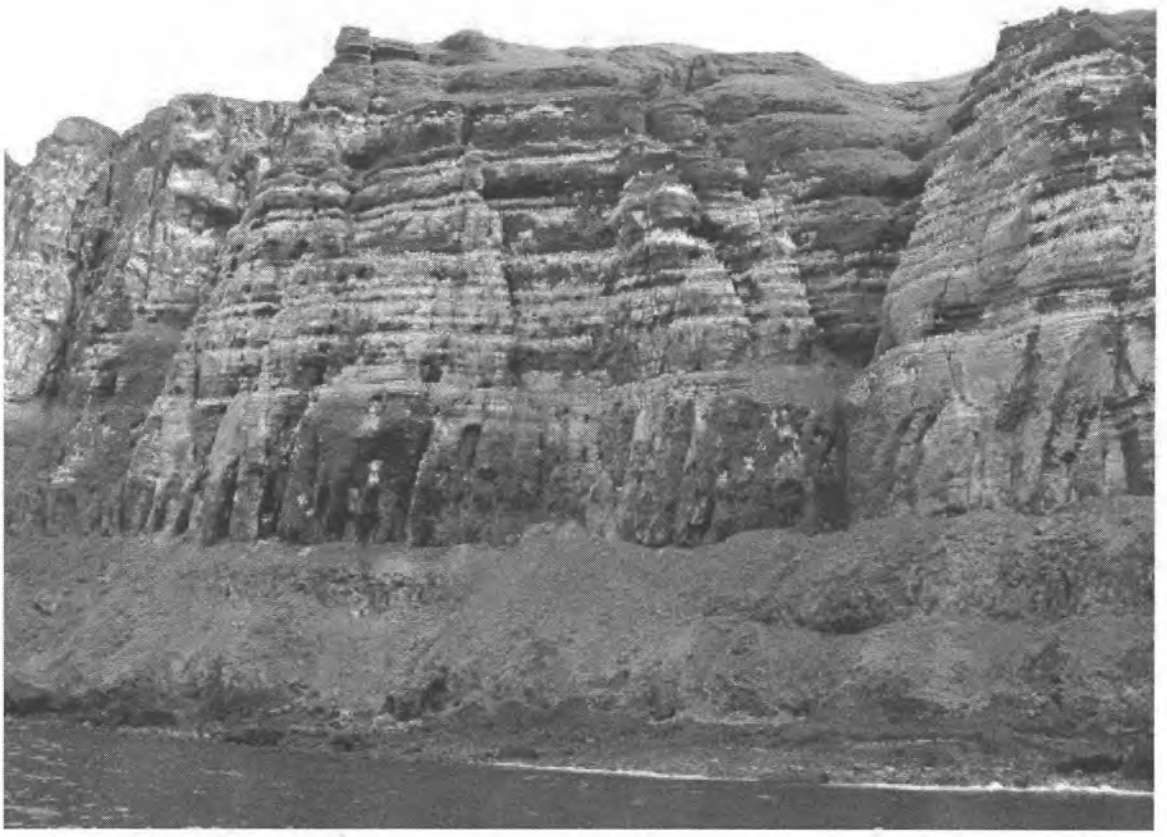

Figure 1. St. Lawrence Island, Bering Sea, Alaska (Lisa Sheffield).

Figure 2. Murres on St. Lawrence Island, Bering Sea, Alaska (Lisa Sheffield).

Murres feed from coastal to pelagic waters, taking a wide range of small fish (<50 g) and invertebrates, including annelids, pteropod and cephalopod molluscs, and mysid, euphausiid, amphipod and decapod crustacea. Common Murres generally feed more on fish than Thick-billed Murres (Gaston and Jones 1998, Anker-Nilssen et al. 2000). Adults of both species weigh about 1 kg, can remain under water for up to 4 min and dive regularly to depths >100 m, reaching a maximum depth of ~150 m. Their diving capacity, when combined to their typical foraging radius of up to100 km from the colony, means that murres sample a relatively large volume of the marine environment around their colonies (Falk et al. 2000, Elliott et al. 2008).

Murres have proven useful indicators of environmental change in studies of population trends (Gaston et al. 2009), nestling growth (Barrett 2002, Gaston et al. 2005) and nestling diet (Osterblom et al. 2001). They breed in very large colonies of up to 1 million birds on mainland cliffs or offshore islands. In most places, they lay their eggs in the open, making breeding adults simple to count. Consequently, their population trends are relatively easy to assess and this, allied to their abundance and widespread distribution, makes them ideal subjects for circumpolar environmental monitoring. In addition, being robust birds and returning annually to the same breeding sites, they are useful platforms on which to deploy depth and temperature recorders, GPS and geolocator tags. These devices have greatly amplified the value of the birds for environmental monitoring.

Status and Trends

The sensitivity of murre populations to changes in environmental conditions has been demonstrated on a hemispheric scale in recent studies by the Seabird Working Group of CAFF

(C-Bird). Irons et al. (2008) combined population trend data from around the Arctic with information on surface sea temperature (SST) and decadal-scale oscillations, to show that both species of murre showed negative population trends where there was a large change in SST, either warmer or cooler. Colony growth was most often positive where conditions remained relatively stable (Fig. 3). More specifically, the northern species, *U. lomvia*, exhibited highest population growth where conditions warmed moderately. *U. aalge* showed highest rates of increase where things cooled moderately. In the context of global warming, this result suggests that not only the direction but the magnitude of change may be important in determining outcomes and that Common and Thick-billed Murres may not necessarily react in the same way to a given temperature change.

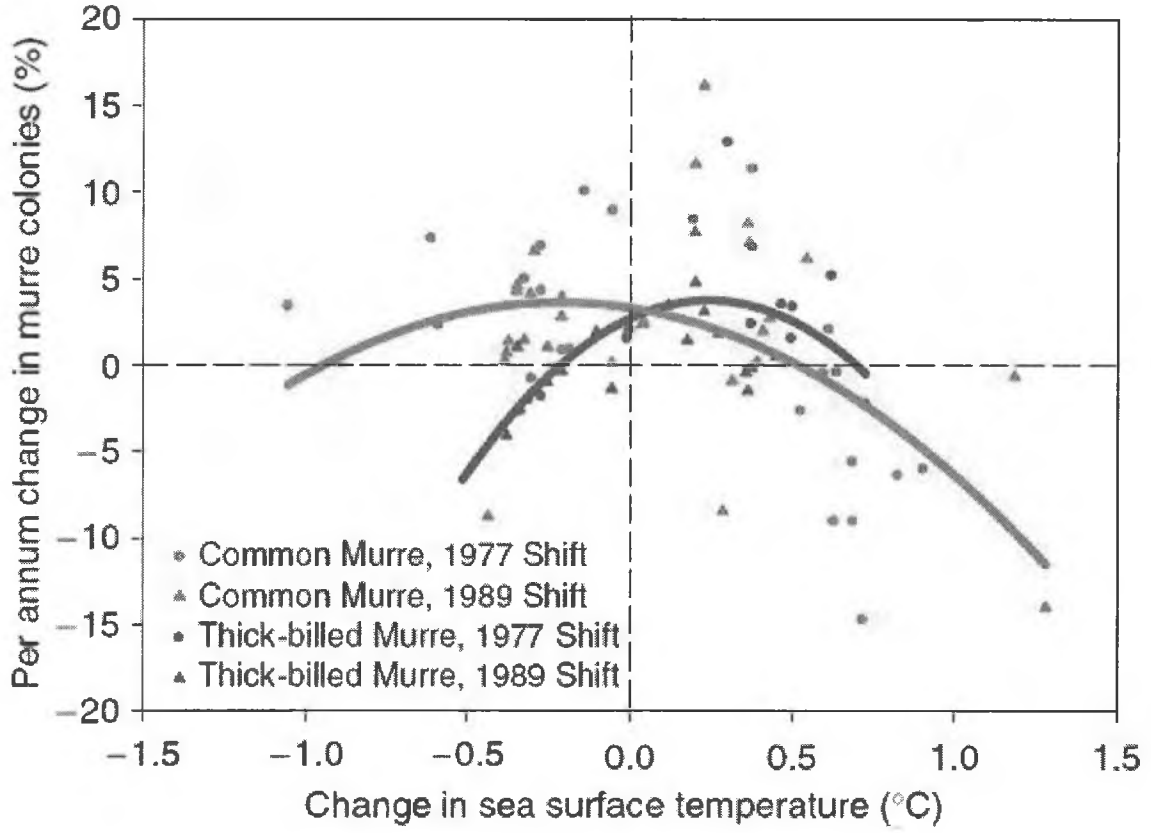

Figure 3. Relationship between per annum change in the size of murre colonies during the 12 years after the1977 climatic regime shift and during 9 years after the 1989 shift, and changes in sea surface temperatures around the colonies from one decadal regime to the next. Population data are from 32 Common and 21 Thick-billed Murre colonies, encompassing the entire circumpolar region. As 10 sites supported both species, 43 different study areas were represented. Quadratic functions were fitted to the data (Thick-billed Murres $P=0.002$, $df=27$, $r2=0.370$; Common Murres $P<0.001$, $df=48$, $r2=0.280$). Reprinted from Irons et al. 2008.

Both species have shown substantial variation in regional population trends since the 1970s. A comparison of the period from 1977–1989, when Sea Surface Temperatures (SST) in the North Pacific were generally above normal and those in the North East Atlantic generally below normal, with the period from 1989–1999 when the situation reversed, showed that populations in the North Pacific were generally decreasing during the earlier decade and increasing subsequently (Fig. 4, Irons et al. 2008). Conversely, those in the eastern Atlantic showed more variable trends. However, several European colonies were affected by widespread collapse of fish stocks in the 1980s (Vader et al. 1990). Those European colonies not affected by fish-stock collapses mostly increased up to 1989, but increases were less general between 1989–1999. Only a few colonies,

principally those in the eastern Canadian Arctic, have shown consistent increases in population and no colonies have shown persistent downward trends (C-bird unpubl. data). Subsequent to 1999, regional trends have been less clear. Populations of both species in the Barents Sea have begun to recover from earlier declines related to fish stock collapse (Barrett et al. 2006). Those in Alaska and in the Canadian Arctic have been stable overall since the 1990s (Dragoo et al. 2008, Gaston et al. in press).

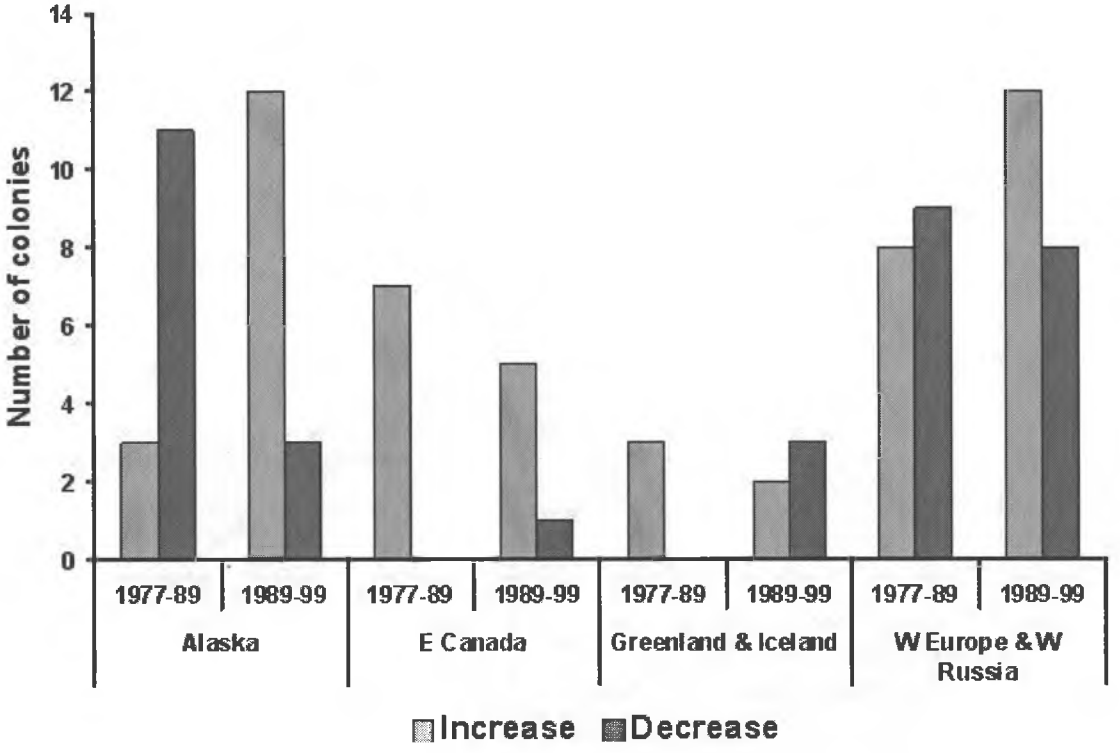

Figure 4. Number of Common and Thick-billed Murre colonies increasing or decreasing during 1977–1989 and 1989–1999.

Threats

Murres, both adults and eggs (especially lomvia), are harvested by aboriginal people and by local communities in many Arctic jurisdictions. These activities are not thought to have much impact on populations except in West Greenland, where some colonies have been substantially reduced by harvesting of adults while breeding (CAFF). Both species are highly susceptible to oiling and they are often the most numerous species killed by oil spills. They are frequently drowned in gill-nets, especially when these are set overnight (Melvin et al. 1999): hundreds of thousands were killed in salmon gill-nets off West Greenland in the 1960s (Tull et al. 1972). Although currently abundant, with few populations showing cause for alarm, climate change will pose a future problem and range contraction appears likely in the longer-term.

Knowledge Gaps

Despite substantial research and monitoring on the two species, information is generally inadequate to quantify changes in murre feeding ecology and food availability, or changes in mortality due to oil pollution, commercial fisheries, and hunting. In 1996, the Circumpolar Seabird Group reviewed conservation issues affecting murres, and produced an *International Murre*

Conservation Strategy and Action Plan to guide future international conservation efforts. The plan proposed action to assess the threats to murres from harvests, and commercial and industrial activities. The Plan also recommended further research to address the potential effects of global climate change on murre populations.

* **Note:** On "murres" vs "guillemots". We think the use of murres is preferable because guillemot does not exclude *Cepphus* spp. when used as a collective noun.

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Fisheries in the Bering Sea

J. Overland

NOAA, Pacific Marine Environmental Laboratory, Seattle, WA

October 5, 2009

With warm sea temperatures during 2000 to 2005, the Bering Sea was showing indications that Arctic species that require the presence of sea ice were being replaced by sub-Arctic species that don't require sea ice. This is shown schematically in the Figure F1 as a shift of the biological energy pathway that favors bottom animals (Benthic) to one favoring species that live closer to the ocean surface (Pelagic).

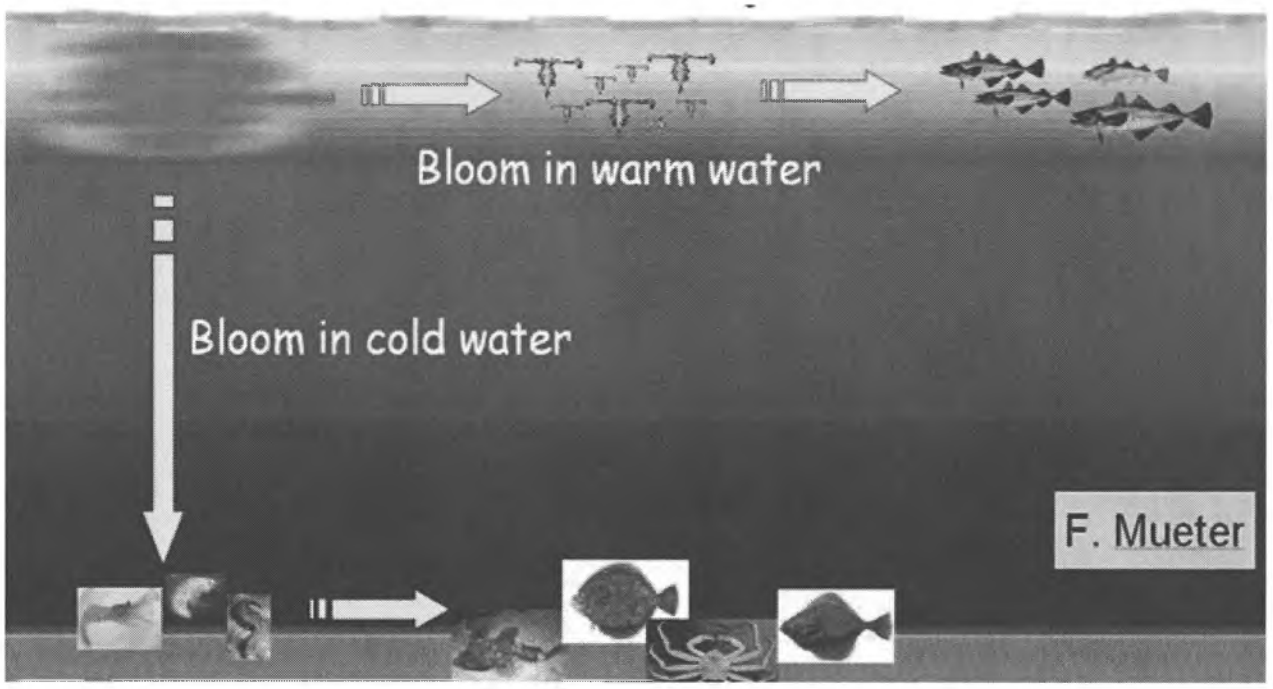

Figure F1. Bering Sea Ice shifting from Benthic to Pelagic Pathway.

However since 2005, the Bering Sea has been relatively cold with more sea ice in the winter and spring than normal. In 2008 and 2009, the winter sea ice extent in the Bering Sea was at a near record maximum, not seen since the early 1970s, and ocean temperatures were at a near record minimum (Figure F2). Under these conditions, cold water species, such as Arctic cod, have returned toward the south. At present Bering Sea climate change and ecosystem response are more effectively characterized by natural variability with multiple years of warm and cold temperatures, than by an emerging global warming trend or by an influence from the major summer sea ice losses in the Arctic Ocean proper.

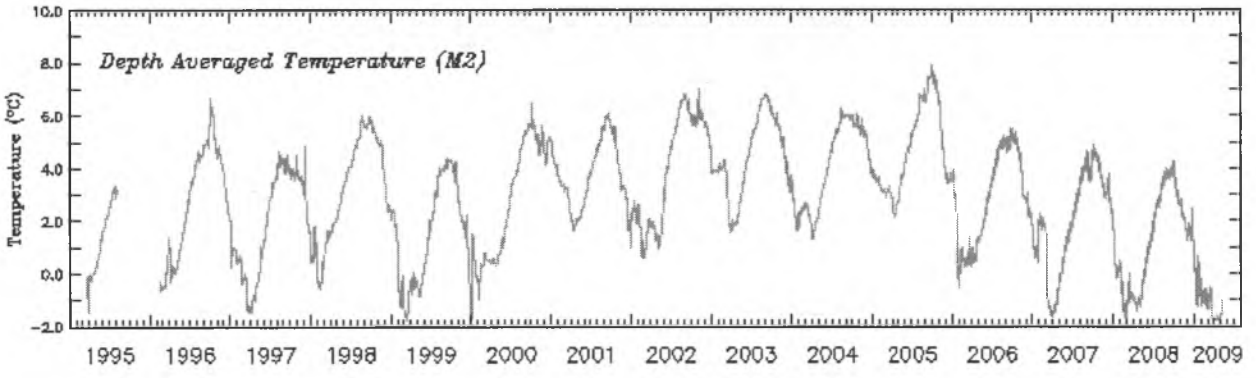

Figure F2. Southeast Bering Sea summer ocean bottom temperatures. From NOAA, P. Stabeno.

Pollock are a major economic resource from the Bering Sea. Warm temperatures and lack of sea ice have tended to favor pollock in the recent past, creating one of highest biomass for any large marine ecosystem throughout the world. The biomass for pollock in the Bering Sea and the number of new fish added each year (called recruitment) are shown in Figure F3. In recent years pollock recruitment has been low, with the decrease beginning before the return of the cold temperatures (Figure F2). The Bering Sea pollock population is now in collapse. It is suggested that during the end of the warm period (2003–2005), the normal food supply for pollock shifted to less favorable species and that pollock predators, such as arrowtooth flounder, became well established. With the recent shift to a cold period, the favorable food supply for pollock returned to the Bering Sea, but it was less available due to the presence of sea ice. Further, the continued presence of arrowtooth flounder as a predator on pollock remained a negative factor.

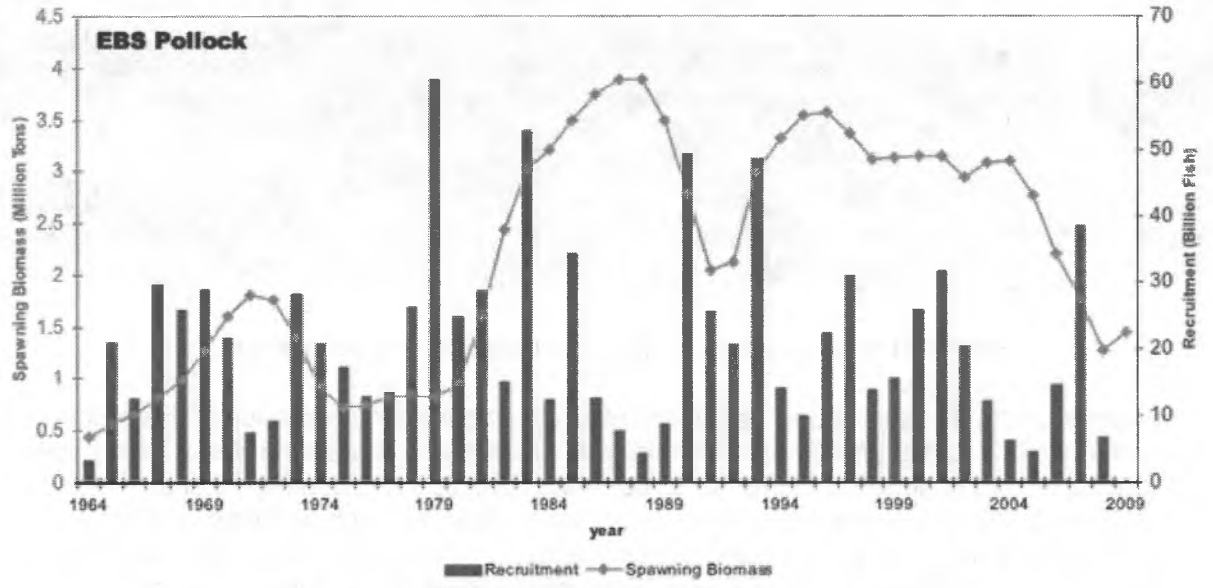

Figure F3. Bering Sea Pollock. Diamonds indicate biomass, and vertical bars indicate recruits to the population each year. From the NOAA/NMFS SAFE report.

Bering Sea temperatures respond both to global warming and large natural variability. While the Bering is cold at present we anticipate a swing back to average temperatures in the coming winter due to El Nino conditions. By 2020 or before, we anticipate a swing back to prolonged warm temperatures. This scenario would continue the negative impact on Arctic and bottom species, such as crab, while favoring sub-Arctic species such as salmon.

Reference

Stock Assessment and Fishery Evaluation Report (SAFE Report) from NOAA / AFSC.

Status of the Barents Sea Ecosystem

Norwegian Institute of Marine Research
http://www.imr.no/filarkiv/havets_ressurser_og_miljo_2009/tilstand_okosyst_BH2sammendrag.pdf/en

September 23, 2009

Summary

The commercial fish stocks in the Barents Sea are, with a few exceptions, in a healthy condition. Positive trends are a growing capelin stock and an increasing spawning stock of Northeast Arctic cod. In a long-term perspective, the water masses are warm, although on average, not as warm as in 2006 (Figure B1). The stock level of blue whiting, a more southern species, has decreased in 2008.

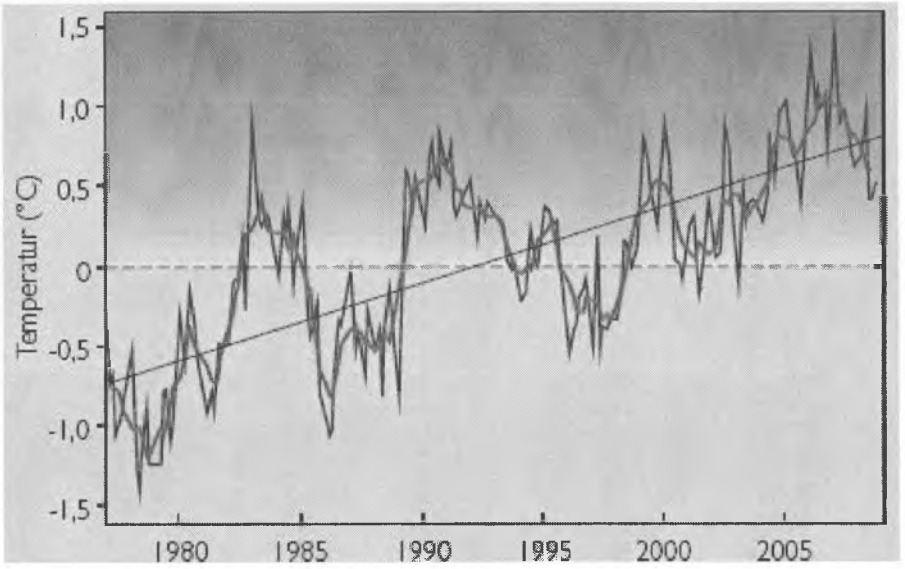

Figure B1. Temperature anomaly in the core of the Atlantic Water flowing into the Barents Sea between Norway and Bear Island (the Fugløya–Bear Island transect). The series are deviations from the long-term mean temperature between 50 and 200 m. Observed values (blue line) and 1 year moving average (red line) are shown. The straight line represents a linear trend over the period.

A clean ocean

Although wind and ocean currents transport various contaminants into the Barents Sea, the level observed in organisms is generally low. The main exception is top predators such as the polar bear, where persistent organic contaminants aggregate.

High temperatures

The water masses in the Barents Sea have been extraordinarily warm since 2000 (Figure B1). However, 2008 was slightly cooler than 2007. This is probably due to a strong reduction of the transport of Atlantic water into the Barents Sea. The amount of ice in the Barents Sea in 2008 was low (Figure B2).

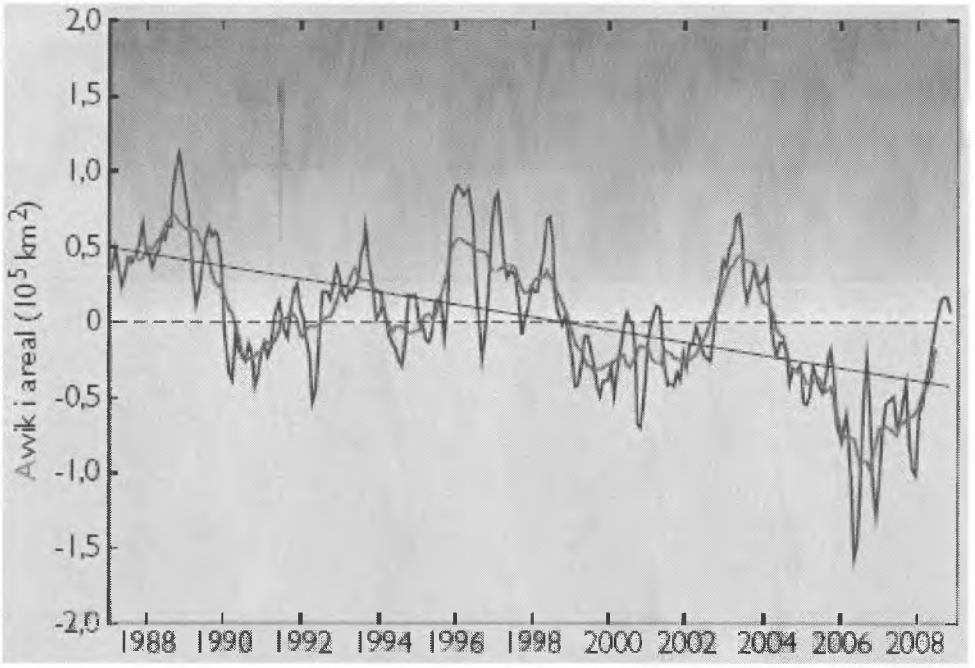

Figure B2. Ice area anomaly for the sector 25–45°E in the Barents Sea, which is the area with the highest variability in ice cover. Monthly mean (blue line) and 1 year moving average (red line) are shown relative to the mean ice area for the period 1987–2007. The straight line represents a linear trend over the period.

Decreasing levels of zooplankton

Compared with the two previous years, considerably less zooplankton was observed in the Barents Sea in 2008. This may be due to a lesser amount of Atlantic water being transported into area, but an increasing capelin stock grazing on zooplankton, mainly copepods and krill, may have contributed to the decrease.

Capelin up, blue whiting down

Based on the number of immature capelin, the stock prognoses indicate an increasing capelin stock the coming year. This is contrary to the prognoses for the other important plankton feeder in the Barents Sea, the young and immature stock (ages 1–4) of Norwegian spring-spawning herring. The year classes 2005–2008 of this stock are smaller than previous years. A decreasing amount of blue whiting is recorded. For polar cod the stock situation seems unchanged.

Healthy stock of Northeast Arctic haddock

The size of the spawning stock of Northeast Arctic cod is slowly increasing and is above the historical average. As in 2007, ICES emphasizes that it is of great importance for the development of this stock that the IUU (illegal, unregulated, unreported) fishery the Barents Sea is stopped. The exact stock size for the Northeast Arctic haddock is difficult to determine. However, the spawning stock is at a relatively high level and strong immature year classes, which will recruit to the spawning stock in the coming years, are observed. The third major demersal fish stock in the Barents Sea, the Greenland halibut, is slowly recovering from a period below historic levels.

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http://www.imr.no/filarkiv/havets_ressurser_og_miljo_2009/1.2_Abiotiske_faktorer_fysikk_sirkulasjon.pdf/en.

The State of Char in the Arctic

C.D. Sawatzky and J.D. Reist

Freshwater Institute, Fisheries and Oceans Canada, Winnipeg, MB

October 15, 2009

Introduction

Arctic Char are the most northerly distributed freshwater fish species and occur in suitable habitats in all Arctic countries. They are widely distributed throughout the circumpolar north (Figure C1) from northernmost areas south to temperate regions (e.g., Switzerland, Italy) (Johnson 1980), with a latitudinal distribution of approximately 40°N to 84°N.

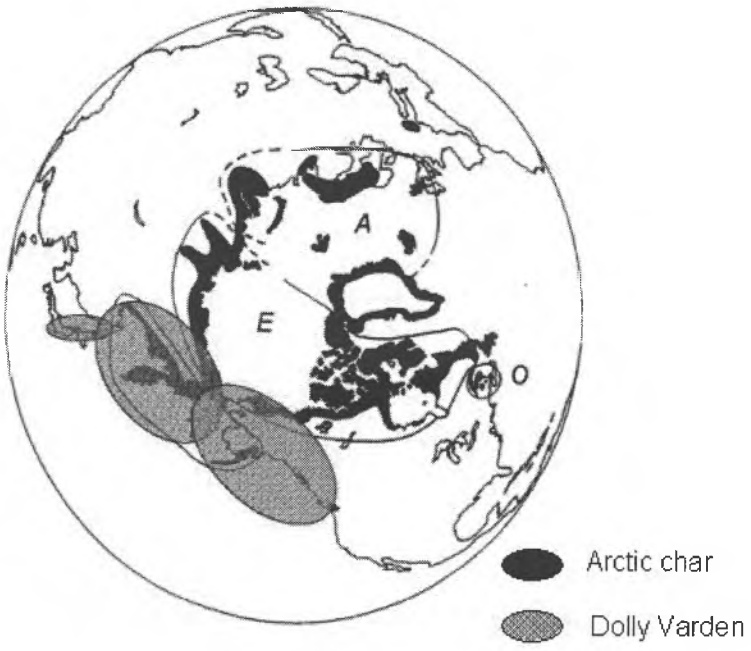

Figure C1. Global distribution of Arctic char and Dolly Varden.

The two most widely distributed groups are Arctic char (*Salvelinus alpinus*), a diverse primarily lake-adapted group (Figure C2), and Dolly Varden (*Salvelinus malma*), primarily a river-adapted group (Figure C3). Both occur as anadromous (sea-run) and freshwater resident forms. They are important components of northern aquatic ecosystems and are economically (subsistence food, commercial and sport fisheries) and culturally significant to northern communities (Conservation of Arctic Flora and Fauna 2001), particularly in Canada. For example, Arctic char made up approximately 45% by number of the top 15 species harvested in Nunavut between 1996 and 2001 (Priest and Usher 2004). The majority of the Canadian commercial Arctic char catch is taken in Nunavut fisheries at Rankin Inlet, Cambridge Bay, Pelly Bay and Nettilling Lake (DFO 2006).

Figure C2. An example of morphological diversity in Arctic char on a regional scale; these fish were sampled from one lacustrine and one marine site in northern Labrador, Canada. Photo by Wendy Michaud.

Figure C3. Adult male anadromous Dolly Varden char in spawning condition captured in the Firth River, Yukon Territory, Canada. Photo by Jim Johnson.

Formal Status Assessments by Conservation Organizations

Several regional and/or national organizations conduct formal status assessments to conserve biodiversity; examples include the International Union for the Conservation of Nature (IUCN http://www.iucn.org/) based in Europe and Natureserve (http://www.natureserve.org/) based in North America. These are supplemented by formal assessment groups in many countries; e.g., in Canada the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, http://www.cosewic.gc.ca/). All conduct assessments of various taxa (species or taxonomic units below species) according to established criteria and based upon the best available information. Summaries are shown in Figure C4 for IUCN assessments.

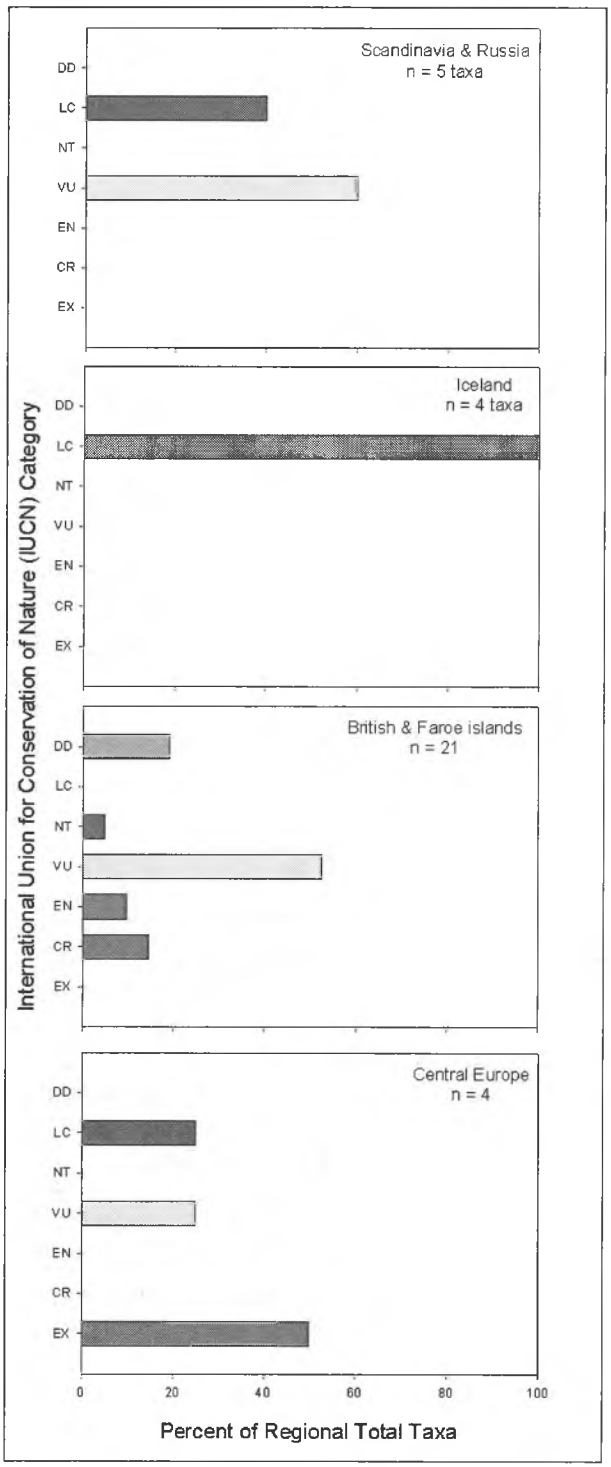

Figure C4. Percentages of European Char Taxa assessed at different levels of risk by IUCN criteria (http://www.iucn.org/; accessed 8 August 2009) for different regions. Note that there is much disagreement regarding the taxonomy used by IUCN, numbers of taxa are small, and assessments tend to be biased towards 'stressed' taxa. Colors indicate different groups of threat levels: gray – information lacking (DD = data deficient), green – assessed at minimal concern (LC = least concern, NT = near threatened), yellow – assessed at increased concern (VU = vulnerable), and, red – assessed at high concern (EN – endangered, CR – critically endangered, EX – extinct). Southern areas exhibit higher percentages of yellow and red threat groups.

Natureserve rankings are not plotted, and taxonomy is not comparable with that used by IUCN (i.e., North American species tend to represent multiple sub-specific taxa). For the five recognized species-level taxa in North America rankings are as follows:

- Southern (non-arctic) – three species are secure and one vulnerable (global rankings);
- Northern (Arctic) – one species is secure.

Natureserve rankings for sub-specific taxa (i.e., components of the above) provide additional understanding as follows:

- Within the continental USA, five of five distinct population groupings of bull char (*S. confluentus*, vulnerable as a species) rank as critically imperiled (n=1) or imperiled (n=4); assessment for 3–4 groups in Canada is underway;
- One southern taxon (*S. alpinus oquassa*) of the Arctic char complex is imperiled in southern Canada and northeastern United States (Natureserve = imperiled, COSEWIC = under assessment; northern Arctic char populations are secure);
- One southern taxon (*S. fontinalis timageamensis*) found in central Ontario of the brook char group is critically imperiled (Natureserve; COSEWIC = endangered);
- The southern taxon (*S. malma lordi*) of the Dolly Varden group is secure throughout its range (southern Alaska, British Columbia to Washington), and the northern taxon (*S. malma malma*) is secure throughout Alaska, however, it appears to be stressed in northwestern Arctic Canada (COSEWIC assessment underway; two of five anadromous populations stressed).

Conclusions

Virtually all stressors which are known to affect fish populations generally have been documented as affecting chars, a group which appears to be particularly susceptible to both local (e.g., exploitation) and pervasive (e.g., climate change) stressors as well as individual and cumulative effects of stressors. From the evidence presented above southern populations (or taxa) of chars, particularly the wider group related to Arctic char, appear to be at greater risk overall as evidenced by higher levels of conservation concern (i.e., more acute conservation status) and by greater percentage of extirpations particularly in Europe. Trends appear to be similar for North America. Two inescapable conclusions thus result: 1) southern populations of chars, particularly those isolated in lakes or requiring unperturbed river habitats, are at acute risk and given their probable evolutionary history represent an irreplaceable component of biodiversity of the Arctic char group; and, 2) southern populations are useful proxies of potential future effects and issues facing northern chars. Accordingly, appropriate care in addressing conservation, management, and stressors of both chars and their ecosystems is required particularly as wide-reaching changes occur throughout the north.

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Priest, H., and Usher, P.J. 2004. The Nunavut Wildlife Harvest Study, August 2004. Nunavut Wildlife Management Board, Iqaluit, NU. 814 p. + CD. [available from: http://www.nwmb.com/english/resources/publications.php; accessed: 24 July 2008].

Additional Resources

Selected Recent Publications on Trends in Canadian Populations of Arctic Char

Dempson, J.B., Shears, M., Furey, G., and Bloom, M. 2004. Review and status of north Labrador Arctic charr, *Salvelinus alpinus*. Canadian Science Advisory Secretariat (CSAS) Research Document 2004/070: 46 p. [available from: http://www.dfo-mpo.gc.ca/Library/284126.pdf; accessed: 24 July 2008].

DFO [Department of Fisheries and Oceans]. 2004a. Cambridge Bay Arctic char. Canadian Science Advisory Secretariat (CSAS) Stock Status Report 2004/10: 15 p. [available from: http://www.dfo-mpo.gc.ca/Library/284796.pdf; accessed: 24 July 2008].

Tallman, R. 2005. Stock assessment report on Kipisa Arctic char. Canadian Science Advisory Secretariat (CSAS) Science Advisory Report 2005/028: 14 p. [available from: http://www.dfo-mpo.gc.ca/csas/Csas/status/2005/SAR-AS2005_028_E.pdf; accessed: 24 July 2008].

Selected Recent Publications on Trends in Canadian Populations of Dolly Varden

DFO [Department of Fisheries and Oceans]. 2001. Rat River Dolly Varden. DFO Science Stock Status Report D5-61: 15 p. [available from: http://www.dfo-mpo.gc.ca/Library/264842.pdf; accessed: 24 July 2008].

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Goose Populations

M.J.J.E. Loonen[1], C. Zöckler[2], B. Ebbinge[3]

[1]University of Groningen, Arctic Centre
[2]UNEP-WCMC, Cambridge
[3]Alterra, Wageningen

March 20, 2008

Since the 1970's, many goose populations have gone through an impressive increase in size. In the last decade, the global goose population almost doubled from 12.5 million birds (Madsen et al. 1996) to a current total of 21.4 million (Wetlands International, 2006). Most of these population increases have coincided with large range extensions within the Arctic, but also into temperate regions. Changing agricultural practices have resulted in new, abundant and high quality food sources for wintering geese (Van Eerden et al. 1996, Fox et al. 2005). This has occurred while hunting pressure has decreased through improved legislative protection, a decline in the ratio of hunters per 1000 geese and the establishment of refuge areas.

Goose populations are intensively monitored. Population estimates are based on simultaneous counts in wintering areas, often supplemented with data on nesting densities, ring recoveries and sightings of colour-marked individuals. Wetlands International (www.wetlands.org) is the organisation which compiles all population data with help of its Goose Specialist Group (www.geese.nl/gsg).

Geese are common in many parts of the Arctic. All Arctic populations are migratory and their annual migration routes and stop over places involve a large proportion of the Northern Hemisphere, including almost all countries in North America, Europe and North, Central and East Asia. Goose populations have a direct and significant influence on Arctic ecosystems as exemplified by recent impacts on tundra vegetation due to expanding populations and via the role played by goslings and eggs as a food source for predators in the Arctic.

The most recent review of water bird populations (Wetlands International, 2006) considers several Arctic goose populations as declining. The declines are widely distributed across all flyways indicating a possible link to phenomena acting on a circumpolar scale. Figure E1 depicts the overall distribution of trends within Arctic goose populations. For nine percent of the population, there is no or insufficient information on trends. Thirty-six percent of the populations are still increasing, thirty-two percent are stable, but twenty-three percent are declining – a proportion slightly higher than compared with ten years ago (Madsen et al. 1996).

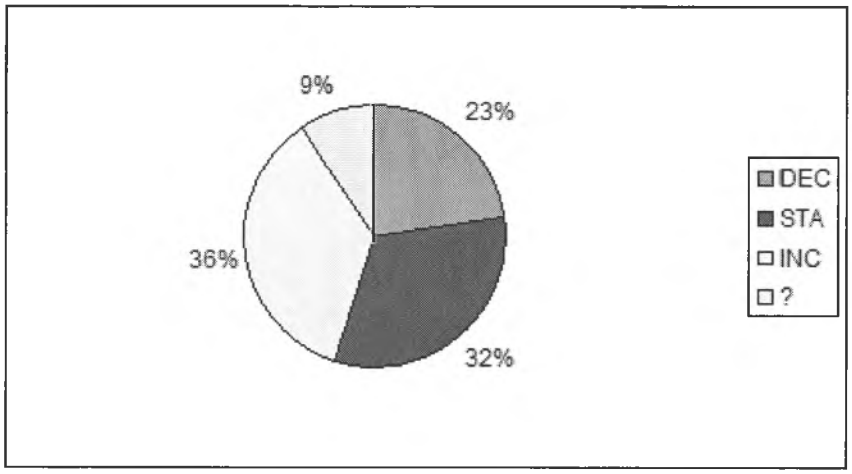

Figure E1. Trends in 47 Arctic Geese populations (Wetlands International, 2006). DEC - population decreasing; STA - population stable; INC - population increasing; ? - unknown

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11.

Arctic Impact Assessment

Arctic Climate Impact Assessment

Policy Document

Issued by the Fourth Arctic Council Ministerial Meeting
Reykjavík, 24 November 2004

The Arctic Council is a high-level, intergovernmental forum comprised of eight Member States (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the United States) and six Permanent Participants (Arctic Athabaskan Council, Aleut International Association, Gwich'in Council International, Inuit Circumpolar Conference, Russian Association of Indigenous Peoples of the North and the Saami Council) representing Arctic indigenous communities. The Arctic Council provides a mechanism to address the common concerns and challenges faced by the Arctic governments and people of the Arctic. In the last several years, the issue of climate impacts in the Arctic has been the subject of increased concern, as reflected in the Arctic Council's sponsorship, together with the International Arctic Science Committee, of the Arctic Climate Impact Assessment, the first comprehensive regional assessment of climate impacts [http://www.amap.no/acia/index.html]. Arctic Council Member States are committed to exercising leadership within the Arctic and globally to address the sources and multiple Arctic impacts and consequences of climate change and ultraviolet radiation, in accordance with the UNFCCC, as well as the Barrow and Inari Arctic Council Ministerial declarations.

Ministers of the Arctic Council meeting in Reykjavik, Iceland in November 2004 addressed the matter of Arctic climate change and variability as follows:

Welcome with appreciation the Arctic Climate Impact Assessment (ACIA) and the scientific work completed in evaluating and synthesizing knowledge on climate variability and change and increased ultraviolet radiation in the Arctic,

Note with concern the impacts documented by the ACIA that are already felt throughout the region. Climate change, and other stressors, presents a range of challenges for Arctic residents, including indigenous peoples,[1] as well as risks to Arctic species and ecosystems,

Recognize that the Arctic climate is a critical component of the global climate system with worldwide implications,

Note the findings of the ACIA with respect to climate change and **acknowledge** that such findings, as well as the underlying scientific assessment, will help inform governments as they implement and consider future policies on global climate change,

Endorse the ACIA policy recommendations for mitigation, adaptation, research, monitoring and outreach contained in the SAO Report to Ministers,

Acknowledge the need to consider the findings of the ACIA and other relevant studies in implementing their commitments under the UNFCCC and other agreements, including through adoption of climate change mitigation strategies across relevant sectors,

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[1] The United States notes that the use of the term "peoples" in this policy document shall not be construed as having any implications as regard the rights which may attach to the term under international law.

Encourage Member States to take effective measures to adapt to and manage the environmental, economic and social impacts of climate change and ultraviolet radiation, *inter alia* through enhancing the access of Arctic residents to information, decision makers and institutional capacity building,

Encourage relevant national and international research bodies and sponsors to take into account the ACIA science recommendations in the planning, development and implementation of their programmes,

Decide to promote global, national and local awareness of the ACIA and any follow up activities through appropriate outreach activities,

Acknowledge the need to further organize the work of the Arctic Council and its subsidiary bodies based on the findings of the ACIA and direct the SAOs to report on the progress made at the 2006 Ministerial Meeting.

Senior Arctic Officials of the Arctic Council reported to Ministers on the work on the climate impacts carried out by the Arctic Council during Iceland's Chairmanship in response to the Minister's declarations at the October 2002 Ministerial Meeting in Inari, Finland. The text of their report is as follows:

BACKGROUND

The Barrow Ministerial Meeting of the Arctic Council in October 2000, endorsed, adopted, and established the Arctic Climate Impact Assessment (ACIA), requesting it to "evaluate and synthesize knowledge on climate variability and change and increased ultraviolet radiation, and support policy-making processes and the work of the Intergovernmental Panel on Climate Change (IPCC); further request that the assessment address environmental, human health, social, cultural and economic impacts and consequences, including policy recommendations."

Since then, a team of more than 300 leading Arctic researchers, indigenous representatives and other experts from fifteen nations has completed its work on the ACIA. They have distilled and synthesised available scientific information, traditional knowledge, and indigenous perceptions in order to examine how climate and ultraviolet radiation have changed in the Arctic, how they are projected to change in the future, and what the consequences of these changes will be for the Arctic and the world. The full assessment is published in a comprehensive science report and synthesised in an overview document "Impacts of a Warming Arctic", designed to be accessible to the lay person and the policy maker. The documents have been reviewed by more that 160 independent scientists and experts and made available to national reviews. Comments were taken into account by authors, who assume responsibility for the final document.

Ministers of the Arctic Council Meeting in Inari in October 2002 welcomed with appreciation the good progress of the ACIA and emphasized "the importance of continued dialogue on the consequences of climate change and on policy measures among national governments, indigenous and other local communities, regional administrations, the business community and scientific experts with the aim for a

transparent and open process, and of enhancing early capacity building to mitigate and adapt to the effects of climate change".

Since Inari, Senior Arctic Officials (SAOs) and representatives of the Permanent Participants have met with climate experts in Svalbard, Nuuk and The Hague to discuss the scientific findings of the ACIA and to further the dialogue among the Arctic states and others on climate change.

The Arctic Monitoring and Assessment Programme (AMAP), the Conservation of Arctic Flora and Fauna (CAFF) and the International Arctic Science Committee (IASC) participated in the ACIA Steering Committee. AMAP and CAFF were the conveners of a drafting group of representatives from Arctic Council Member States and Permanent Participants, that produced early drafts of recommendations to relate the findings from ACIA to the policy needs of the Arctic Council. SAOs then assumed responsibility for the drafting of these policy recommendations.

The ACIA is the world's most comprehensive and detailed regional climatic and ultraviolet radiation assessment to date and documents impacts that are already felt throughout the Arctic region. Climate change, together with other stressors such as ultraviolet radiation, presents a range of challenges for human health, culture and well-being of Arctic residents, including indigenous peoples and communities, as well as risks to Arctic species and ecosystems.

The authors of the overview document of the ACIA identified the following ten key findings:

1. The Arctic climate is now warming rapidly and much larger changes are projected.
2. Arctic warming and its consequences have worldwide implications.
3. Arctic vegetation zones are projected to shift, bringing wide-ranging impacts.
4. Animal species' diversity, ranges, and distribution will change.
5. Many coastal communities and facilities face increasing exposure to storms.
6. Reduced sea ice is very likely to increase marine transport and access to resources.
7. Thawing ground will disrupt transportation, buildings, and other infrastructure.
8. Indigenous communities are facing major economic and cultural impacts.
9. Elevated ultraviolet radiation levels will affect people, plants, and animals.
10. Multiple influences interact to cause impacts to people and ecosystems.

Such findings, as well as the underlying scientific assessment, will help inform governments as they implement and consider future policies on global climate change.

ARCTIC CLIMATE POLICY ACTIONS

In responding to climate change, Member States are taking two sets of actions: mitigation and adaptation. Both kinds of actions require extensive communication and education about climate change and its impacts. Further research, observations, monitoring and modelling is needed to refine and extend the ACIA findings.

Mitigation

To address the risks associated with climate change in the Arctic of the magnitude projected by the ACIA and other relevant studies, timely, measured and concerted action is needed to address global emissions. Even though overall emissions of greenhouse gases within the Arctic region are limited, there are important mitigation opportunities in the region that would contribute to sustainable development and global emission reduction efforts.

Mindful of their countries' share in total global greenhouse gas emissions, SAOs, taking into account specific national circumstances, recommend to Ministers that the Member States:

Consider the findings of the ACIA and other relevant studies in implementing their commitments under the UNFCCC and other agreements.

Adopt climate change mitigation strategies across relevant sectors. These strategies should address net greenhouse gas emissions and limit them in the long term to levels consistent with the ultimate objective of the UNFCCC, integrating mitigation and adaptation measures, building on partnerships, and, where synergies are possible, addressing other social, economic and environmental issues.

Promote the development and adoption of appropriate energy sources, uses, technologies and efficiencies. The International Partnership for Hydrogen Economy (IPHE) and The Carbon Sequestration Leadership Forum (CSLF), together with initiatives to promote renewable energy production and more efficient energy use, are examples of relevant initiatives.

Adopt policies and programmes that conserve and enhance carbon sinks and reservoirs in accordance with the principles of sustainable development.

Adaptation

While mitigation is necessary to address the risks associated with climate change, the scenarios used by the ACIA and elsewhere project that some climate change is inevitable, indicating that continued adaptation is needed.

Adaptation to climate change and its impacts in the Arctic must take into account the especially sensitive and vulnerable natural and human systems of the region. Special attention needs to be paid to strengthening the adaptive capacities of Arctic residents. Recognizing that not all impacts of climate change can be properly addressed through adaptation, the SAOs recommend to Ministers that the Member States:

Work closely with Arctic residents, including indigenous and local communities, to help them to adapt to and manage the environmental, economic and social

impacts of climate change and ultraviolet radiation change. Adaptation needs will vary. Arctic residents may need *inter alia* enhanced access to information, decision makers, and institutional capacity building to safeguard their health, culture and well-being.

Recognize that opportunities related to climate change, such as increased navigability of sea routes and access to resources, should be developed and managed in a sustainable manner, including through the consideration of environmental and social impacts and taking appropriate measures to protect the environment, local residents and communities.

Implement, as appropriate, adaptive management strategies for Arctic ecosystems, making use of local and indigenous knowledge and participation, review nature conservation and land and resource use policies and programmes, and to the extent possible reduce risks related to infrastructure damage, permafrost degradation, floods and coastal erosion, taking into account costs and benefits.

Research, Observations, Monitoring and Modelling

The authors of the ACIA have made recommendations for additional research, observations, monitoring and modelling. It is of particular importance to focus on those research needs that play a significant role in developing and applying mitigation and adaptation measures.

Therefore, the SAOs recommend to Ministers that the Member States:

Stress the importance of intensifying natural and social science research on impacts and adaptation, including studies to enhance understanding of fundamental processes and sustainability, procedures for integrating indigenous and local knowledge into scientific studies, and partnerships between indigenous peoples, local communities, and scientists in defining and conducting research and monitoring associated with Arctic climate and ultraviolet radiation changes.

Encourage relevant national and international research bodies and sponsors to take into account the ACIA science recommendations in the planning, development and implementation of their programmes.

Seek to expand and link circumpolar research and monitoring networks, including community-based networks, applying standardized methodologies focusing on year round observations of climate and ultraviolet radiation and their impacts on species and ecosystems, residents and communities, stressing seasonal variations. Given its international character and potential global significance, the Arctic ocean, its ice and atmosphere, are of special importance.

Seek to ensure that relevant data from research, observation, monitoring and modelling activities are made available to local, national and international research and monitoring programmes.

Recognize the need to consider how to conduct further studies of climate change within the Arctic region, especially through added focus on regional and climate variability, socio-economic impacts, vulnerabilities of Arctic human-environment systems, climate modelling, and use of historical and long-term data on climate variability.

Outreach

In order to ensure global, national and local awareness of the ACIA and any follow up activities, the SAOs recommend to Ministers that the Member States:

Disseminate the ACIA documents within international fora in order to advance co-operation to address the environmental, social, economic and cultural implications of climate change in the Arctic.

Promote the ACIA at the national and local level and explore the use of a variety of methods, languages and partners to engage Arctic residents.

Seek to provide Arctic residents and communities with information and knowledge on climate research and monitoring that they require to adapt to Arctic climate change, including taking advantage of new opportunities.

Encourage the incorporation of materials from the ACIA into educational, research and training programmes.

THE ROLE OF THE ARCTIC COUNCIL

Based on the findings of the ACIA, there is a need for the Arctic Council and its subsidiary bodies to further organize their work. Therefore, SAOs recommend to Ministers to:

- *Direct* relevant technical working groups of the Arctic Council to review the scientific chapters of the ACIA in the context of their ongoing and future work programmes and to report on the progress made at the 2006 Ministerial Meeting.

  Decide to keep under review the need for an updated assessment of climate change in the Arctic, drawing *inter alia* on the IPCC fourth assessment report and the results of the International Polar Year 2007-2009.

  Direct SAOs to nominate a focal point, to be responsible for an ACIA follow up, including an assessment of gaps in knowledge.

Communicate as appropriate, any Arctic Council ACIA follow-up actions to the Conference of the Parties to the UNFCCC.

12.

U.S. Navy Report

DEPARTMENT OF THE NAVY
VICE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON DC 20350-2000

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MEMORANDUM FOR DISTRIBUTION

Subj: NAVY ARCTIC ROADMAP

Encl: (1) Navy Arctic Roadmap

1. Scientific evidence indicates that the Earth's climate is changing, and the most rapid changes are occurring in the Arctic. Because the Arctic is primarily a maritime environment, the Navy must consider the changing Arctic in developing future policy, strategy, force structure, and investment.

2. During the Chief of Naval Operations (CNO) Executive Board on 15 May 2009, CNO directed the establishment of Task Force Climate Change (TFCC) and the development of an Arctic roadmap for the Navy. Enclosure (1) provides a holistic, chronological list of Navy action items, strategic objectives, and desired effects regarding the Arctic for Fiscal Years (FY) 2010-2014.

3. The Navy Arctic Roadmap will remain in effect until promulgation of the next Quadrennial Defense Review (QDR) report in FY-14, when the roadmap will be reviewed and revised to incorporate QDR guidance.

J. W. GREENERT
Admiral, U.S. Navy

Distribution:
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U.S. NAVY ARCTIC ROADMAP

October 2009

This document is sponsored by:

Task Force Climate Change / Oceanographer of the Navy

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Executive Summary

The Navy Arctic Roadmap provides a chronological list of Navy action items, objectives, and desired effects for the Arctic region from FY10-14. Focus areas include:

- Strategy, policy, missions, and plans
- Operations and training
- Investments in weapons, platforms, sensors, command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), installations, and facilities
- Strategic communications and outreach
- Environmental assessment and prediction

Navy action items and objectives within this roadmap are intended to achieve the following desired effects:

- Developing strong cooperative partnerships with interagency and international Arctic stakeholders
- Actively and competently contributing to safety, security, and stability in the Arctic
- Acquiring the right capability at the right cost and right time to meet combatant commander requirements for the region
- The media, public, Department of Defense, and the interagency, and international communities recognizing the US Navy as a positive and active contributor to a safe, secure, and stable Arctic region
- Understanding when significant access for Arctic shipping and other maritime activity is likely to develop

This roadmap specifies Navy actions over three phases – FY10 (phase 1), FY11-12 (phase 2), and FY13-14 (phase 3). Significant action items in phase 1 include:

- Assessments of Fleet readiness and mission requirements in the Arctic region
- Development of Navy Strategic Objectives in the Arctic region
- Continued partnership-building with stakeholders in the region and conduct of a limited objective experiment (LOE) for the Arctic
- Continued monitoring of USAF's Polar Military Satellite Communications (MILSATCOM) program
- Advocacy for accession to the United Nations Convention on the Law of the Sea
- Developing a Navy position regarding combatant commander authorities and responsibilities for the Arctic
- Research and development of a next generation environmental prediction capability applicable to the Arctic

Phase 2 (FY11-12) significant actions include:

- Initiation of Capabilities Based Assessments regarding required Navy Arctic capabilities
- Development of recommendations to address Arctic requirements in Sponsor Program Proposals for the Navy's Program Objective Memorandum for FY14 (POM-14)
- Continuing biennial participation in Arctic exercises including ICEX-11, ICEX-13,

Arctic Edge and Arctic Care

- Formalizing new cooperative relationships that increase Navy experience and competency in search and rescue (SAR), maritime domain awareness (MDA), humanitarian assistance and disaster response (HA/DR) in the Arctic, and defense support of civil authorities (DSCA) in Alaska

Phase 3 (FY13-14) significant actions consist of:

- Execution of the Navy POM-14 budget initiatives that address Arctic requirements, and
- Initiation of combined and bilateral activities which support safety, security, and stability in the region

Director of Task Force Climate Change (TFCC) will provide the Chief of Naval Operations (CNO) quarterly reports on the progress of action items in this roadmap using both activity-based and effects-based metrics. TFCC will review and revise this roadmap every four years following promulgation of the Quadrennial Defense Review (QDR) and will incorporate QDR guidance as appropriate.

1. Introduction

The Chief of Naval Operations (CNO) examined Navy issues and concerns due to global climate change during a CNO Executive Board (CEB) on May 15, 2009. That CEB resulted in decisions to establish Task Force Climate Change (TFCC) and develop Navy Roadmaps first for the Arctic, and then later for global climate change responses more generally.

TFCC is a matrixed organization that runs across multiple Navy staff codes and warfare enterprises. Consisting of a Flag-level Executive Steering Committee, led by the Oceanographer of the Navy, and several senior level working groups, TFCC is tasked to make recommendations to Navy leadership regarding policy, strategy, force structure, and investments relating to the changing Arctic specifically and global climate change in general. TFCC invites advisory participants from interested Joint and interagency stakeholders including U.S. Northern Command (NORTHCOM); Commander, Pacific Fleet (COMPACFLT); U.S. European Command (EUCOM); the Office of Naval Research (ONR); the National Maritime Intelligence Center (NMIC); U.S. Coast Guard Headquarters; the National Oceanic and Atmospheric Administration (NOAA); the Office of the Secretary of Defense (OSD); the office of the Chairman of the Joint Chiefs of Staff (CJCS); and the Center for Naval Analyses (CNA).

TFCC's initial deliverable is this Navy Arctic Roadmap. TFCC's Navy Climate Change Coordination Office (NCCCO), under the Office of the Oceanographer of the Navy, will coordinate execution of the roadmap by TFCC.

2. Strategic Considerations

This roadmap considers a number of strategic drivers including national policy guidance, the changing Arctic environment, the potential increase in natural resource extraction and inter- and intra-Arctic shipping, the activity and interests of other Arctic nations, past and present Navy experience in the Arctic, and current Fleet capabilities and limitations for Arctic operations.

The primary policy guidance statements influencing this roadmap are the National Arctic Policy as defined in National Security Presidential Directive 66 / Homeland Security Presidential Directive 25 (NSPD 66/HSPD 25) and the Cooperative Strategy for 21st Century Seapower (CS21). The National Arctic Policy directs the Departments of State, Homeland Security, and Defense to develop greater capabilities and capacity, as necessary, to protect U.S. borders; increase Arctic maritime domain awareness (MDA); preserve global mobility; project a sovereign United States maritime presence; encourage peaceful resolution of disputes; cooperate with other Arctic nations to address likely issues from increased shipping; establish a risk-based capability to address hazards in the region including cooperative search and rescue (SAR), basing and logistical support; and evaluate the feasibility for using the Arctic for strategic sealift.

CS21 is the Navy, Coast Guard, and Marine Corps Maritime Strategy and applies equally to the Arctic as well as other maritime regions. The expanded core capabilities of

CS21 applicable to the Arctic include: forward presence, deterrence, maritime security, and humanitarian assistance/disaster relief (HA/DR) through the formation and sustainment of cooperative relationships with international partners. As in every other region, the naval services must be prepared to prevent or limit regional conflict when required.

The changing Arctic environment is a significant consideration of the roadmap. The Arctic is warming twice as fast as the rest of the globe. While significant uncertainty exists in projections for Arctic ice extent, the current scientific consensus indicates the Arctic may experience nearly ice free summers sometime in the 2030's. As mentioned in CS21, this opening of the Arctic may lead to increased resource development, research, tourism, and could reshape the global transportation system. These developments offer opportunities for growth, but also are potential sources of competition and conflict for access and natural resources. Reducing the uncertainty in these projections will enable the Navy to make better-informed investment and policy decisions. This is a key objective of this roadmap.

While the United States has stable relationships with other Arctic nations, the changing environment and competition for resources may contribute to increasing tension, or, conversely, provide opportunities for cooperative solutions. The importance of the Arctic region is identified in the strategic guidance of all Arctic nations; therefore, this roadmap considers the requirement for the governance framework provided by the United Nations Convention on the Law of the Sea (UNCLOS).

The Navy's Arctic experience and current operational capabilities and limitations provide the point of departure for this roadmap. Maintaining a presence in the region for decades, Navy experience spans Admiral Byrd's historic overflight of the North Pole in 1926, various campaigns in World War II, consistent activity during the Cold War, and Joint and combined exercises with surface, subsurface, aviation, and expeditionary forces today. This roadmap acknowledges that while the Arctic is not unfamiliar for the Navy, expanded capabilities and capacity may be required for the Navy to increase its engagement in this region.

3. Roadmap Overview

The action items, objectives, and desired effects in this five-year roadmap are organized into the following focus areas:

- Strategy, Policy, Missions, and Plans: Identify Navy's strategic objectives in the Arctic region and provide guidance to achieve these objectives
- Operations and Training: Identify required Navy activities to achieve Navy's strategic objectives in the Arctic region
- Investments (weapons, platforms, and sensors, command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), installations, and facilities): Guide capability development
- Strategic Communications and Outreach: Guide public discussion

- Environmental Assessment and Prediction: Understand the current environmental changes and identify with high confidence a timeline for increased access in the region

For each focus area, action items are assigned to responsible Navy offices with suspense dates for completion. Supporting organizations are identified but are not limited to those listed.

4. Navy Arctic Roadmap

4.1 Strategy, Policy, Missions, and Plans

Desired Effect: The Navy is engaged in strong cooperative partnerships that preserve a safe, stable and secure Arctic region.

Roadmap Objective 1.1: To identify Navy's strategic objectives in the Arctic region and provide recommendations to operational staffs to achieve these objectives.

Action Item 1.1 Determine *Navy Strategic Objectives and Restrictions in the Arctic Region.*

Description: TFCC, with applicable Navy Component Commands (NCCs) and Combatant Commands (COCOMs), will analyze National, Joint, and Service strategies and policies, determine the desired end-state and strategic objectives for Navy, and translate these into measurable effects. TFCC will also identify undesired side-effects and unintended consequences in the Arctic region, expressing these results-without-side-effects as Navy goals for the Arctic region. These goals shall be reviewed and updated with this roadmap following each Quadrennial Defense Review (QDR). Applicable references will include but not be limited to:

- The U.S. Arctic Region Policy (NSPD-66/HSPD-25)
- National Strategy for Maritime Security (NSMS)
- National Defense Strategy (NDS)
- QDR Report
- Guidance for Development of the Force (GDF)
- Guidance for Employment of Forces (GEF)
- Navy Operating Concept (NOC)
- *A Cooperative Strategy for 21st Century Seapower*

Navy Arctic strategic objectives will be submitted for inclusion in subsequent versions of these documents, as applicable. TFCC will coordinate directly with USCG, and with the interagency community through the Maritime Security Interagency Policy Committee, to ensure Navy's strategic objectives are consistent with the U.S. Government's desired outcome in the Arctic region.

Lead: OPNAV N51
Support: OPNAV N31, N52, USFF, PACOM/CPF, NORTHCOM, EUCOM
Suspense: Q2, FY10

Action Item 1.2 Describe the strategic environment.

Description: TFCC will characterize the current and probable strategic environment in the Arctic region based on its predicted physical and political environment, and key stakeholders' interests in the region. This assessment will be reviewed and updated with this roadmap following each Quadrennial Defense Review (QDR). Additional elements of this assessment will include, but not be limited to:

- Current and predicted threats in order to determine the most dangerous and most likely threats in the Arctic region in 2010, 2015, and 2025.
- Focus on threats to U.S. national security, although threats to maritime safety and security may also be considered.
- Identify the relevant actors concurrent to the forecast timeframe.
- Determine incentives and motivations for each actor

Lead: OPNAV N2/N6C2
Support: ONI, NMIC, USFF, PACOM/CPF, NORTHCOM, EUCOM
Suspense: Q2, FY10

Action Item 1.3 Conduct *mission analyses*.

Description: Based on the Navy goals for the Arctic region and the results of the threat assessment, TFCC, with applicable Navy Component Commands (NCCs) and Combatant Commands (COCOMs), will conduct a thorough mission analysis in order to determine best courses of action to achieve Navy's strategic objectives in the Arctic region. Continuing to utilize the fundamentals of game theory, this analysis will consider the interdependencies between actors and actions in the Arctic and how incentives and decisions are influenced by other actors' decisions. This mission analysis shall be reviewed and updated with this roadmap following each Quadrennial Defense Review (QDR). Specific attention will be given to the following missions highlighted in the National Arctic Policy and CS21:

- Maritime Security
- Search and Rescue
- Humanitarian Assistance/Disaster Response (HA/DR)
- Defense Support of Civil Authorities (DSCA)
- Maritime Domain Awareness
- Strategic Sealift by the Naval Fleet Auxiliary Force (NFAF)
- Strategic Deterrence
- Ballistic Missile Defense

Lead: OPNAV N00X
Support: OPNAV N51, N31, USFF, PACOM/CPF, EUCOM, NORTHCOM, Naval War College (NWC)
Suspense: Q2, FY10

Action Item 1.4 Develop a five-year *Strategic Implementation Plan* (SIP) to achieve Navy's Strategies and Policies in the Arctic region for FY11-15.

Description: The *Navy Arctic Strategic Implementation Plan (NASIP)* will translate strategy and policy into action. This plan will be updated with this Arctic Roadmap every four years following the QDR, and include but not be limited to the following:

- Look forward and reason backwards, using the strategic environment description and mission analysis in *Action Items 1.2 & 2.3*.
- Anticipate other actors' actions or reactions and determine the implications for potential courses of action.
- Incorporate input from applicable Navy Component Commands (NCCs) and Combatant Commands (COCOMs) and translate Navy Whole Goals in the Arctic Region into a results-based list of specified actions
- Based on scientific facts, make actionable recommendations to operational staffs to achieve the desired strategic objectives.
- Inform and direct capability analysis and decisions.
- Inform future strategy and policy development including, but not limited to, updates to the U.S. Arctic Region Policy (NSPD-66/HSPD-25), National Strategy for Maritime Security (NSMS), National Defense Strategy (NDS), QDR, Guidance for the Employment of Forces (GEF), Navy Operating Concept (NOC), and *A Cooperative Strategy for 21st Century Seapower.*
- Include coordinating and collaborative efforts with USCG, and with the interagency community through the Maritime Security Interagency Policy Committee, to ensure consistency with the U.S. Government's desired outcome in the Arctic region and the actions of other Departments and Agencies.
- Incorporate NCC and COCOM input to ensure alignment among Navy stakeholders in the region.

Lead: OPNAV N51
Support: TFCC NCCCO, USFF, USCG, NOAA, ONR, OPNAV OJAG Code 10
Suspense: Q4, FY10

Action Item 1.5 Propose additional studies and research regarding Arctic security.

Description: TFCC will identify potential topics and areas for further research or study and recommend these to appropriate organizations, including but not limited to:

- Interagency Arctic Research Policy Committee
- Commission on Ocean Policy
- Office of Naval Research (ONR)
- National Science Foundation (NSF)
- Naval Post Graduate School (NPS)
- Naval War College (NWC)
- National Defense University's Institute of National Strategic Studies
- National Intelligence Council (NIC)
- Center for Naval Analyses (CNA)
- Center for New American Security (CNAS)
- Naval Studies Board (NSB)
- National Ice Center
- National Academy of Science (NAS)
- Naval Facilities Engineering Service Center (NAVFAC ESC)
- Commander Naval Installations Command (CNIC)

Lead: OPNAV N51
Support: OPNAV N2/N6, N31, N81, OJAG Code 10
Suspense: Q4, FY10

Action Item 1.6 Beginning for FY14, and biennially each POM year thereafter, consider required Navy Arctic capabilities in developing the Navy Strategic Plan.

Description: Navy Arctic requirements will be considered during the development of the Navy Strategic Plan using the following :

- Navy Strategic Objectives for the Arctic (*Action Item 1.1*)
- Arctic mission analysis and strategic environment descriptions (*Action Items 1.2 & 1.3*)
- Arctic-related CBA's (*Action Items 3.2 & 5.2*)
- Arctic Environmental Assessment & Outlook Reports (*Action Item 5.8*)

Lead: OPNAV N3/5
Support: OPNAV N31, N51, N2/6, TFCC NCCCO
Suspense: Q4, FY11

Roadmap Objective 1.2: Promote a safe, stable, and secure Arctic region by strengthening existing and fostering new cooperative relationships.

Action Item 1.7 Develop a Navy position on COCOM responsibilities in the Arctic for the Unified Command Plan (UCP).

Description: Currently, COCOM responsibility for the Arctic region is divided between U.S. EUCOM, U.S. NORTHCOM, and U.S. PACOM. TFCC will develop a recommended Navy position on COCOM responsibilities in the Arctic

based on the desired end-state(s) and recommended courses of action to achieve them. TFCC will review these responsibilities as necessary.

Action: OPNAV N51
Support: OPNAV N31, N2/N6, USFF, PACOM/CPF, EUCOM
Suspense: Q3, FY10

Action Item 1.8 Expand cooperative partnerships with Joint, interagency, and international Arctic Stakeholders.

Description: Navy partnerships in the Arctic region will provide capability and contribute to achieving the Navy's objectives and desired effects in the region. The process to develop and strengthen these partnerships will include:

- Evaluate existing agreements with the USCG, U.S. Air Force, U.S. Army, foreign militaries, and foreign government agencies/organizations (e.g. Canadian Coast Guard) that operate in the Arctic.
- Initiate discussions with the USCG, U.S. Air Force, U.S. Army, and foreign militaries to expand existing, or form new agreements concerning interoperability and collaborative efforts in the Arctic. Topic areas will include operations, training, and common investments to achieve economies of scale. Every attempt will be made to leverage existing venues (e.g. USN-USCG Staff Talks).
- Formalize new or revised agreements with the USCG, U.S. Air Force, U.S. Army, and foreign militaries concerning interoperability and collaborative efforts in the Arctic.

Lead: OPNAV N3/5
Support: OPNAV N51, OJAG Code 10, USFF, EUCOM, PACOM/CPF, NORTHCOM
Suspense: Q2, FY10 – Evaluate existing agreements
Q4, FY10 – Initiate discussions
Q1, FY12 – Formalize new or revised agreements
Q1, FY12 – Implement new agreements

Action Item 1.9 As applicable, provide support for U.S. accession to the United Nations Convention on the Law of the Sea (UNCLOS).

Description: TFCC will provide support for U.S. accession to UNCLOS as applicable to Navy's interests in the Arctic. Key aspects of this support will include, but not be limited to:

- Expression of Navy interest in the areas for which UNCLOS provides effective governance: freedom of navigation, treaty vs. customary law, environmental laws, and extended continental shelf claims.
- Development of talking points, information papers, or briefings for senior Navy leadership and Congressional staffs as requested.

- Expression of the related message that the Navy is committed to being responsible stewards of the environment. While being committed to conducting military readiness activities in an environmentally sound manner, the Navy is opposed to any framework which unreasonably restricts or prevents our ability to train and operate effectively.

Lead: OPNAV OJAG Code 10
Support: OPNAV N31, N51, N52, N2/N6,
Suspense: Ongoing/As requested

4.2 Operations and Training

Desired Effect: The Navy is a capable and active contributor to a safe, stable, and secure Arctic region.

Roadmap Objective 2: Develop competency in accomplishing Arctic missions assigned by combatant commanders.

Action Item 2.1 Conduct a *Fleet Readiness Assessment* for operating in the Arctic.

Description: A *Fleet Readiness Assessment* will identify current capabilities and limitations for operating in the Arctic environment. Suitability of current doctrine, such as ATP-17 (Navy Arctic Manual) will be evaluated, and consideration will be given to anticipated requirements based on mission and strategic environment assessments performed in *Action Items 1.2 & 1.3* of this roadmap. Specific attention will be given to the following:

- Strategic Sealift
- Maritime Security
- Search and Rescue
- Humanitarian Assistance/Disaster Response (HA/DR)
- Defense Support of Civil Authorities (DSCA)
- Maritime Domain Awareness (MDA)
- Strategic Sealift by the Naval Fleet Auxiliary Force (NFAF)
- Strategic Deterrence
- Ballistic Missile Defense
- C4ISR
- Integration with USCG capabilities

Lead: USFF
Support: TFCC NCCCO, OPNAV N31, N51, N2/N6, ONI, NMIC, USCG
Suspense: Q3, FY10

Action Item 2.2 Continue participation in periodic Arctic exercises and operations, and evaluate feasibility and requirement to expand these activities.

Description: The Navy has frequently participated in exercises, training events, and operations in the Arctic region including the state of Alaska. Continuing this participation will support the strategic objectives of this roadmap to develop Navy competency in the region and substantially contribute to a safe, secure, and stable region. By coordinating with the Arctic combatant commanders and the USCG, the Navy will consider engagement in the following periodic events and operations:

- ICEX-11, ICEX-13
- Arctic Edge (Formerly Northern Edge)
- Northern Eagle
- Innovative Readiness Training (IRT) initiatives under Alaska Command
- HA/DR
- DSCA (e.g. support to Exxon Valdez oil spill)
- Limited Objective Experiment (LOE) 7 (NORTHCOM lead)
- Arctic Care
- Arctic Crossroads

Lead: USFF
Support: PACOM/CPF, EUCOM, ONR, COMSUBFOR, ASL, COMSECONDFLT, COMTHIRDFLT, CNMOC, USCG
Suspense: FY10-14 (Ongoing)

Action Item 2.3 Increase the number of observers sent to, and hosted from the Arctic nation navies, and document knowledge gained from these exchanges into Navy Lessons Learned.

Description: COMSECONDFLT recently gained valuable lessons learned by observing the Canadian Navy's Operation NANOOK 2009. Increasing this practice and reciprocal opportunities for our foreign counterparts will yield more knowledge and understanding that will ensure safe and effective engagement in the Arctic. Knowledge gained from these exchanges will be included in Navy Lessons Learned.

Lead: USFF
Support: NORTHCOM, ALCOM, PACOM/CPF, EUCOM, ONR, COMSUBFOR, ASL, COMSECONDFLT, COMTHIRDFLT, CNMOC, OPNAV OJAG Code 10
Suspense: Q1, FY11

4.3 Investments

Desired Effect: The Navy has the right weapons, platforms, sensors, C4ISR capability, and installations and facilities at the right time and cost to meet combatant commander requirements in the Arctic region

Roadmap Objective 3: Provide weapon, platform, sensor and C4ISR capability, and installations and facilities required to implement Navy, DOD, and National policy regarding the changing Arctic region

Action Item 3.1 Monitor Polar MILSATCOM implementation.

Description: Navy will review the annual submission of the USAF Enhanced Polar Program for polar MILSATCOM and advocate continued funding. Sustainment of this program and development of a replacement in POM-12 is critical to Navy operations in the Arctic.

Lead: OPNAV N2/N6
Support: None
Suspense: Q4, FY10-FY14 (Annually)

Action Item 3.2 Initiate a *Capabilities Based Assessment* (CBA) for Naval Arctic capabilities.

Description: This assessment will be performed in accordance with JCIDS guidance in CJCSI 3170.01G and will include, but not be limited to the following:

- Assessment of current and required capability to execute undersea warfare, expeditionary warfare, strike warfare, strategic sealift, regional security cooperation, HA/DR, and DSCA.
- Assessment of current and required C4ISR capability.
- Assessment of current and required infrastructure, installations, and facilities in the region.
- Leveraging results from the studies and environmental assessment in *Action Items 3.2 & 5.7* of the roadmap, and the mission analysis and description of the strategic environment identified in *Action Items 1.2 & 1.3* of the roadmap.
- Assessment of the potential for leveraging Joint, interagency, and international partnerships addressed in *Action Item 1.8* of this roadmap.
- Potential for Joint, international, and interagency investments to find efficiencies and/or economies of scale

Lead: TFCC NCCCO
Support: OPNAV N2/N6C5, N31, N45, N46, N51, N8F, N81, N85, N86, N87, N88, USFF, USCG, CAN, NAVFAC ESC, CNIC
Suspense: Q1, FY11

Action Item 3.3 Identify *Arctic Capability Science and Technology (S&T) Needs* to assist with the development of required Naval capability for operating in the Arctic.

Description: TFCC will maintain a standing list of *Arctic Capability Science and Technology Needs* to annually inform Arctic science and research organizations

so that they may improve the Navy's capability for operating in the Arctic environment. These needs will be determined from the CBA conducted in *Action Item 3.2*, outreach to the scientific and academic community, and engagement with combatant commanders and the Fleet concerning Arctic requirements. Specific areas to address will include, but not be limited to:

- Undersea Warfare
- Expeditionary Warfare
- Strike Warfare
- Strategic Sealift
- Regional Security Cooperation
- HA/DR
- DSCA
- C4ISR
- Infrastructure

Lead: ONR
Support: OPNAV N8F, N81, N85, N86, N87, N31, N51, TFCC NCCCO, USCG, USFF
Suspense: Q2, FY11 (Annually)

Action Item 3.4 Investigate C4ISR interoperability with the U.S. Coast Guard.

Description: In anticipation of increased Joint USN-USCG operations in the region, this effort will assess to what extent the two services can communicate, exchange ISR data, and share C2 data. Capability gaps, and potential solutions to improve Arctic C4ISR interoperability between the services will also be identified. The overall objective of this effort will be to identify ways to improve sharing common MDA of the region to enhance interoperability.

Lead: OPNAV N2/N6
Support: OPNAV N31, N51, N81, N85, N86, N87, N88, ONI, NMIC, PEO C4I, TFCC NCCCO
Suspense: Q2, FY11

Action Item 3.5 Beginning with POM-14 and biennially each POM year thereafter, assess the Navy Strategic Plan's guidance, if any, relating to warfare capability in the Arctic, and address these requirements in Sponsor Program Proposals.

Description: If required, Sponsor Program Proposals will include recommendations relating to the Navy's Arctic capability gaps identified in the CBA in *Action Item 3.2* and will include, but not be limited to:

- Science and technology (S&T) needs from *Action Item 3.3*
- Research and development (R&D) requirements
- Leveraging Joint, interagency and international partnerships evaluated in

Action Item 1.8 of the roadmap to find efficiencies and/or economies of scale

Lead: OPNAV N2/N6, N4, N8F, N80
Support: OPNAV N81, N85, N86, N87, N88, N31, N51, TFCC NCCCO, NAVFAC
ESC, CNIC, USFF, USCG
Suspense: Q1, FY12

4.4 Strategic Communications and Outreach

Desired Effect: The media, public, government, DOD, and interagency, and international community believe the Navy is contributing to a safe, secure, and stable Arctic region

Roadmap Objective 4: To inform the media, public, government, Defense, and inter-agency, and international audiences regarding the Navy's policy, strategy, investments, intentions, and actions regarding the changing Arctic.

Action Item 4.1 Develop a Navy Arctic Strategic Communications Plan (SCP) for FY10-14.

Description: The Navy Arctic SCP for FY10-14 will provide a framework for how the Navy discusses the Arctic in the public and media, and will define the targeted audiences, organizations, venues, and milestones for communicating Navy action and outreach with regard to the Arctic. These will include but are not limited to:

- CHINFO Rhumblines
- Navy News
- Navy Times
- Stars and Stripes
- Naval Institute *Proceedings*
- Navy League's *Seapower* Magazine
- Social media venues (e.g. Facebook)
- Alaska Public Radio Network
- National Public Radio
- Military Channel
- Weather Channel
- Major US Newspapers
- Local & regional Alaska radio stations & newspapers

The SCP will be reviewed and updated every two years or as required by the Director, TFCC.

Lead: TFCC NCCCO
Support: OPNAV N51, CHINFO, MSC

Suspense: Q1, FY10

Action Item 4.2 Develop a Navy Arctic Outreach & Engagement Plan for FY10-14.

Description: The Navy Arctic Outreach & Engagement Plan will identify organizations the Navy will inform, be informed by, and partner with for achieving the objectives and desired effects of this roadmap. This outreach and engagement plan will be reviewed and updated every two years or as required by the Director, TFCC. Elements of this plan will include, but not be limited to:

- Socializing and requesting OSD designate TFCC as the Department of Defense (DOD) Executive Agent for the Arctic
- Providing DOD assets with *Arctic Environmental Assessment Reports* (*Action Item 5.7* of the roadmap), other TFCC products, and information and reports concerning the Arctic DOD, scientific, media, interagency, and international sources. These DOD assets will include but not be limited to:
    - NORTHCOM
    - EUCOM
    - PACOM
    - USFF
    - COMSECONDFLT, COMTHIRDFLT, COMSEVENTHFLT
    - COMSUBFOR
    - COMNAVSURFOR
    - COMNAVAIRFOR
    - OSD
    - CJCS
    - USAF Director of Weather
    - Arctic Submarine Lab (ASL)
    - Commander, Naval Meteorology and Oceanography Command
    - Office of Naval Intelligence (ONI)
- Establishing and maintaining consistent outreach with, and providing information related to the Navy Arctic Roadmap to U.S. government and interagency organizations involved in the Arctic. These organizations will include but not be limited to:
    - White House Office of Science and Technology Policy (OSTP), Council on Environmental Quality (CEQ)
    - Commission on Ocean Policy
    - Department of State's Arctic Policy Group
    - Department of Energy
    - NOAA
    - U.S. Coast Guard
    - NASA
    - USGS
    - National Geospatial Intelligence Agency (NGA)
- Establishing and maintaining consistent outreach with, and providing information related to the Navy Arctic Roadmap to scientific, research and

academic organizations involved in the Arctic. These organizations will include but not be limited to:

- National Science Foundation (NSF)
- National Academy of Science
- National Research Council
- U.S. Arctic Research Commission
- Naval Post Graduate School
- Naval War College
- National Defense University
- Office of Naval Research (ONR)
- Strategic Environmental Research and Development Program (SERDP)
- U.S. Army Corps of Engineers (USACE) Cold Regions Research Lab (CRREL)
- University of Washington's Applied Physics Lab Polar Science Center
- University of Colorado, Boulder
- University of California, Los Angeles
- Pennsylvania State University
- Wood Hole Oceanographic Institution
- University of Alaska, Fairbanks' International Arctic Research Center
- University of New Hampshire
- NASA's Jet Propulsion Laboratory
- NOAA's National Snow and Ice Data Center, National Climatic Data Center, National Weather Service, National Ocean Service, Climate Program Office, and Pacific Marine Environmental Laboratory
- Consortium for Ocean Leadership
- National Ice Center

- Establishing and maintaining consistent outreach with, and providing information related to the Navy Arctic Roadmap to international offices, agencies, governments, and militaries involved in the Arctic. These will include but not be limited to:
  - Canadian Navy
  - Royal Navy
  - UK Hydrographic Office
  - Russian Navy
  - Danish Navy
  - Norwegian Navy
  - International Ice Patrol
  - Japanese Maritime Self Defense Force (JMSDF)
  - Icelandic Coast Guard
  - Canadian Coast Guard
  - Russian Border Guard
- Establishing and maintaining consistent outreach with, and providing information related to the Navy Arctic Roadmap to indigenous peoples

within the state of Alaska. This will include adherence to relevant executive orders and legislation relating to consultation to Native American and Native Alaskan tribes and regional cooperations.

- Establishing and maintaining consistent outreach with, and providing information related to the Navy Arctic Roadmap to organizations within industry that will be working and investing in the Arctic region.

Lead: TFCC NCCCO
Support: CHINFO, ONR, NOAA, USCG. OPNAV OJAG Code 10
Suspense: Q1, FY10

4.5 Environmental Assessment and Prediction

Desired Effect: The Navy understands the changes and projections for the Arctic environment, specifically when and to what extent ice will recede allowing for increased maritime access to the Arctic.

Roadmap Objective 5: To provide Navy leadership and decision makers a comprehensive understanding of the current and predicted Arctic physical environment on tactical, operational, and strategic scales in time and space. The science-based timeline developed through this focus area will inform accomplishment of the action items and objectives within the other focus areas of this roadmap.

Action Item 5.1 Contribute to the development and implementation of the National Ocean Policy

Description: The White House Council on Environmental Quality (CEQ) is leading a National Ocean Policy Task Force that will deliver a National Ocean Policy which will include a framework for Marine Spatial Planning in the Arctic in December 2009. Navy contribution through the Office of the Secretary of Defense (OSD), Joint Chiefs of Staff (JCS), and Department of the Navy (DoN) will ensure the Navy's equities and strategic concerns regarding the Arctic are represented in both the final policy document, and in the implementation of that document.

Lead: OPNAV N45, TFCC NCCCO, OJAG Code 10
Support: None
Suspense: FY10-14 (Ongoing)

Action Item 5.2 Initiate a *Capabilities Based Assessment* (CBA) of the Navy's Arctic observing, mapping, and environmental prediction capabilities in the Arctic.

Description: This assessment will be performed in accordance with Joint Capability Integration and Development System (JCIDS) guidance in CJCS 3170.01G. It will evaluate the Navy's capability and requirements to observe the physical environment in the Arctic region, to include hydrographic, atmospheric,

oceanographic, and ice data, and will recommend future investments. This CBA also will evaluate the Navy's capability to predict air-ocean-ice conditions on tactical (hours-days), operational (days-weeks), and strategic (months-decades) scales. Specific emphasis will be placed on new capabilities that current technology may provide to reduce uncertainty in 10-30 year predictions of arctic ice coverage. Current and programmed systems will be assessed, and future investments will be recommended. This CBA will include, but not be limited to, the following elements:

- Assessment of previous or ongoing studies regarding the Arctic, climate change, and national security such as:
  - CNA, National *Security and the Threat of Climate Change* (2007)
  - Center for New American Security (CNAS), *Uncharted Waters: The U.S. Navy and Navigating Climate Change* (2008)
  - National Intelligence Council, *National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030* (2008)
  - CNA, *Impact of Climate Change on Naval Operations in the Arctic* (2009)
  - CNA, *Global Climate Change and State Stability* (2009)
  - Pew Center on Global Climate Change, *National Security Implications of Global Climate Change* (2009)
  - OSD QDR, *Assessment of DOD infrastructure vulnerability* (ongoing)
  - GAO, *Survey of Federal Government Efforts to Adapt to a Changing Climate* (ongoing)
  - Strategic Environmental Research and Development Program (SERDP), *Climate Change Planning for Military Installations* (ongoing)
  - Naval Studies Board, *National Security Implications of Climate Change on U.S. Naval Forces* (ongoing)
- Assessment of existing and programmed DOD, interagency, and international observation programs, processes, and organizations for meeting Navy requirements:
  - National Ocean Policy
  - T-AGS multi-mission survey ships
  - National Ice Center
  - Study of Environmental Arctic Change (SEARCH)
  - Arctic Observing Network (AON)
  - Sustained Arctic Observing Network (SAON)
  - International Arctic Buoy Program
  - Space based monitoring (e.g. RADARSAT)
  - Extended Continental Shelf (ECS) Task Force and related efforts
  - Science Exercise (SCICEX) Science Accommodation Missions (SAMs)
  - National Ocean Partnership Program (NOPP efforts)

    - Russian-America Long Term Census of the Arctic (RUSALCA)
    - NOAA Arctic Program
    - Tiksi Arctic Observatory
    - APL-UW Polar Science Center experimentation
    - APL-UW Arctic glider surveys
    - University of Alaska, Fairbanks International Arctic Research Center
    - University of Washington, Applied Physics Laboratory's Polar Science Center
    - Woods Hole Oceanographic Institute
    - U.S. Army Corps of Engineers Cold Weather Research and Engineering Laboratory
    - Naval Facilities Engineering Service Center
- Assessment of FY09 validation and verification of numerical weather prediction capability
- Assessment of current and required architecture and computational capacity
- Evaluation of the potential for developing a coupled, air-ocean-ice, single-km resolution, non-hydrostatic prediction capability suitable for the Arctic region
- Potential for leveraging interagency partnerships with NOAA, DOE, NASA, and the National Ocean Partnership Program
- Potential for leveraging international partnerships

Lead: OPNAV N2/N6
Support: OPNAV N81, TFCC NCCCO, USFF, CNMOC, ONR
Suspense: Q1, FY11

Action Item 5.3 Continue SCICEX accommodation missions (SAMs).

Description: SCICEXs have provided the scientific community with data important to our understanding of the Arctic environment and predicting future changes. When operational requirements permit, SAMs will be conducted according to the Science Plans agreed to by the SCICEX Science Advisory and Interagency Committees.

Lead: COMSUBFOR
Support: USFF, OPNAV N87, ONR, ASL, NSF, LDEO, NSIDC, CRREL
Suspense: FY10-14 (Ongoing)

Action Item 5.4 Identify *Science and Technology Needs for Arctic Assessment and Prediction.*

Description: TFCC will maintain a standing list of science and technology needs for Arctic assessment and prediction to annually inform Arctic science and research organizations so that they may improve the Navy's understanding of the

current and predicted Arctic environment. These needs will be determined from the CBA conducted in *Action Item 5.2*, outreach to the scientific and academic community, and engagement with combatant commanders and the Fleet concerning Arctic requirements. Specific areas to address will include, but not be limited to:

- Hydrography
- Oceanography
- Ice Extent and Dynamics
- Meteorology
- Climate
- Geology and geophysics and engineering (foundation) properties of seafloor and substrates

Lead: ONR
Support: OPNAV N2/N6, TFCC NCCCO, NOAA, USFF, CNMOC
Suspense: Q4, FY10-14

Action Item 5.5 Develop cooperative partnerships for environmental observation and mapping with interagency and international Arctic stakeholders.

Description: Navy partnerships in the Arctic region will provide capability and contribute to achieving the Assessment and Prediction Objective and Desired Effects in this roadmap. The process to develop and strengthen these partnerships will include:

- Evaluate existing agreements with Arctic stakeholders, including but not limited to:
  - USCG
  - NOAA
  - NGA
  - U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL)
  - Interagency Arctic Research Policy Committee
  - U.S. Arctic Research Commission
  - National Science Foundation (regarding SERCH and AON)
  - Department of State (regarding SAON)
  - Hydrographic offices of the UK, Japan, and the Arctic Council Member States
  - Meteorological offices of the UK, Japan, and the Arctic Council Member States
  - Canadian Ice Service
  - Industry
- Initiate discussions with the Arctic stakeholders to expand existing, or form new agreements concerning collaborative efforts for environmental observation and mapping in the Arctic. Every attempt will be made to

leverage existing forums (e.g. quarterly Navy, NOAA, USAF Tri-Agency lunch). Topic areas will include but not be limited to:
    - Hydrographic, oceanographic, and meteorological data exchange
    - Joint investments to achieve economies of scale.
    - Cooperative hydrographic surveys in the Bering Strait choke points, logistic ports of debarkation, and in Fleet Arctic Operating areas to ensure safe navigation of Fleet (surface and subsurface) units operating in the region.
    - Become an active member of the proposed Arctic Hydrographic Commission.
- Formalize new or revised agreements with the Arctic environmental stakeholders.

Lead: TFCC NCCCO
Support: USFF, CNMOC, ONR, NOAA, USCG, OJAG Code 10
Suspense: Q2, FY10 – Evaluate existing agreements
Q4, FY10 – Initiate discussions
Q1, FY12 – Formalize new or revised agreements
Q1, FY12 – Implement new agreements

Action Item 5.6 Establish an interagency partnership to develop and implement a Next Generation Numerical Environmental Prediction (NEP) capability for coupled air-ocean-ice modeling.

Description: Environmental prediction capabilities exist, and are being programmed across DOD and the interagency community. Establishing a permanent partnership to synchronize these efforts towards a common goal of improving global environmental assessment and prediction will improve the Navy's understanding of the current, and projected Arctic environment – thereby achieving the Assessment and Prediction Objective and Desired Effects in this roadmap. The process to develop this partnership will include:

- Evaluate existing agreements with environmental prediction stakeholders, including but not limited to:
    - NOAA
    - NASA
    - Department of Energy and its subordinate national laboratories
    - USAF
    - US Group on Earth Observations
- Initiate discussions with these stakeholders to form a new collaboration agreement on environmental prediction. Every attempt will be made to leverage existing venues (e.g. quarterly Navy, NOAA, USAF Tri-Agency Lunch). Topic areas will include but not be limited to:
    - Leveraging existing programmed efforts (e.g. the National Unified Operational Prediction Capability – NUOPC)
    - Exploiting each agency's unique areas of expertise (e.g. data

assimilation for the Navy)
    - Reducing redundancy in research, development, and investment.
- Formalize the new agreement and begin implementation

Lead: TFCC NCCCO
Support: USFF, CNMOC, ONR, NOAA, USCG
Suspense: Q2, FY10 – Evaluate existing agreements
Q4, FY10 – Initiate discussions
Q1, FY12 – Formalize new or revised agreements
Q1, FY12 – Implement new agreements

Action Item 5.7 Beginning in FY10 for POM-14, and biennially each POM year thereafter, produce an *Arctic Environmental Assessment and Outlook Report* to inform Navy policy, strategy, and investment decisions.

Description: This biennial report will provide a comprehensive assessment of the state of the Arctic environment, including the oceanography, hydrography, meteorology, fisheries, ice-extent, and climatic trends. Also included will be projections based upon the latest scientific studies, research, and modeling efforts regarding future Arctic environmental conditions, with particular emphasis on the time-frame in which ice extent and thickness will allow for trans-Arctic shipping and significant increases in intra-Arctic shipping resource extraction, and eco-tourism.

Lead: TFCC NCCCO
Support: ONR, CNMOC, NPS
Suspense: Q4, FY10

Action Item 5.8 Beginning with POM-14 and biennially each POM year thereafter, assess the Navy Strategic Plan's requirements, if any, relating to Navy environmental observation, mapping, and numerical environmental prediction capability in the Arctic, and address these requirements in recommendations to Sponsor Program Proposals.

Description: If required, Sponsor Program Proposal recommendations relating to the Navy environmental observation, mapping, and numerical environmental prediction capability gaps will be based upon the CBA in *Action Item 5.2* and will include, but not be limited to:

- Science and technology (S&T) needs from *Action Item 5.3.*
- Research and development (R&D) requirements
- Leveraging Joint, interagency, and international partnerships evaluated in *Action Itesm 5.5 & 5.6* to find efficiencies and/or economies of scale
- Application of unmanned systems for observation and mapping

Lead: TFCC NCCCO
Support: USFF, CNMOC, ONR

Suspense: Q1, FY12

Action Item 5.9 Evaluate the re-establishment of ONR's High Latitude Program.

Description: In the past, ONR's High Latitude Program coordinated mission-driven science to address national security needs through scientific data gathering in the Arctic. ONR's High Latitude Program was a proven and effective funding agency that provided a wealth of knowledge to the Navy and the nation. Re-establishing this program, with emphasis on support to research of sea ice thickness using Navy submarines, will lead to improved understanding and prediction of Arctic ice extent and the timeline for increasing access in the Arctic.

Lead: ONR
Support: USFF, CNMOC, TFCC NCCCO
Suspense: Q4, FY11

Action Item 5.10 Initiate *Environmental Planning Documentation* for the Arctic region.

Description: The Navy's Director of Environmental Readiness (OPNAV N45) is coordinating the completion of a phased, comprehensive approach to environmental planning for Navy military readiness and scientific research activities at sea. This documentation is required by the Secretary of the Navy and regulations contained in Executive Order (EO) 12114 Environmental Effects Abroad of Major Federal Actions, the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), and the National Environmental Policy Act. Documentation for the Arctic region will cover at sea Fleet Training, and as practicable Acquisition-related research, development, test, and evaluation (RDT&E) activities sponsored by program executive offices (PEO), environmental effects of new systems that reach Initial Operating Capability (IOC), and ONR-sponsored science and technology activities.

Lead: USFF/CNMOC
Support: OPNAV N45, N31, ONR, NAVAIR, NAVSEA
Suspense: Q2, FY12

Action Item 5.11 Increase operations of unmanned systems for Arctic data collection, monitoring, and research.

Description: Using capabilities from the Naval Oceanography Program's Littoral Battlespace Sensing, Fusion, and Integration (LBSF&I) program, assets from the Commander, Naval Meteorology and Oceanography Command (CNMOC) will increase the temporal and spatial coverage of Arctic data collection, monitoring, and research in order to improve nautical charts, atmospheric and ocean models, estimates of ice extent and thickness, and climate change indicators. Specific capabilities will include, but not be limited to:

- Gliders systematically deployed to map oceanographic conditions
- Unmanned underwater vehicles (UUVs) for oceanographic and hydrographic data collection
- Buoys to collect atmospheric and ice-related data
- Evaluation of the potential for collecting atmospheric and ice-related data using unmanned aerial systems (UASs)

Lead: USFF/CNMOC
Support: OPNAV N86, N87, N2/N6, TFCC NCCCO, NOAA
Suspense: Q1, FY13

5. Roadmap Execution

The Oceanographer of the Navy, as Director, TFCC will oversee execution of this roadmap. Navy offices responsible for action items in this roadmap will report accomplishment status quarterly to TFCC's Navy Climate Change Coordination Office (NCCCO), led by the TFCC Deputy Director. The following additional action items will support execution of this roadmap:

Action Item 6.1 Identify costs for the assessments in this roadmap

Description: TFCC will evaluate the costs for the mission, threat, and capability based assessments in this roadmap and provide them to OPNAV N81 for consideration and potential inclusion in Navy's PR-11 end game decisions.

Lead: TFCC NCCCO
Support: N81, N00X
Suspense: Q1, FY10

Action Item 6.2 Develop metrics to assess roadmap execution status.

Description: TFCC will develop a set of both activity-based and effects-based metrics to assess accomplishment of the roadmap. The activity-based metrics will apply to the roadmap action items and objectives, while the effects-based metrics will apply to the roadmap's five desired effects.

Lead: TFCC NCCCO
Support: N81
Suspense: Q1, FY10

Action Item 6.3 Provide quarterly reports regarding roadmap execution to the CNO.

Description: TFCC will submit Quarterly Arctic Roadmap Execution Reports to the CNO via the DNS. These reports will provide an assessment of the accomplishment of the roadmap's action items, objectives, and desired effects using metrics developed by TFCC. These reports also will provide a summary of

significant Navy engagement and near-term future actions regarding the Arctic.

Lead: TFCC NCCCO
Support: OPNAV N2/6, N3/5, N4, N8, CHINFO, ONR, USFF, USCG, NOAA, OJAG Code 10
Suspense: Q1-Q4, FY10-14

Action Item 6.4 Evaluate the requirement for a classified annex to this roadmap and initiate development if required.

Description: The classified Annex to this roadmap will provide a list of actions from FY10-14 that will accomplish the roadmap objectives and desired effects in this document.

Lead: OPNAV N2/N6C2
Support: OPNAV N31, OPNAV N51, USFF, EUCOM, PACOM/CPF, NORTHCOM, ONI, NMIC
Suspense: Q2, FY10

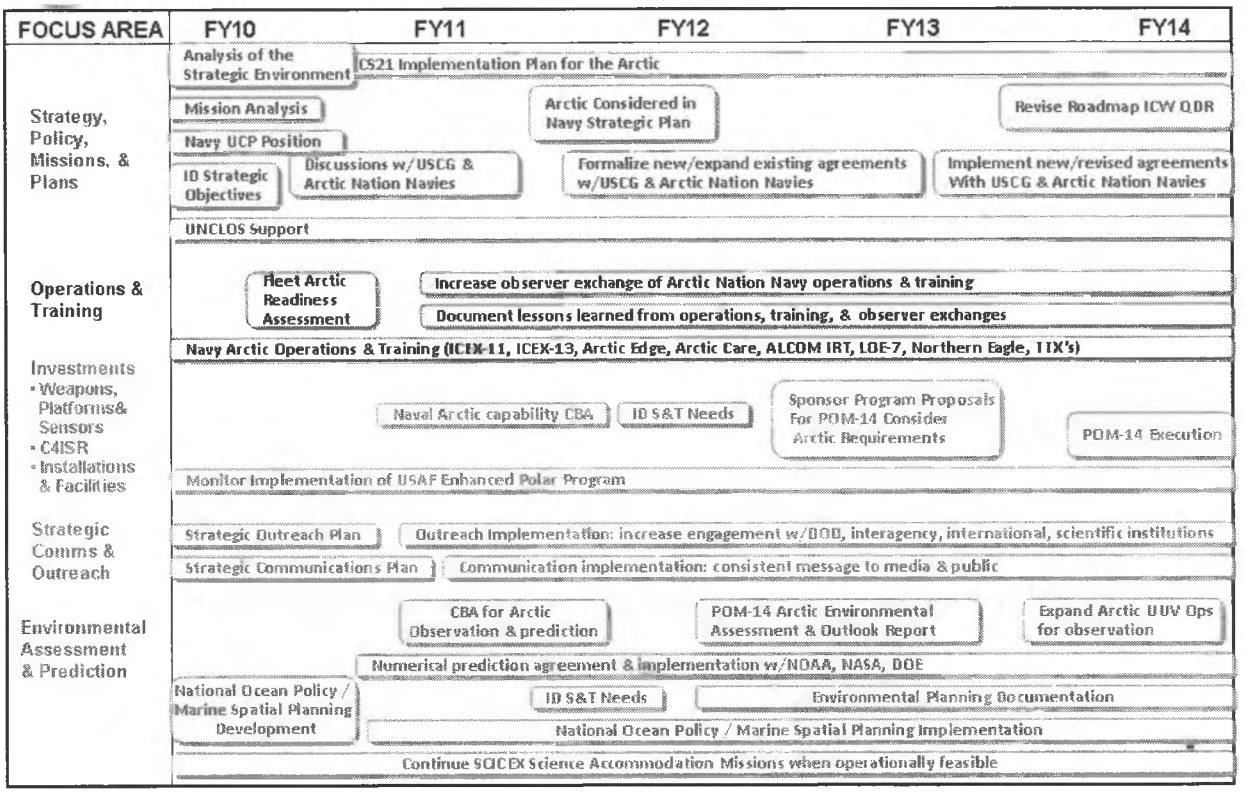
Action Item 6.5 Review and revise the Navy Arctic Roadmap.

Description: TFCC will review and revise this roadmap every four years after promulgation of the Quadrennial Defense Review (QDR) and incorporate QDR guidance as appropriate. The revised roadmap will provide a 5-year action plan for FY 14-19 with Navy objectives and desired effects regarding the Arctic.

Lead: TFCC NCCCO
Support: OPNAV N2/6, N3/5, N4, N8, CHINFO, ONR, USFF, USCG, NOAA, OJAG Code 10
Suspense: Q1, FY14

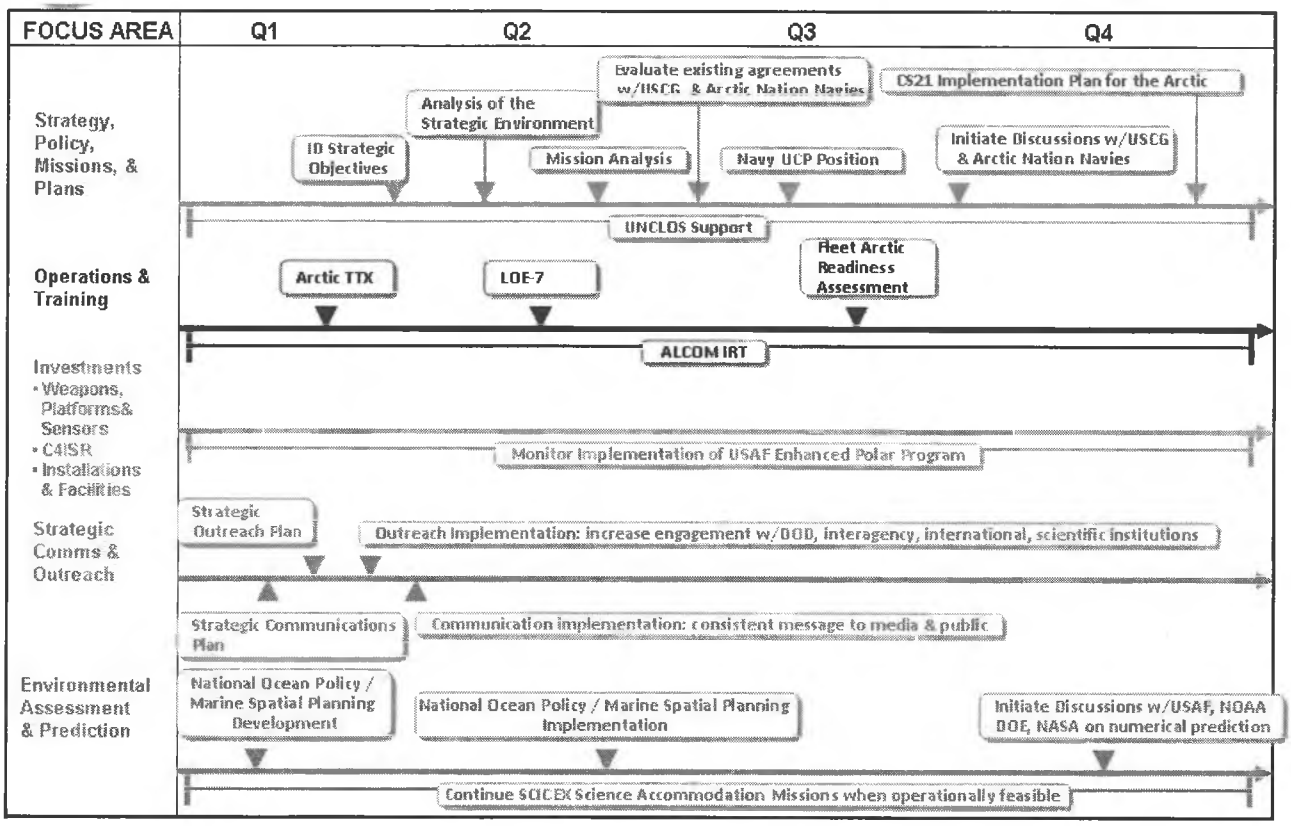
Appendix A

Navy Arctic Roadmap – Significant Actions



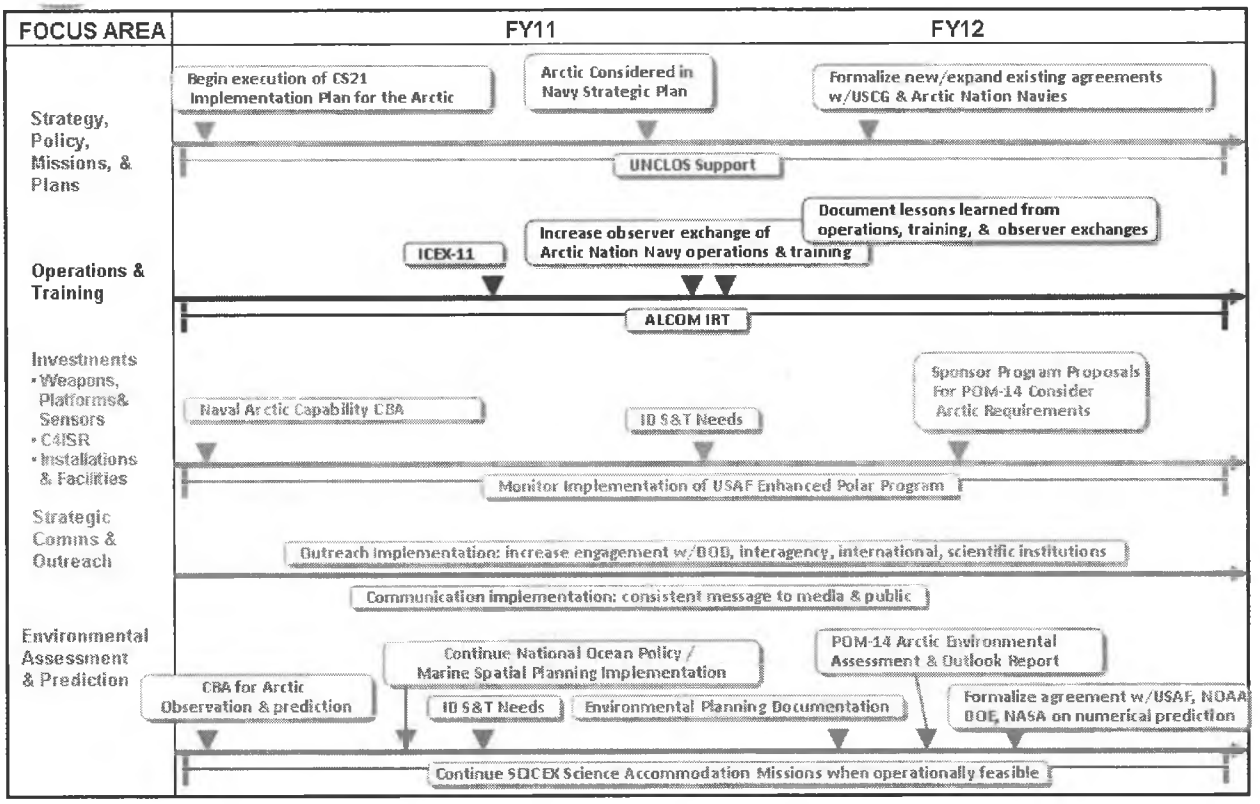
Appendix A

Navy Arctic Roadmap - Phase 1 (FY10)



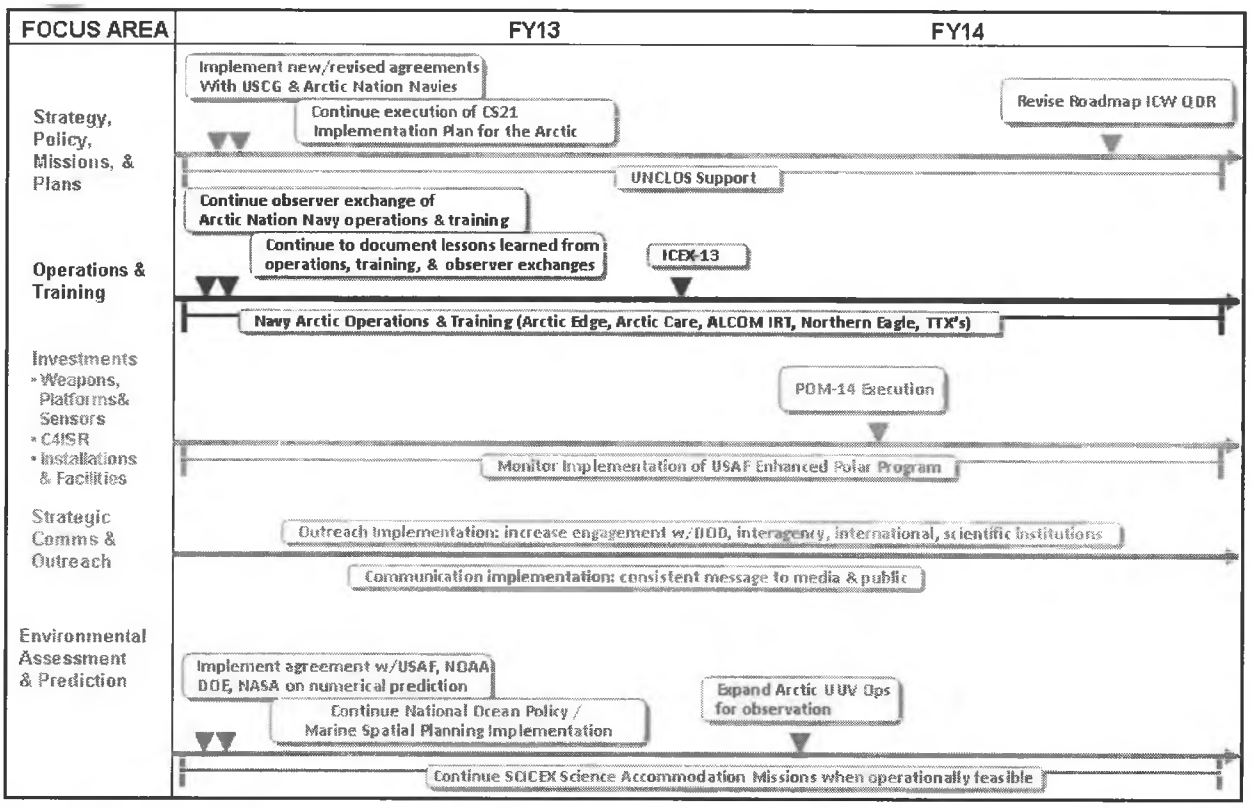
Appendix A

Navy Arctic Roadmap - Phase 2 (FY11-12)



Appendix A

Navy Arctic Roadmap - Phase 3 (FY13-14)



Appendix B

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Manual for the Operation of the Joint Capabilities Integration and Development System, February 2009.

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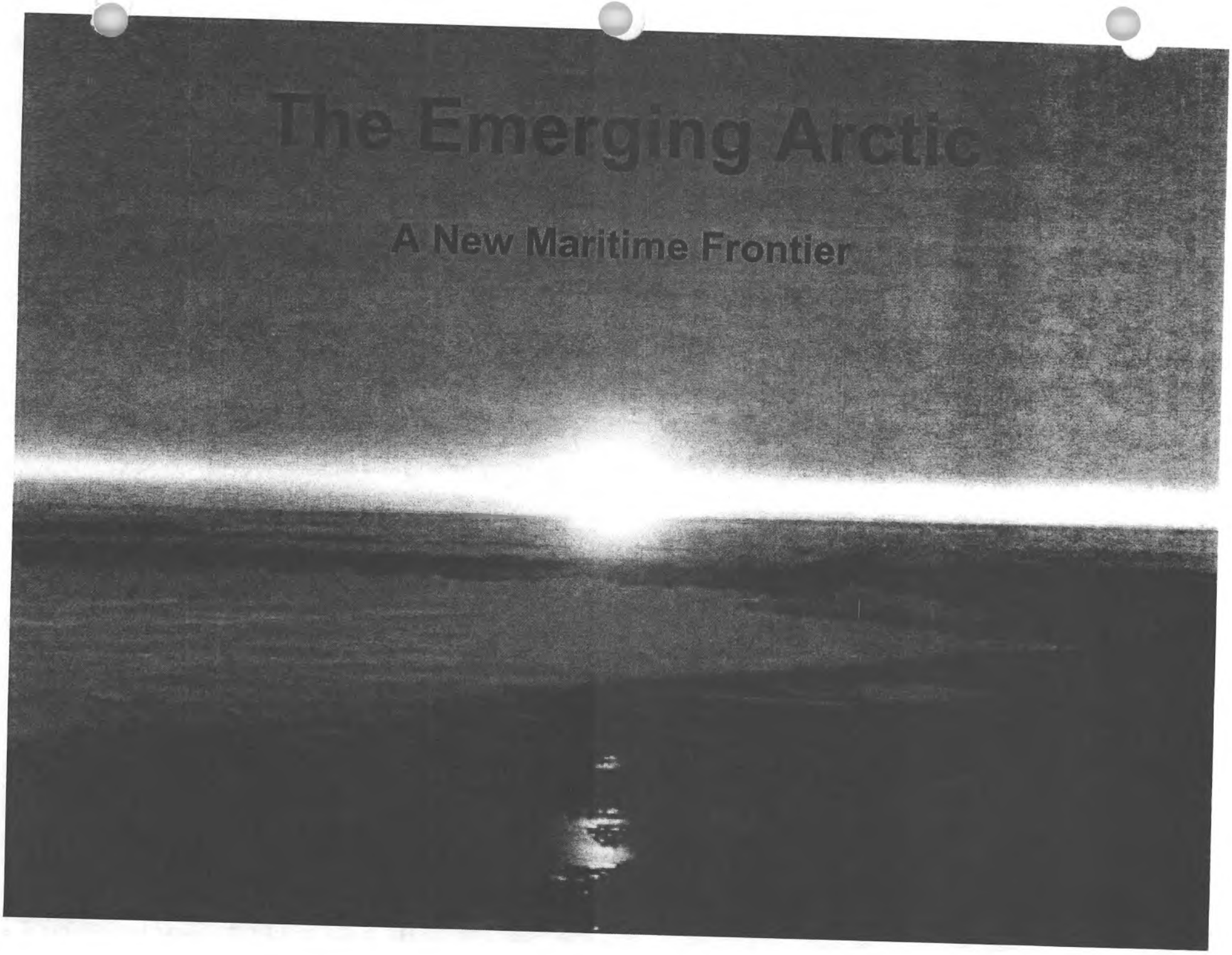
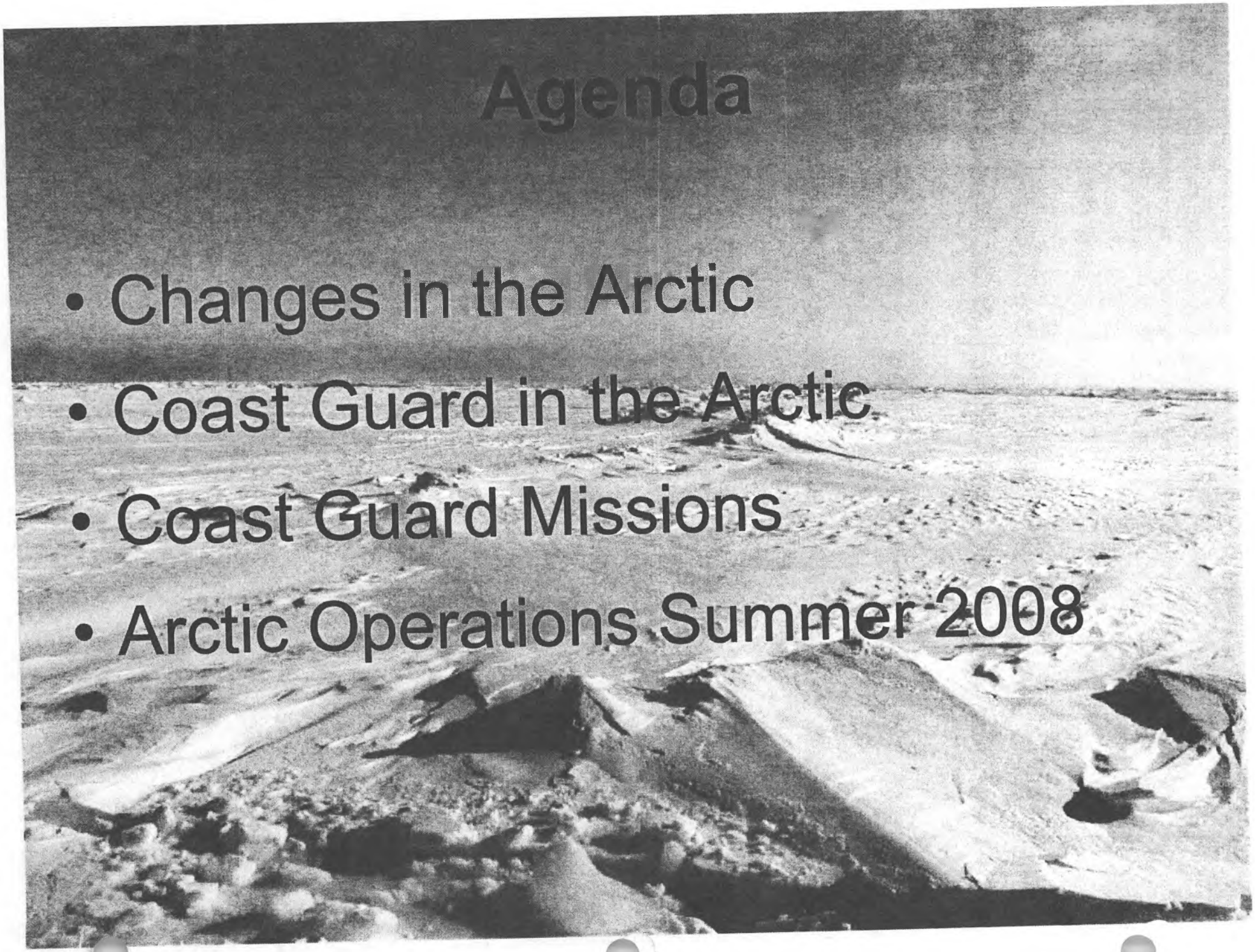
13.

United States Coast Guard Power Point Presentation on the Arctic

The Emerging Arctic

A New Maritime Frontier




Agenda
• Changes in the Arctic
• Coast Guard in the Arctic
• Coast Guard Missions
• Arctic Operations Summer 2008

Summer Sea Ice Retreat

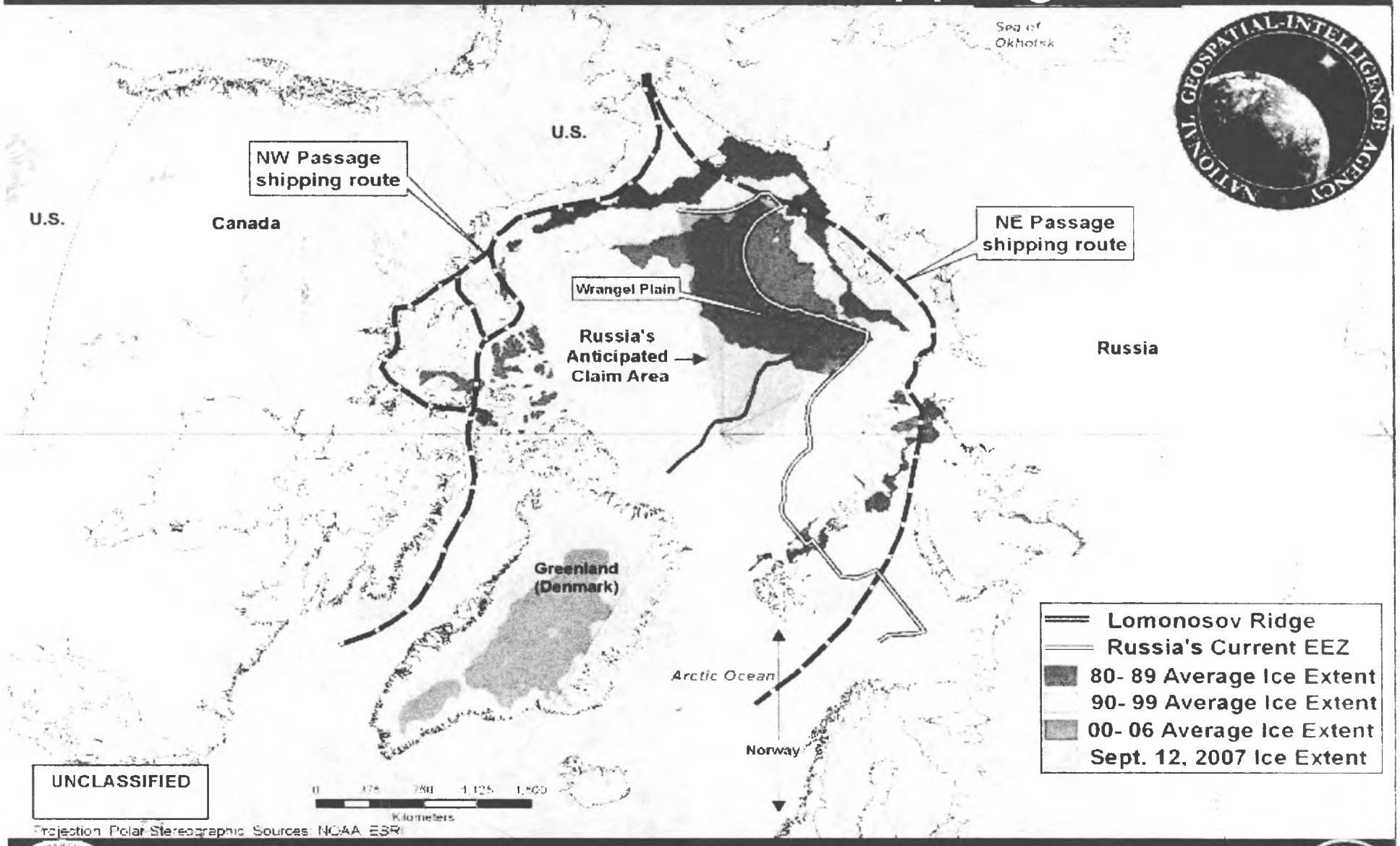
National Aeronautics
and Space Administration

Boundary Claims

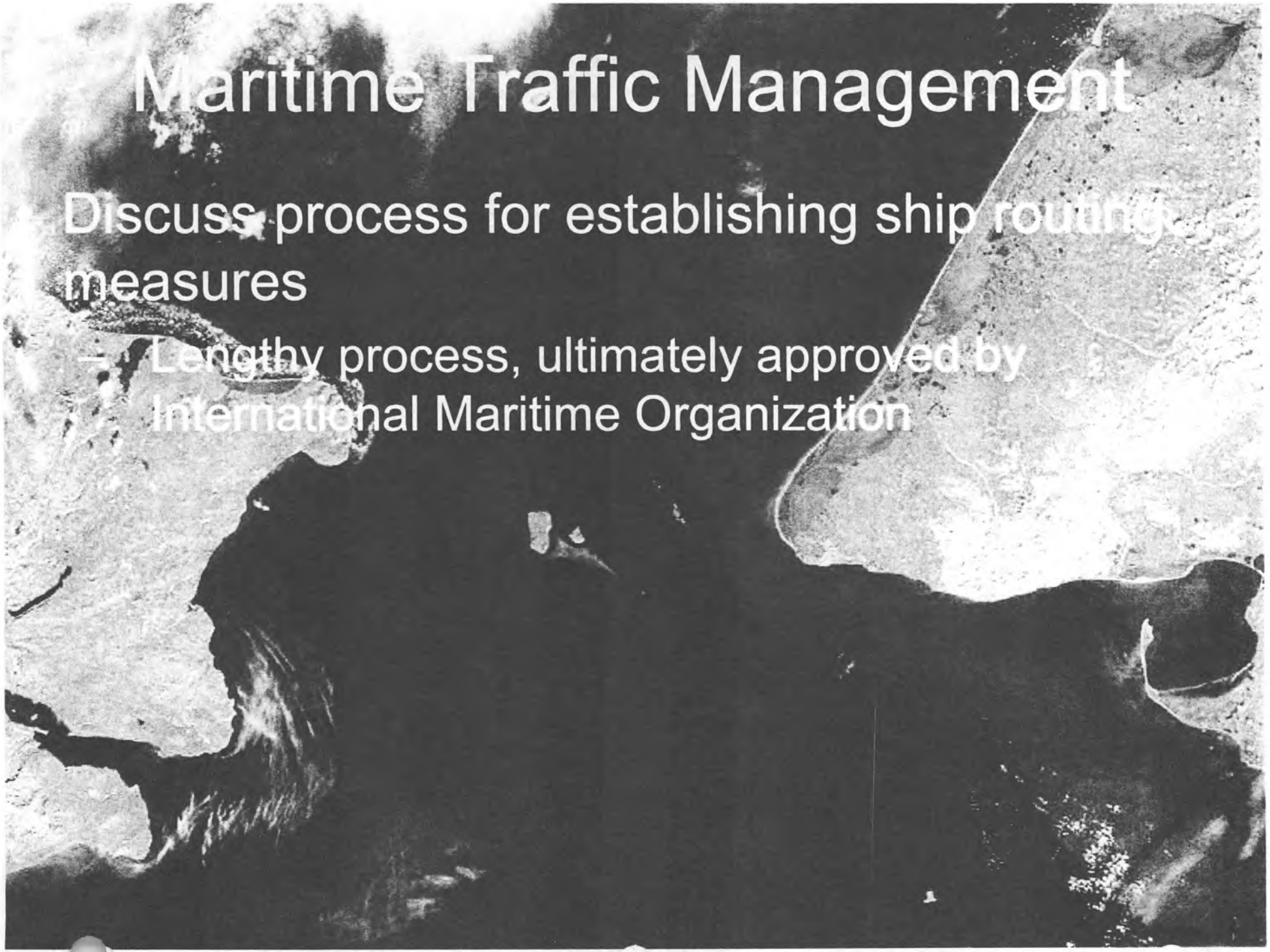
Homeland Security

1) North Pole
2) Lomonosov Ridge
3) 200 nautical mile line
4) Russian-claimed territory

Future Maritime Arctic – Shipping Routes



Homeland Security

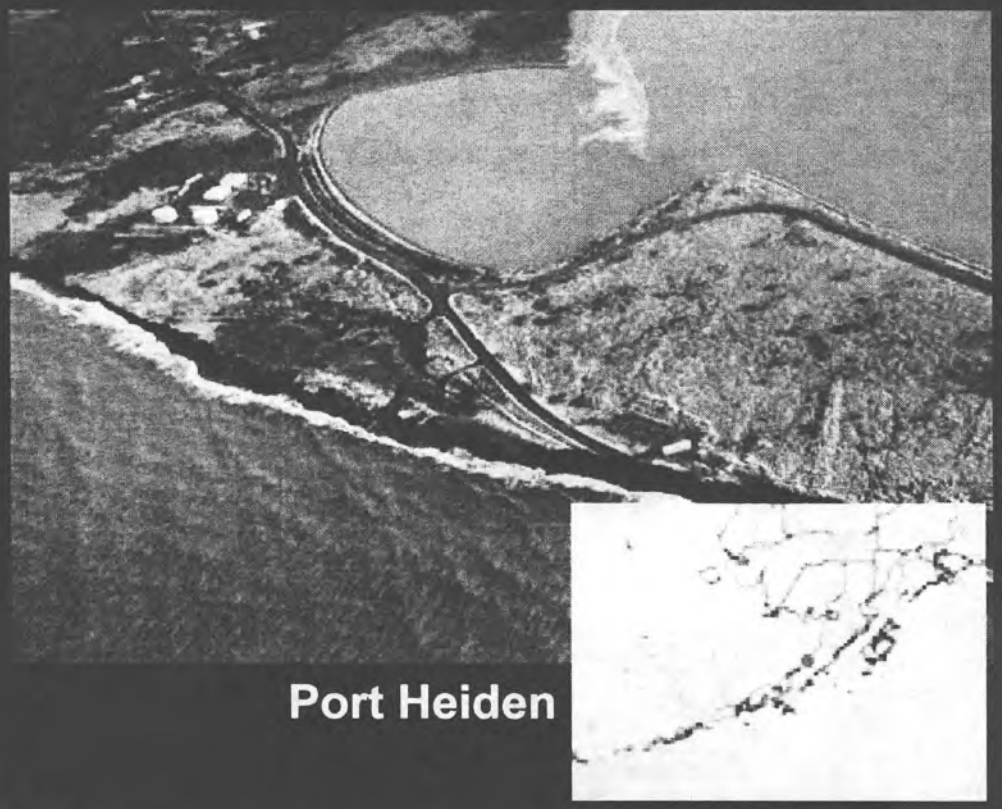


Maritime Traffic Management

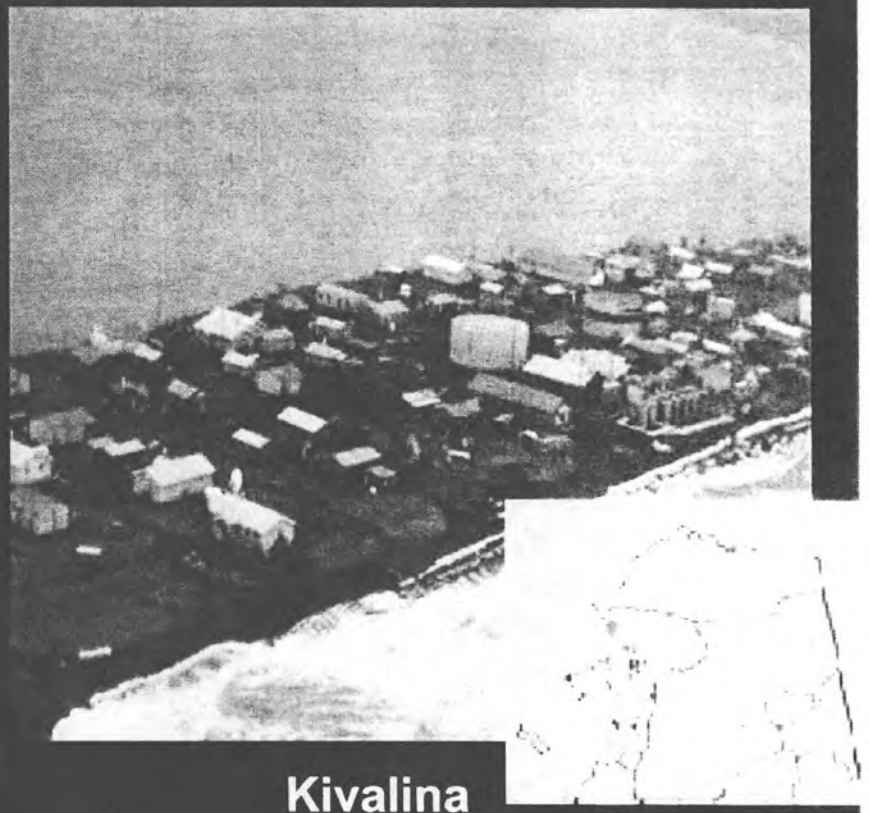
- Discuss process for establishing ship routing measures
  - Lengthy process, ultimately approved by International Maritime Organization

Coastal Erosion

- Loss of protection from fall storms



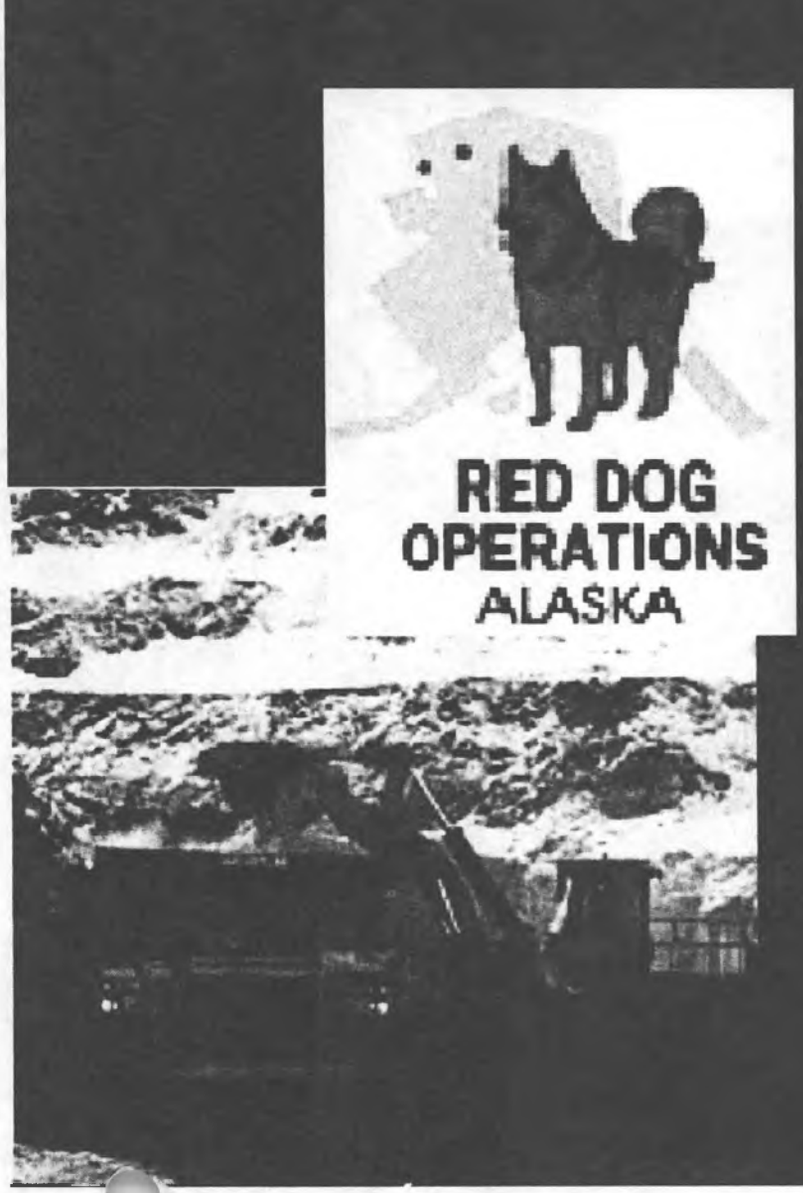
Port Heiden



Kivalina

Homeland Security

Seasonal Ore Operations

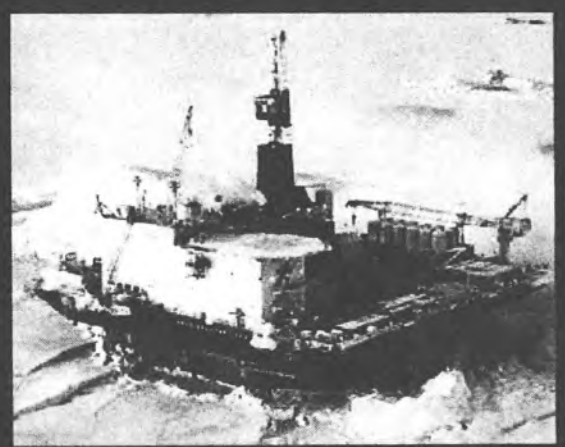


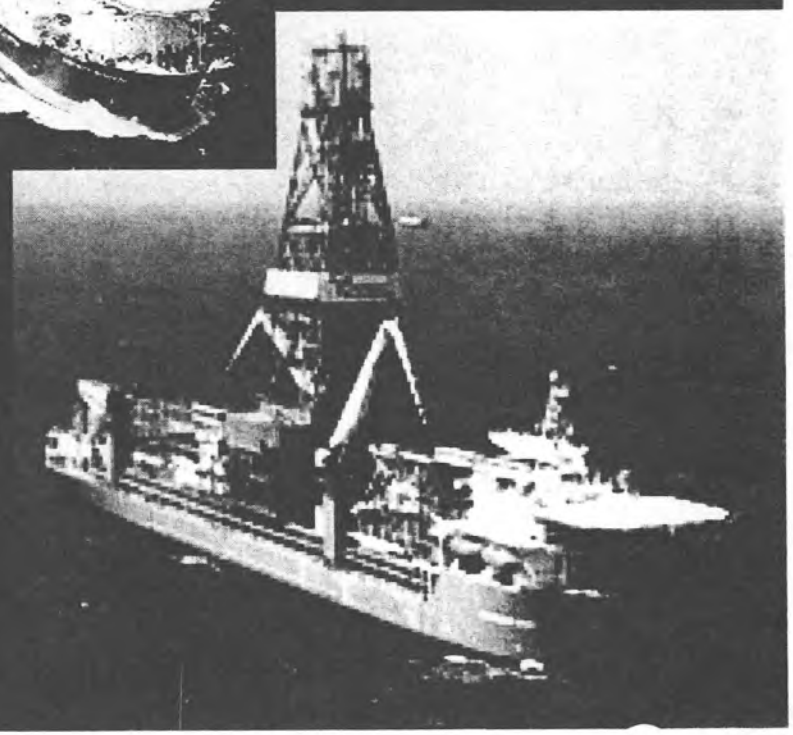
Growing Eco-Tourism

- M/S Explorer
  - Nov 2007: 154 people abandon a cruiseliner that struck an iceberg and sank in the Antarctic

Expanding Resource Exploration

- Increased offshore exploration
  - 18 commercial vessels
  - 12 exploration wells
- Legal issues pend

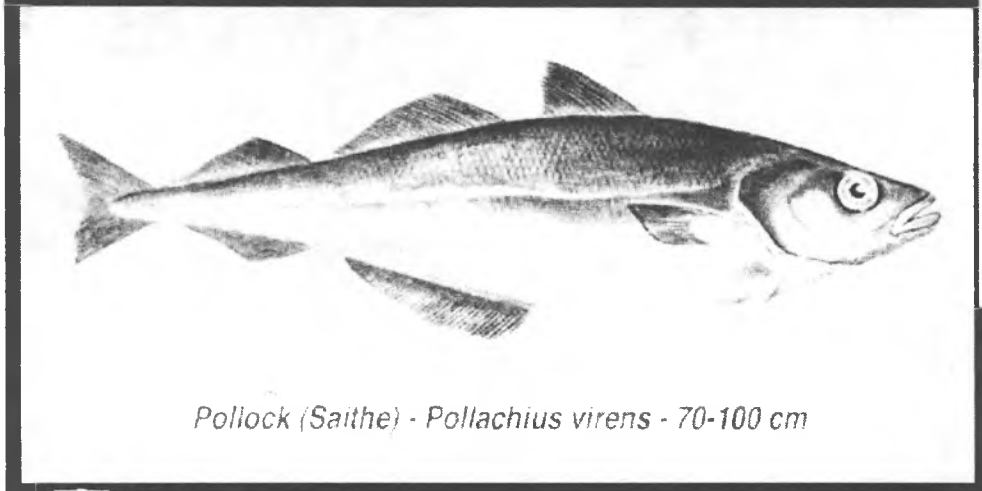




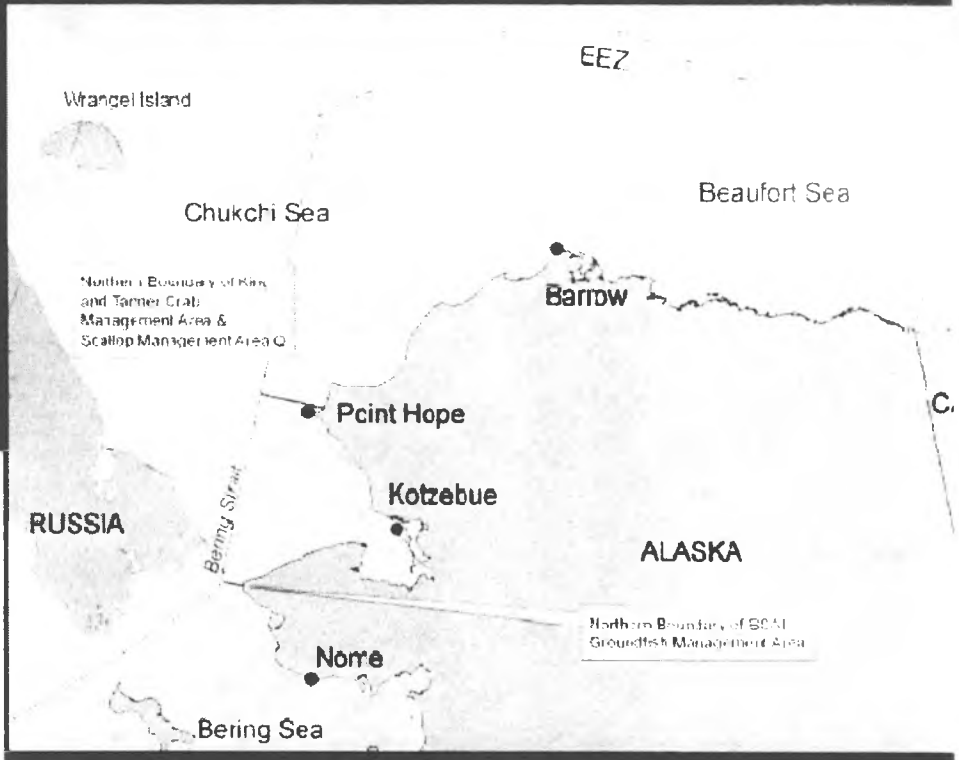
Homeland Security

Species Movement North

- Stocks are moving North
- No commercial fishing in Arctic
  - Awaiting NPFMC decision



Pollock (Saithe) - Pollachius virens - 70-100 cm



NPFMC – North Pacific Fishery Management Council

Homeland Security

Coast Guard in the Arctic

USRC *Bear*

Bering Sea Patrol

1867- present

CG brings federal presence to Alaska

USRC *Manning*

USCGC *Polar Sea*

Overland Relief Expedition

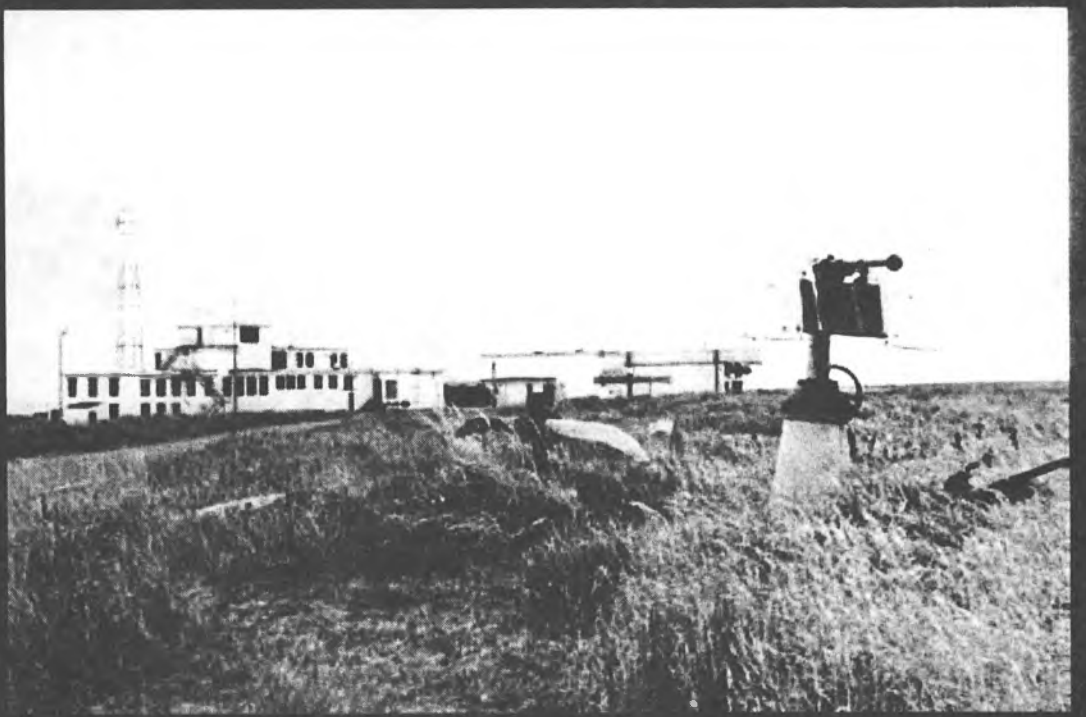
Crews race across the frozen sea to trapped vessels

Reindeer meat “on the hoof” herded to crews in time to prevent starvation

Loran

- Post WII, Coast Guard sets up 6 loran stations.

Loran Station Attu
Loran Station Kodiak
Loran Station Port Clarence
Loran Station Shoal Cove
Loran Station St. Paul
Loran Station Tok



Loran: LOng **RA**nge **N**avigation

Homeland Security

Northwest Passage Expedition

- 1957 – CG Cutters Storis, Spar, Bramble circumnavigate North America.

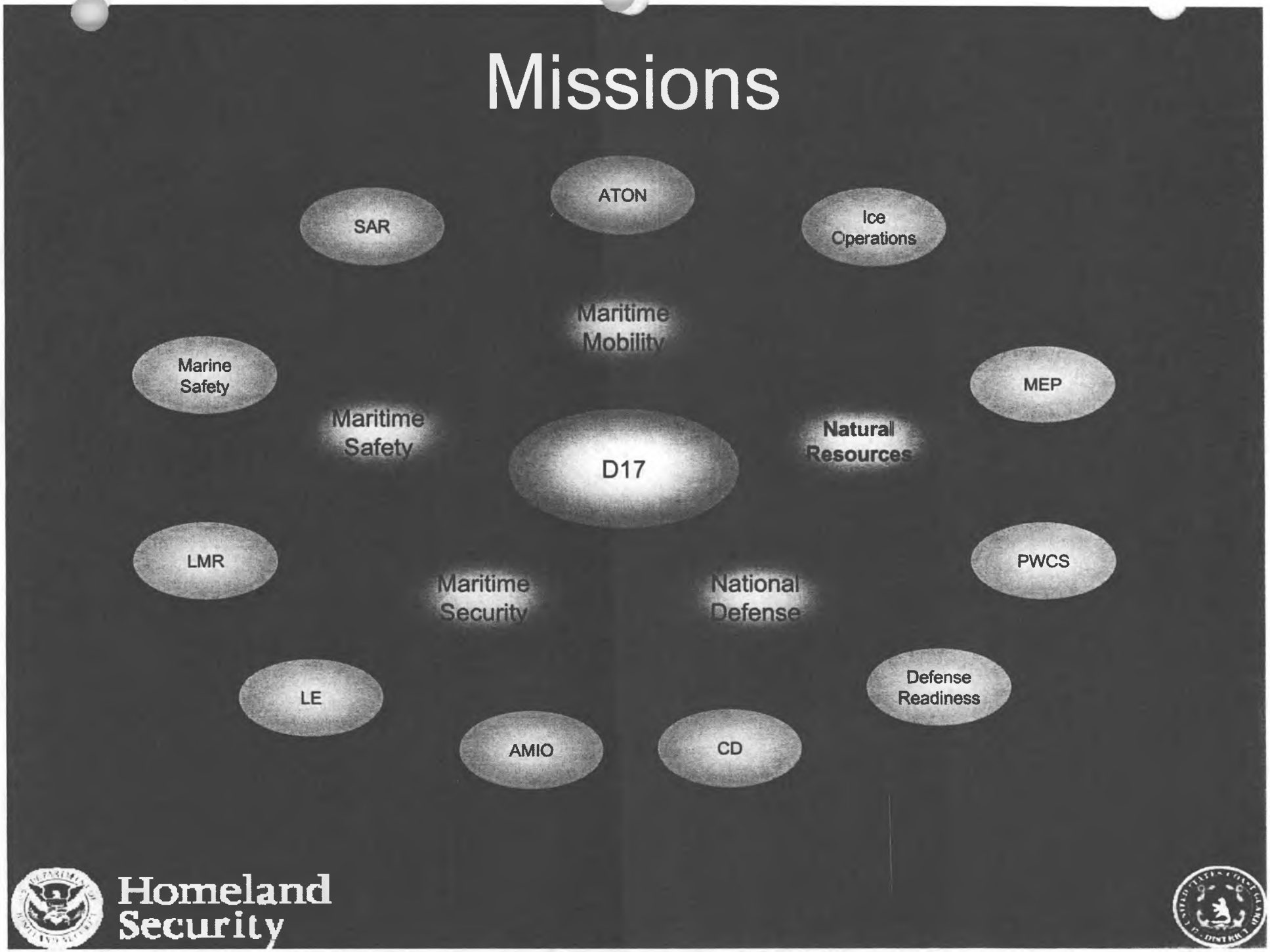
The CG has 142 years of Arctic Service

USRC *Bear*

- Ice breaking
- Ice patrol
- Loran
- Marine mammal protection
- Bering Sea Patrols
- World War II
- Overland Expedition
- Exploration
- Marine Safety

Homeland Security

Missions



Homeland Security

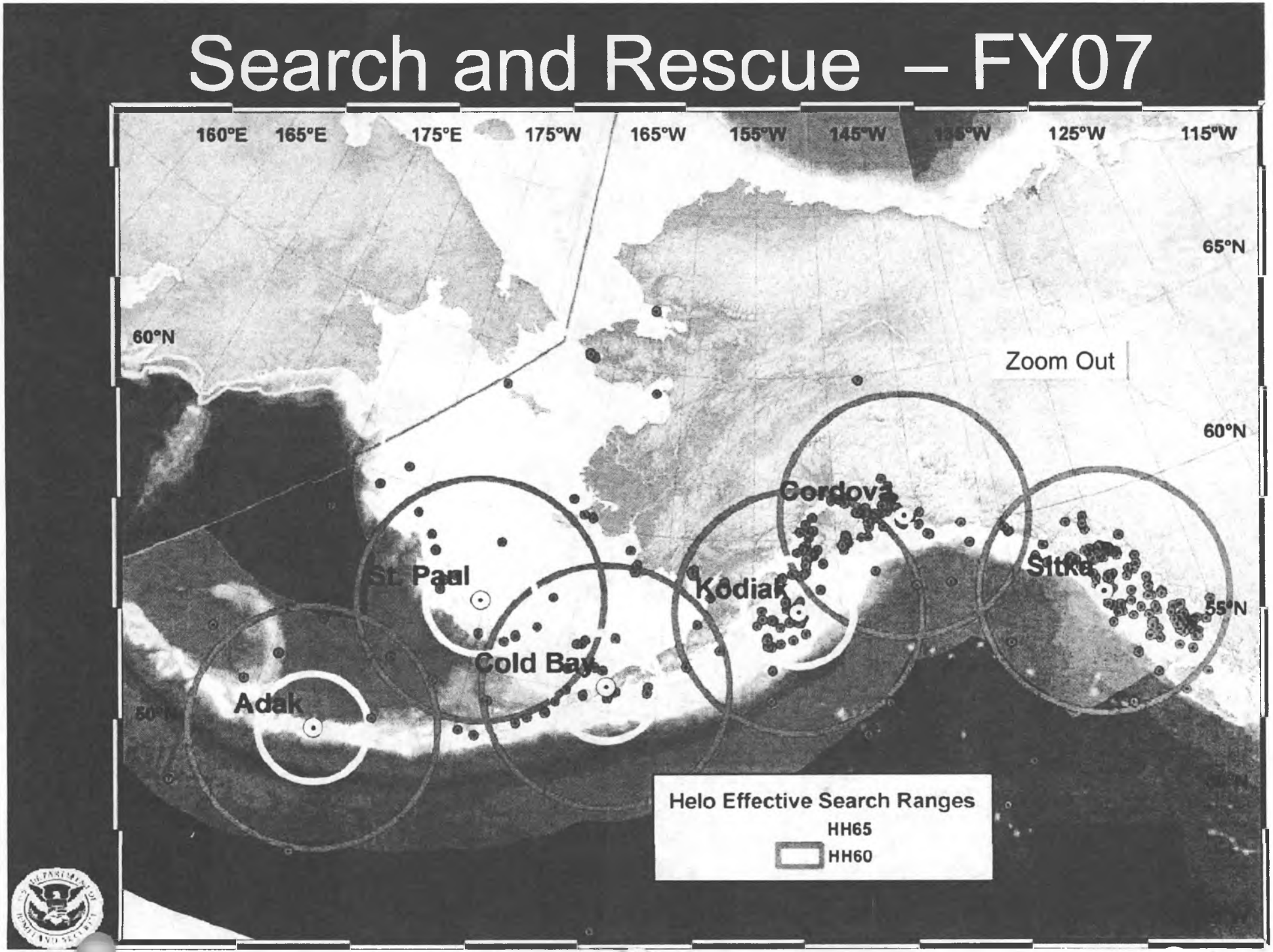
Maritime Law Enforcement

- Domestic Fisheries
- US Russian Maritime Boundary Line (MBL)
- IUU/HSDN
- LE Partnerships

Homeland Security

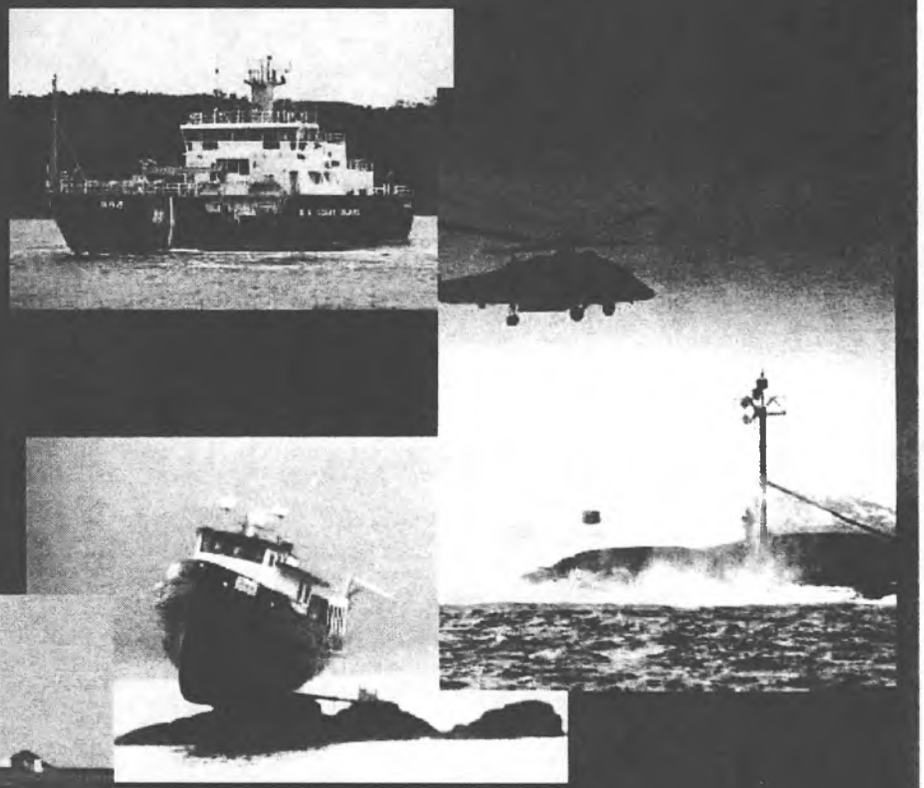
Marine Safety

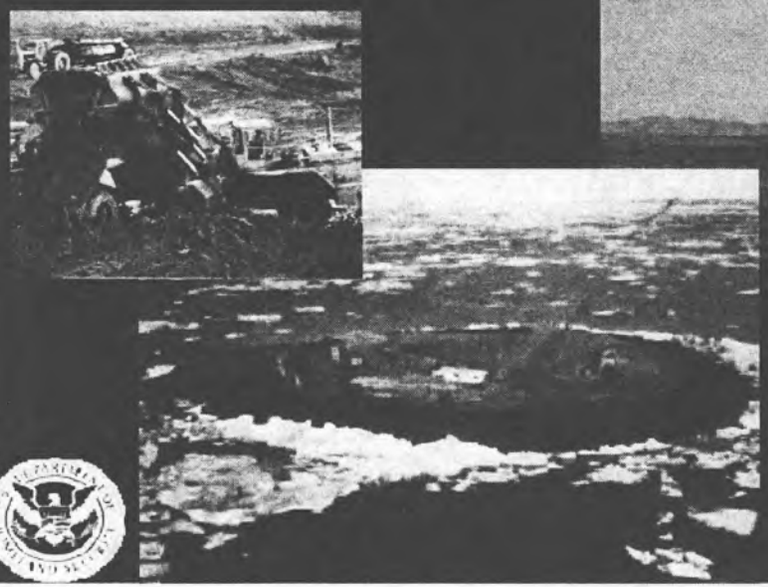
Search and Rescue – FY07



Aids to Navigation

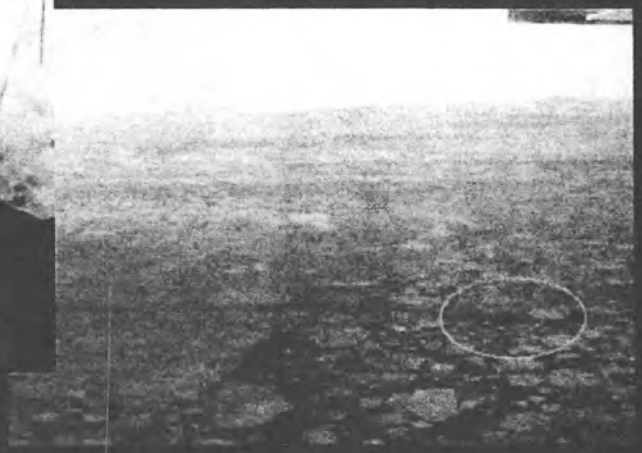
- Largest Buoy Tender Fleet in Pacific Area
- Flying ANTs
- Loran Stations





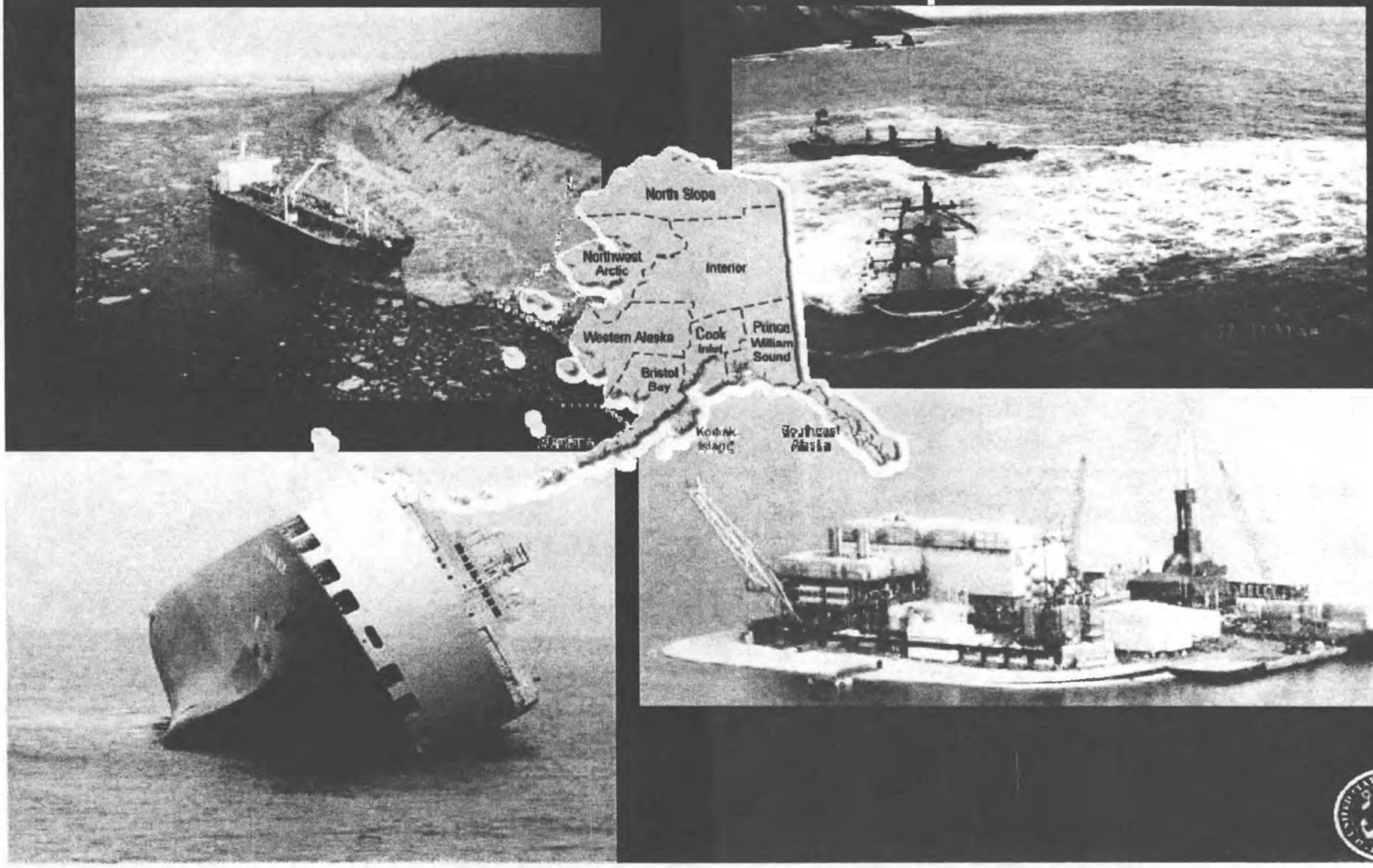
Ice Operations

- Polar Region Ice Breaking – Scientific & National Security Activities
- Cook Inlet – Ice Measures
- Valdez – Ice Routing



Homeland Security

Marine Environmental Response



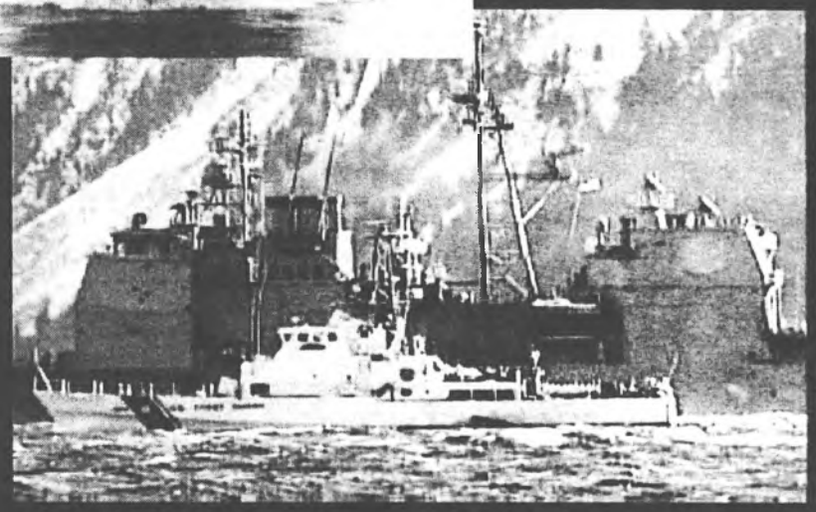
Homeland Security

- AMSC Sub-Committees (PSCs)
- HCPV Security
- SEAK “1 Port” ANOA Concept
- 225’ WLB MSST Transports

Homeland Security

Defense Readiness

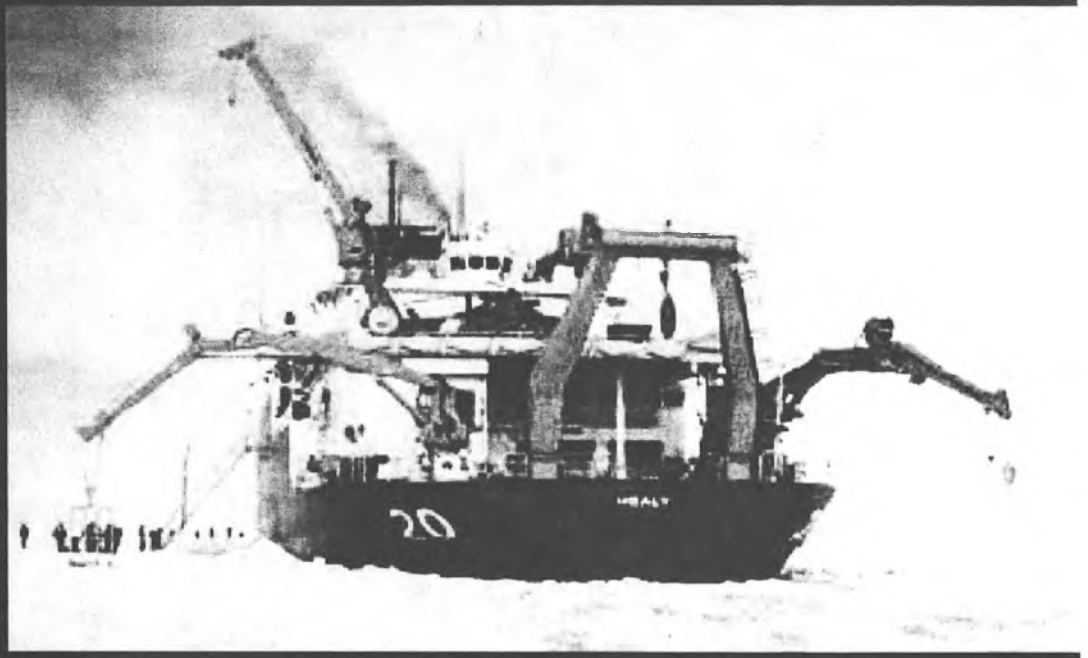
- Joint Exercises
- Military Outload Security



Arctic Changes Drive Coast Guard Mission Expansion North

Science is More Critical

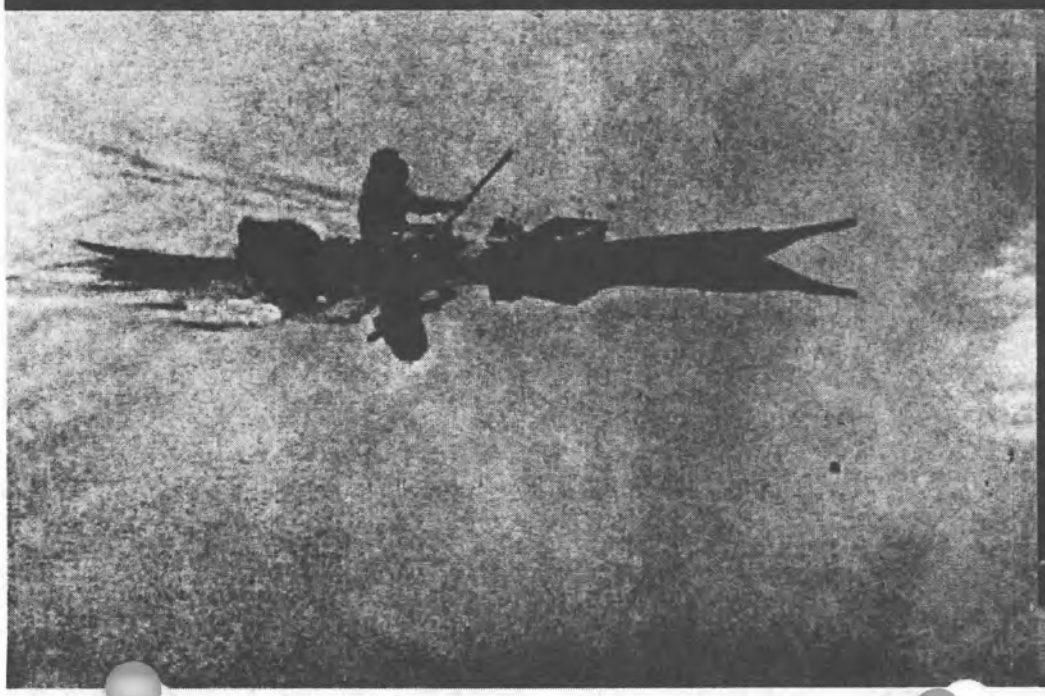
- Support of scientific endeavors
  - Research on climate change and its effects

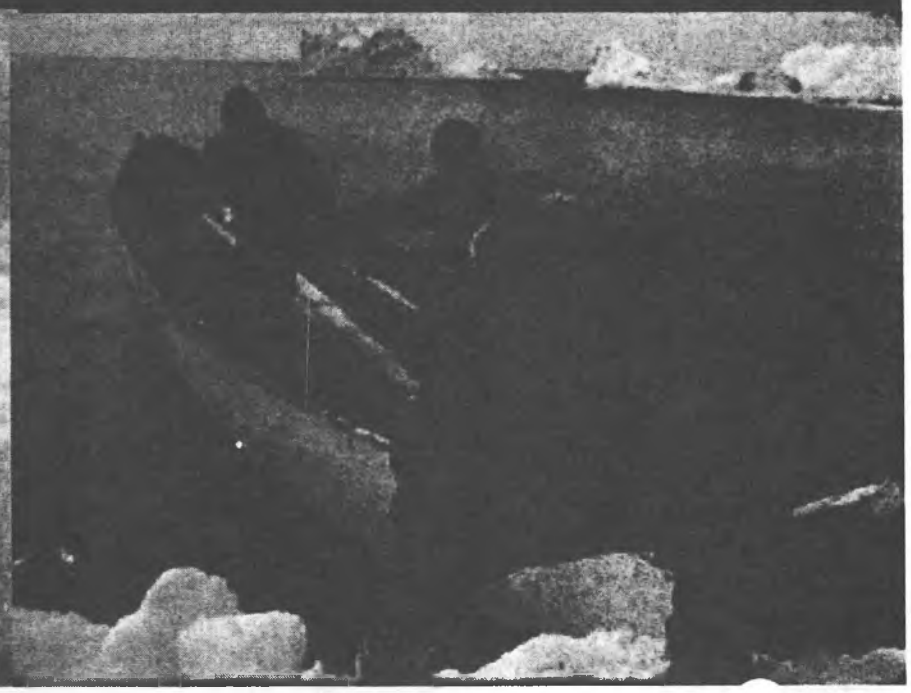


Homeland Security

Coastal Community Engagement

- Engagement with the peoples of the Northern regions of Alaska
  - Leverage thousands of years of experience
  - Promote environmental and cultural understanding





Arctic Ops Summer '08

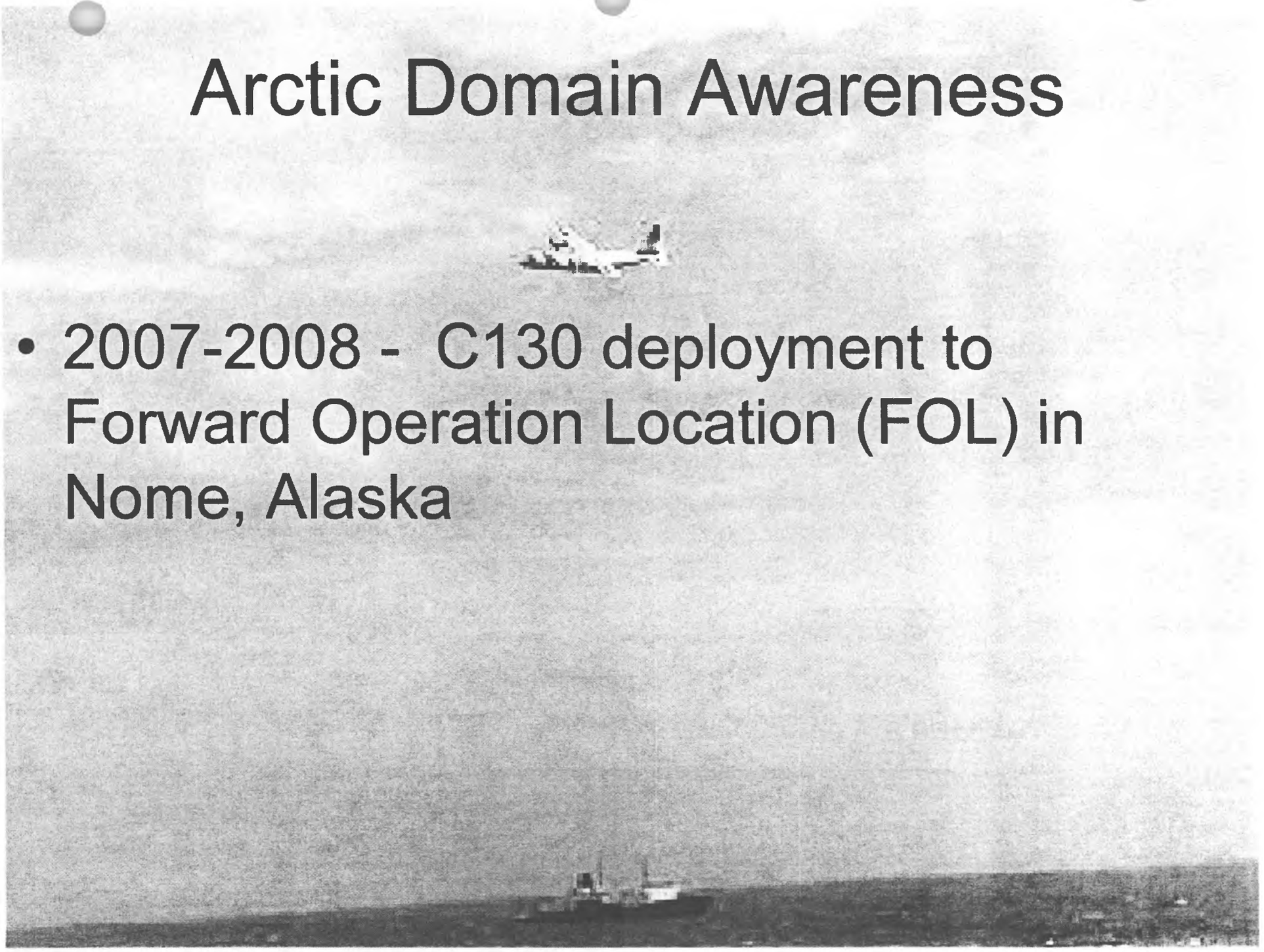
- Develop Arctic Domain Awareness
  - Nome C130 Deployment
- Cutter Operations
  - HEALY, POLAR SEA
- CGC SPAR Waterways Analysis & Management System
- International Search and Rescue Exercise
- Tailored Force Package Deployment
- Prudhoe Bay Maritime Security Deployment
- Coastal Community Engagement

Arctic Domain Awareness

- Air Patrols
  - 'Eyes on' above the Arctic Circle
  - Provide scientists platforms of opportunity

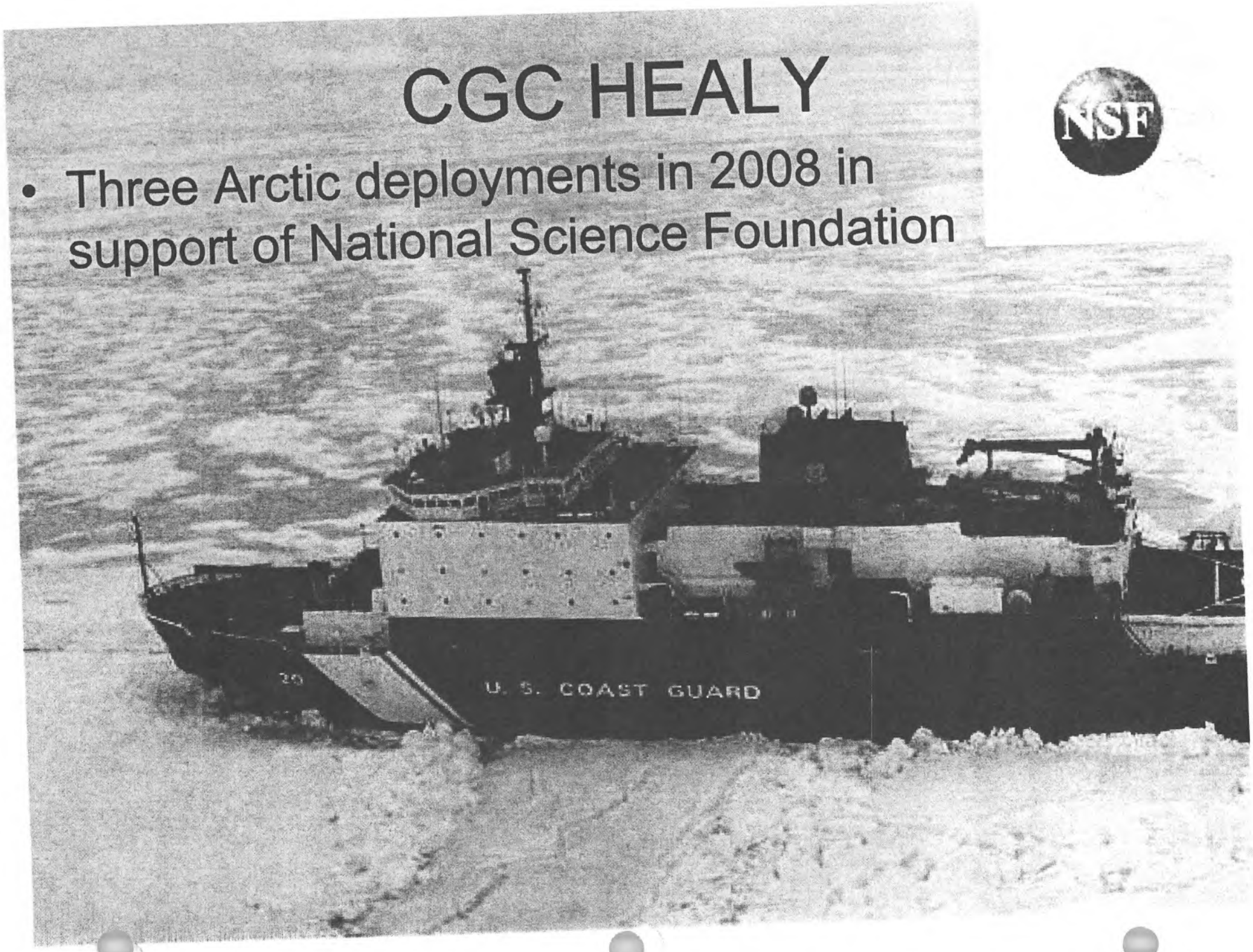
Arctic Domain Awareness

- 2007-2008 - C130 deployment to Forward Operation Location (FOL) in Nome, Alaska

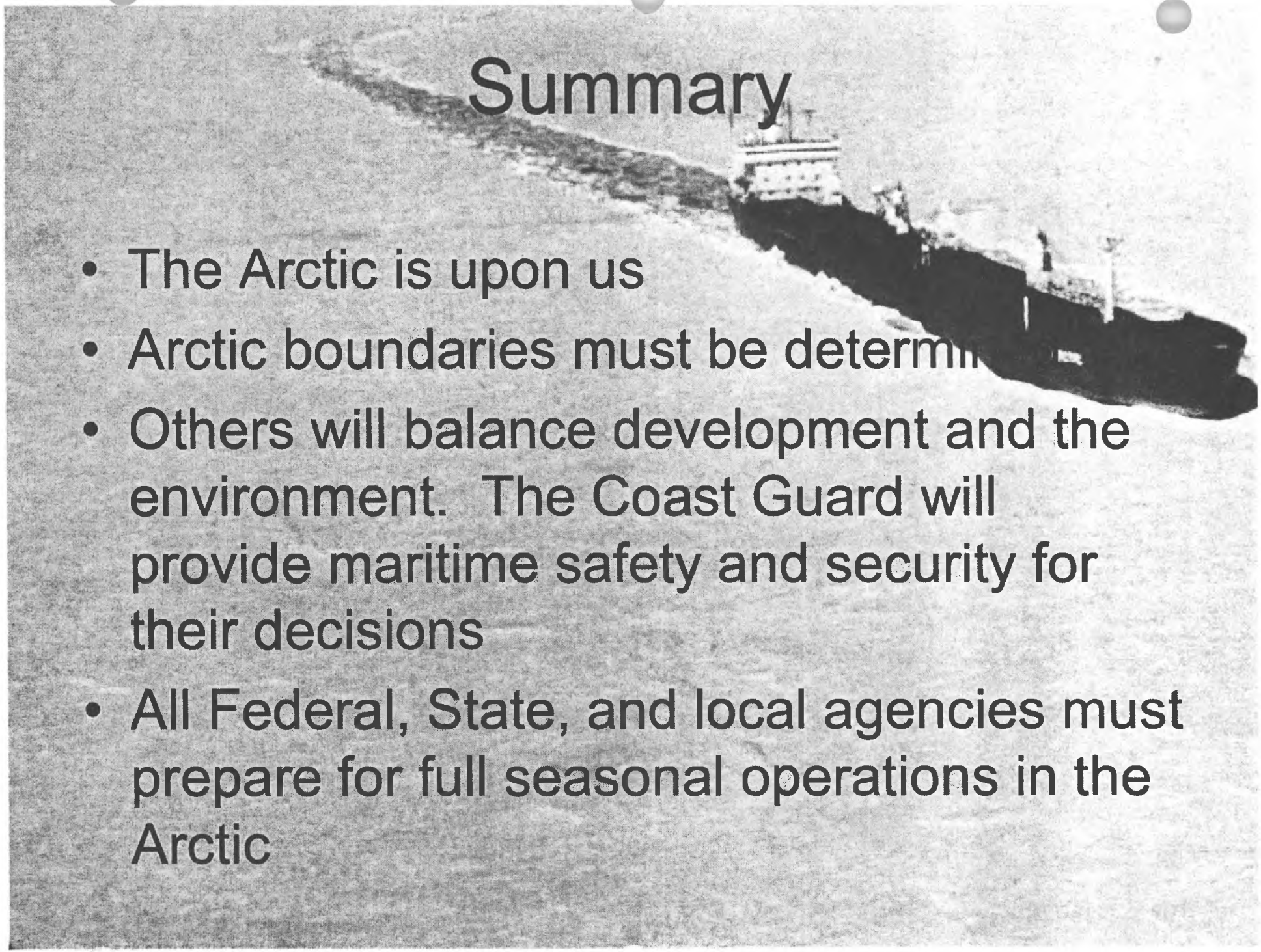


CGC HEALY

- Three Arctic deployments in 2008 in support of National Science Foundation



Summary



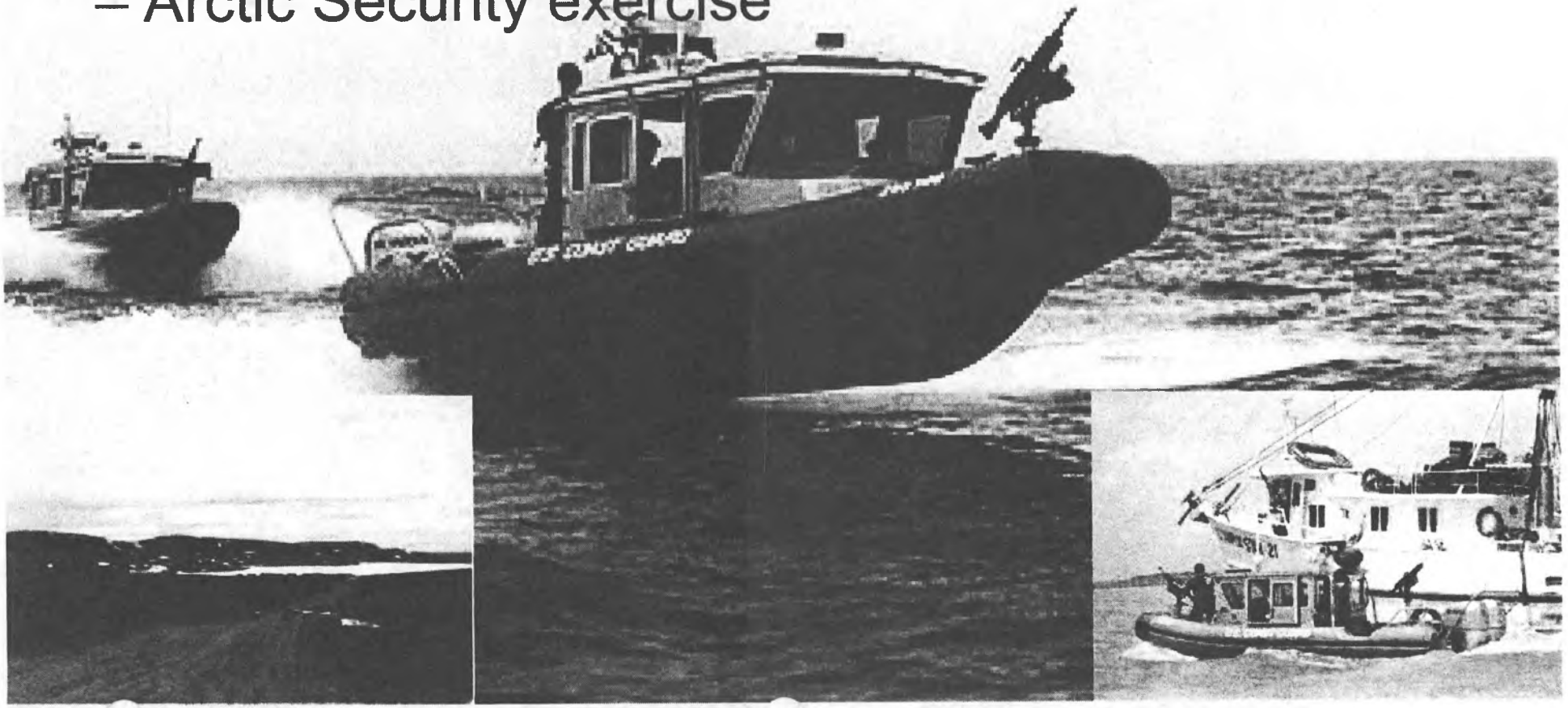
- The Arctic is upon us
- Arctic boundaries must be determi
- Others will balance development and the environment. The Coast Guard will provide maritime safety and security for their decisions
- All Federal, State, and local agencies must prepare for full seasonal operations in the Arctic

Way Ahead

- Potential establishment of one or more Forward Operating Locations on the North Slope and Western Alaska
- Collect lessons learned from summer operations
- Build operational requirements baseline

Prudhoe Bay Maritime Security Deployment

- 2008 - Prudhoe Bay, AK
  - Community/tribal liaison Team
  - Arctic Security exercise



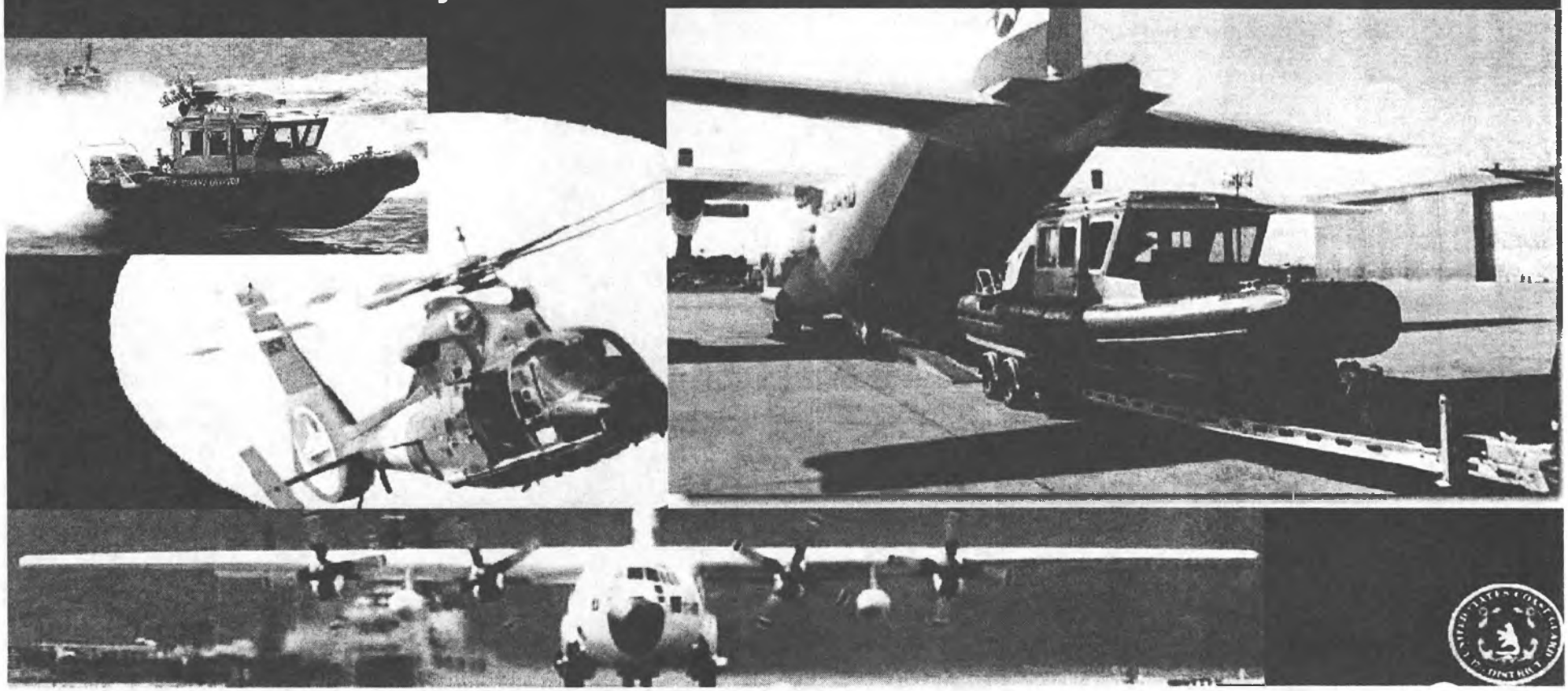
Auxiliary in the Arctic

- Provide boating safety services tailored to each Arctic Community's need.
- Conduct educational exchange on boating safety.
- Current plans for visits include Barrow, Kotzebue, Nome, and possibly some of the remote North Slope villages.

Homeland Security

Tailored Force Package

- August 2008 - Barrow, AK
  - 2 Helos and 2 25' small boats via C-130
  - Boating Safety Training Team
  - Community/tribal liaison Team



Joint Search and Rescue Exercise

- 2008 – Tentative plans to invite Arctic nations to participate to build partnerships and test our capabilities.

Norway

Canada

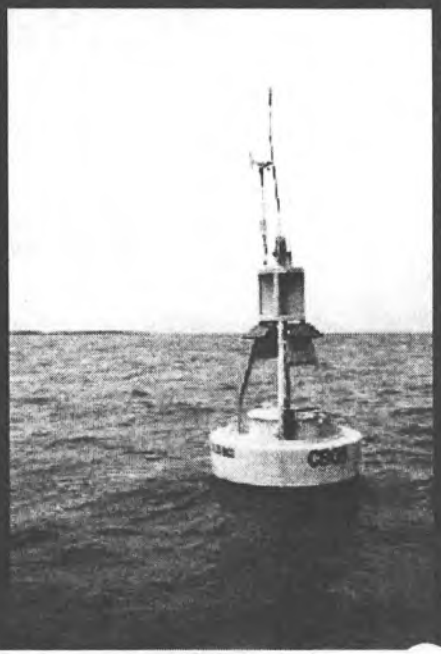
Denmark

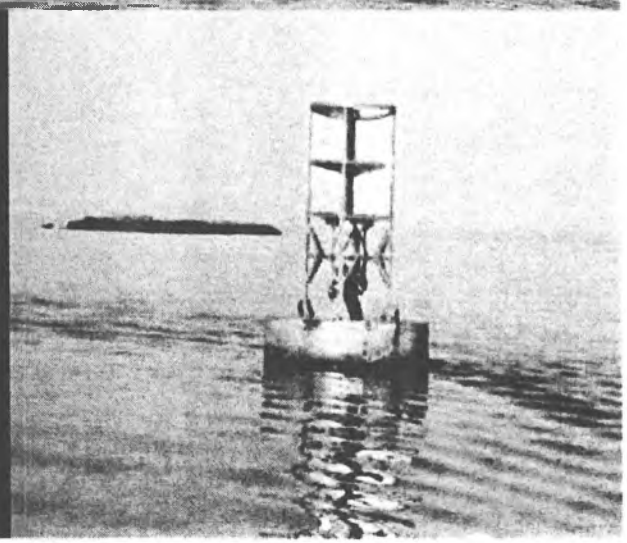
Russia

Homeland Security

CGC SPAR

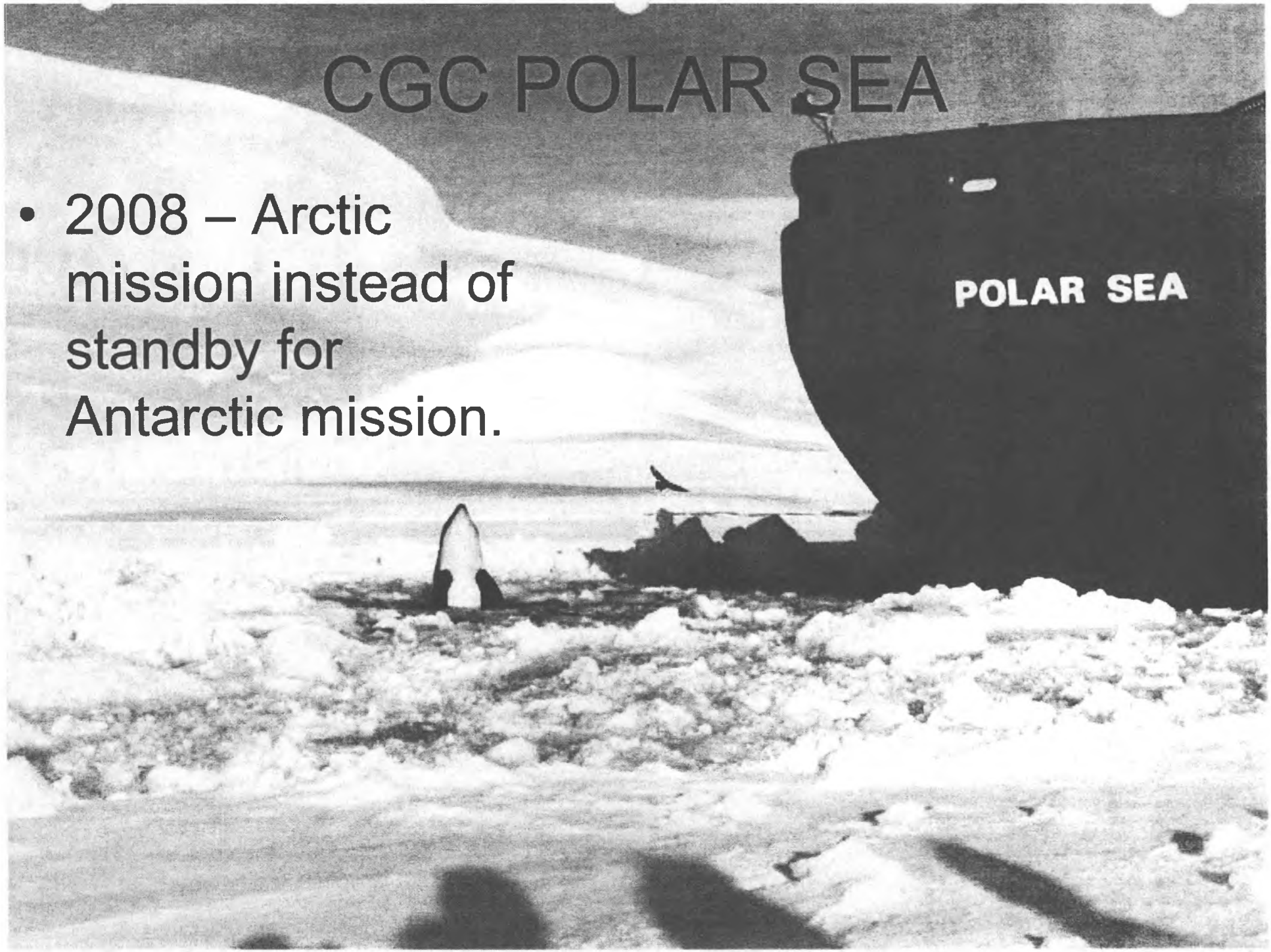
- Waterways Analysis & Management System (WAMS) assessment/reassessment of North Slope



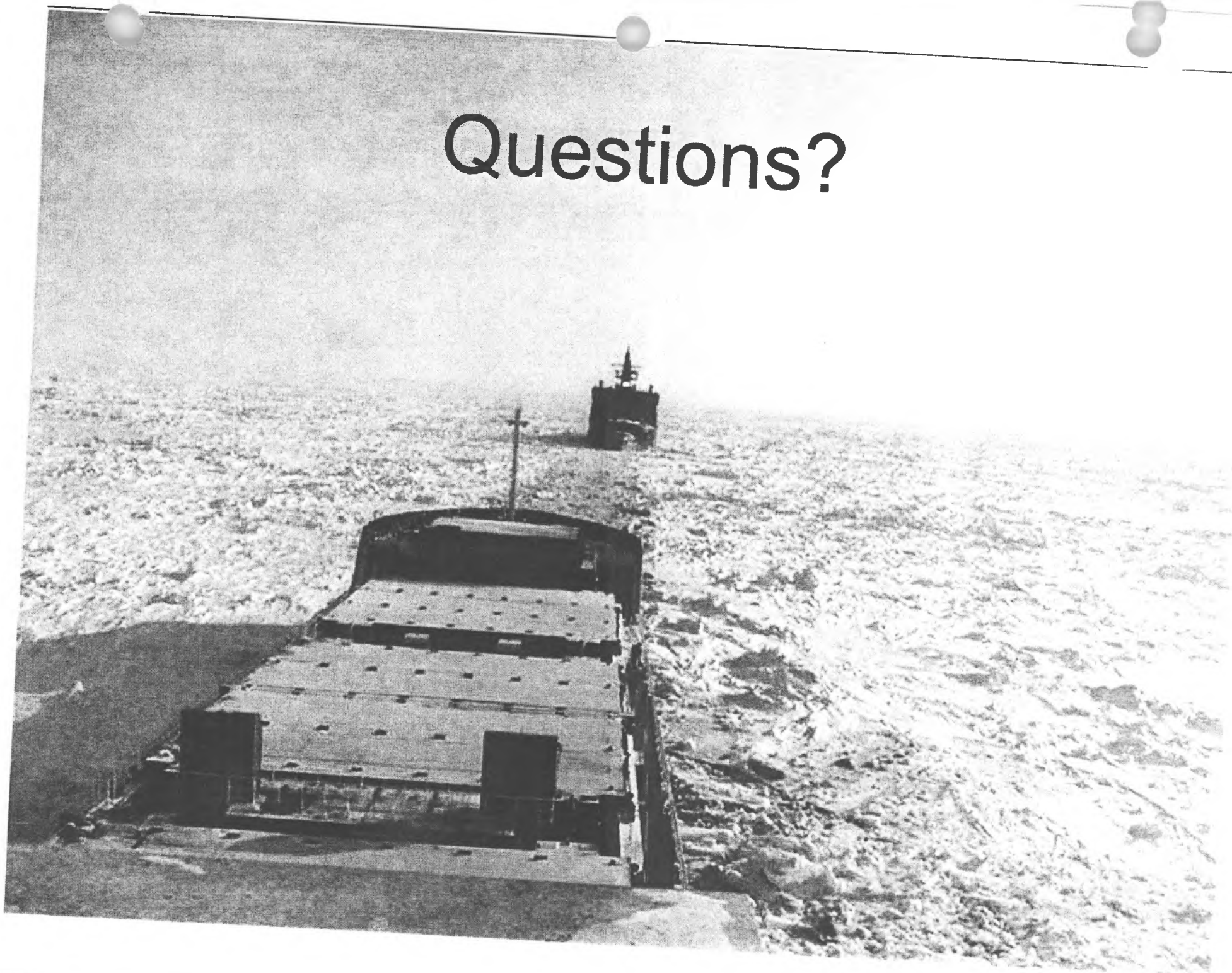


CGC POLAR SEA

- 2008 – Arctic mission instead of standby for Antarctic mission.



Questions?



14.

Alaska Climate Change Executive Roundtable Power Point Presentation

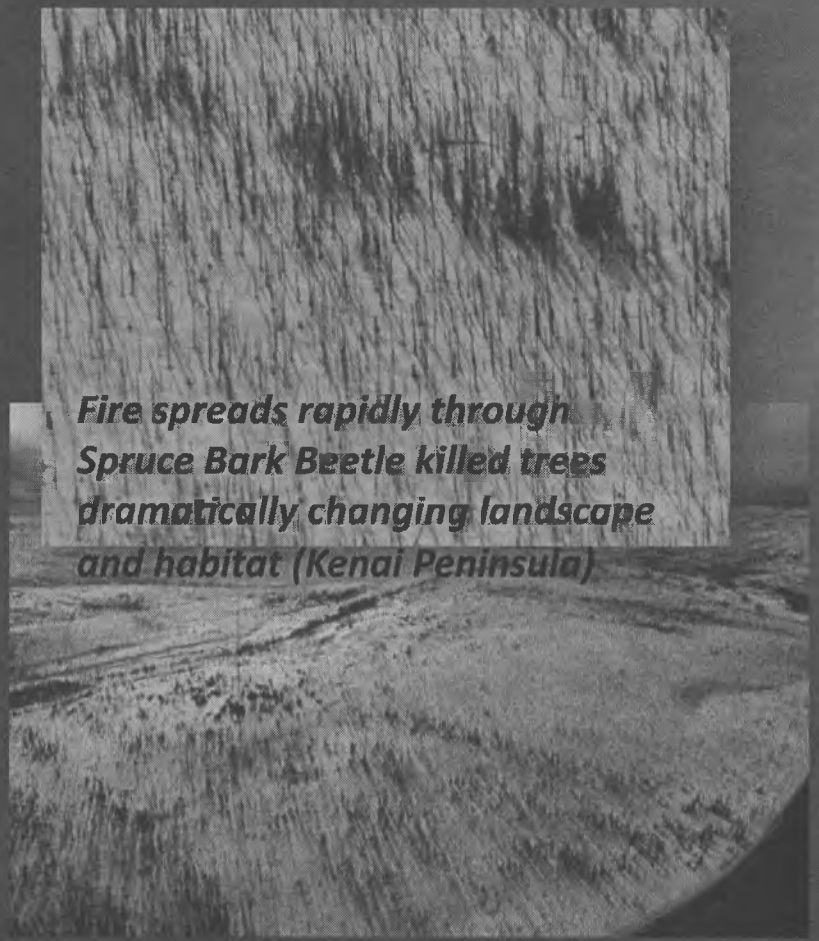
Alaska's
Climate Change Executive Roundtable:

Coordinating Federal and State Agency Efforts in the Great Land

State of the Arctic

March 18, 2010, Miami, FL

Alaska Climate Change Executive Roundtable (ACCER) Background



Fire spreads rapidly through Spruce Bark Beetle killed trees dramatically changing landscape and habitat (Kenai Peninsula)

- Established in 2007 at Alaska Forum on the Environment
- Mechanism for Federal and State science agencies in Alaska to share information about climate change activities and facilitate cooperation among agencies
- Evolved to planning & executing own activities

ACCER Membership

- Federal
  - DOI: USGS, MMS, FWS, BLM, NPS, BIA
  - DOC: NOAA (NWS, NMFS, NOS, AOOS)
  - USDA: FS
  - EPA
- State
  - Department of Environmental Conservation
  - Department of Natural Resources
  - Department of Fish and Game
  - Governor's Office

ACCER focus areas

- data integration and collaboration
- needs for down-scaled climate data and physical parameter monitoring networks
- sea level rise and physical hazard assessment
- forecasting biological species and habitat changes

Physical & Biological

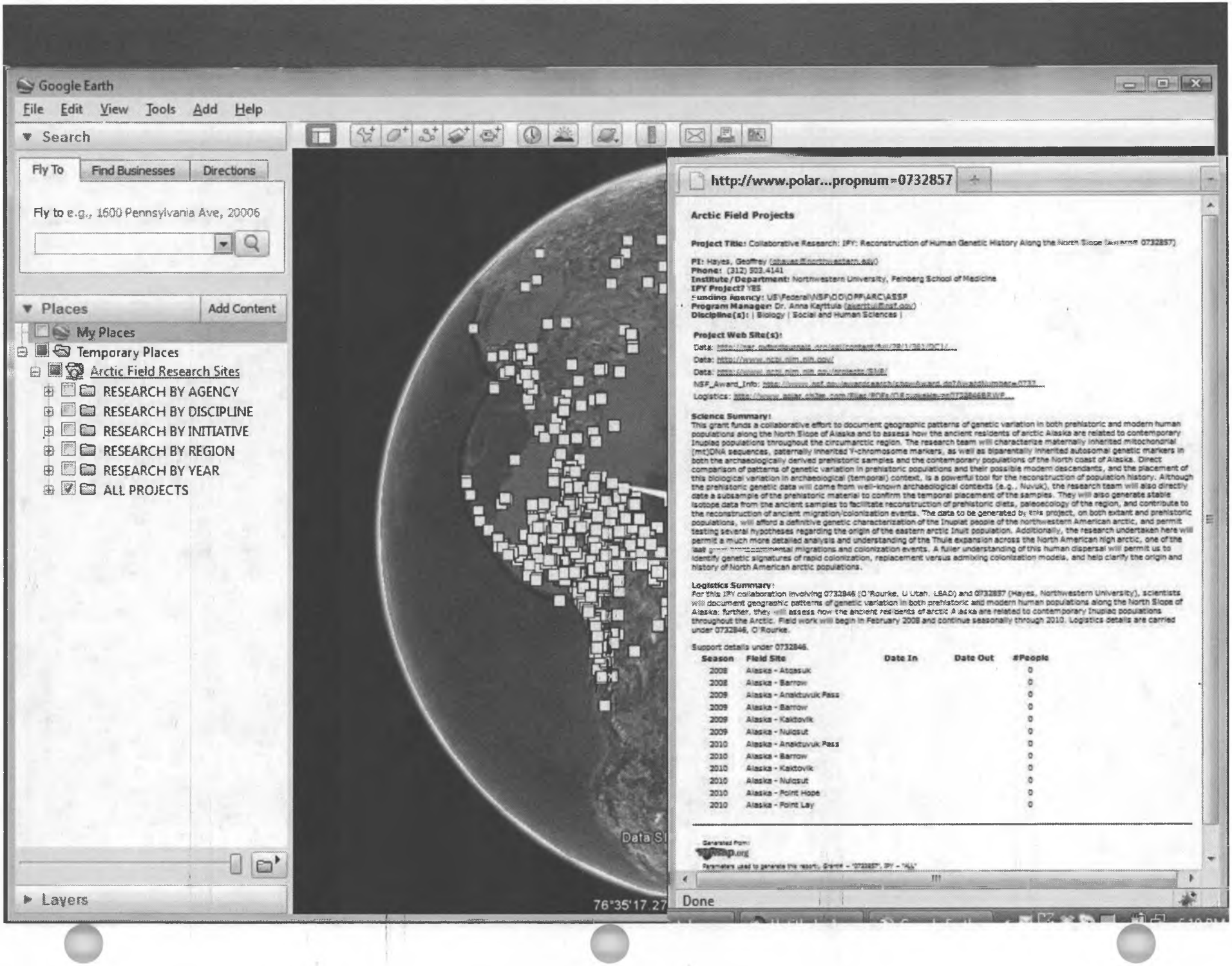
- Projections of change – most important
- ID monitoring needs; mine historical data to show status & trends over time
- Next step: gap analysis

ACCER Data Integration And Collaboration

- History:
  - Established 2008
  - Groups have met regularly
- Structure:
  - Two groups: executive (policy) and technical
- Progress to date:
  - Initial focus is on developing compatible project tracking systems
  - Will then turn to metadata and data system integration

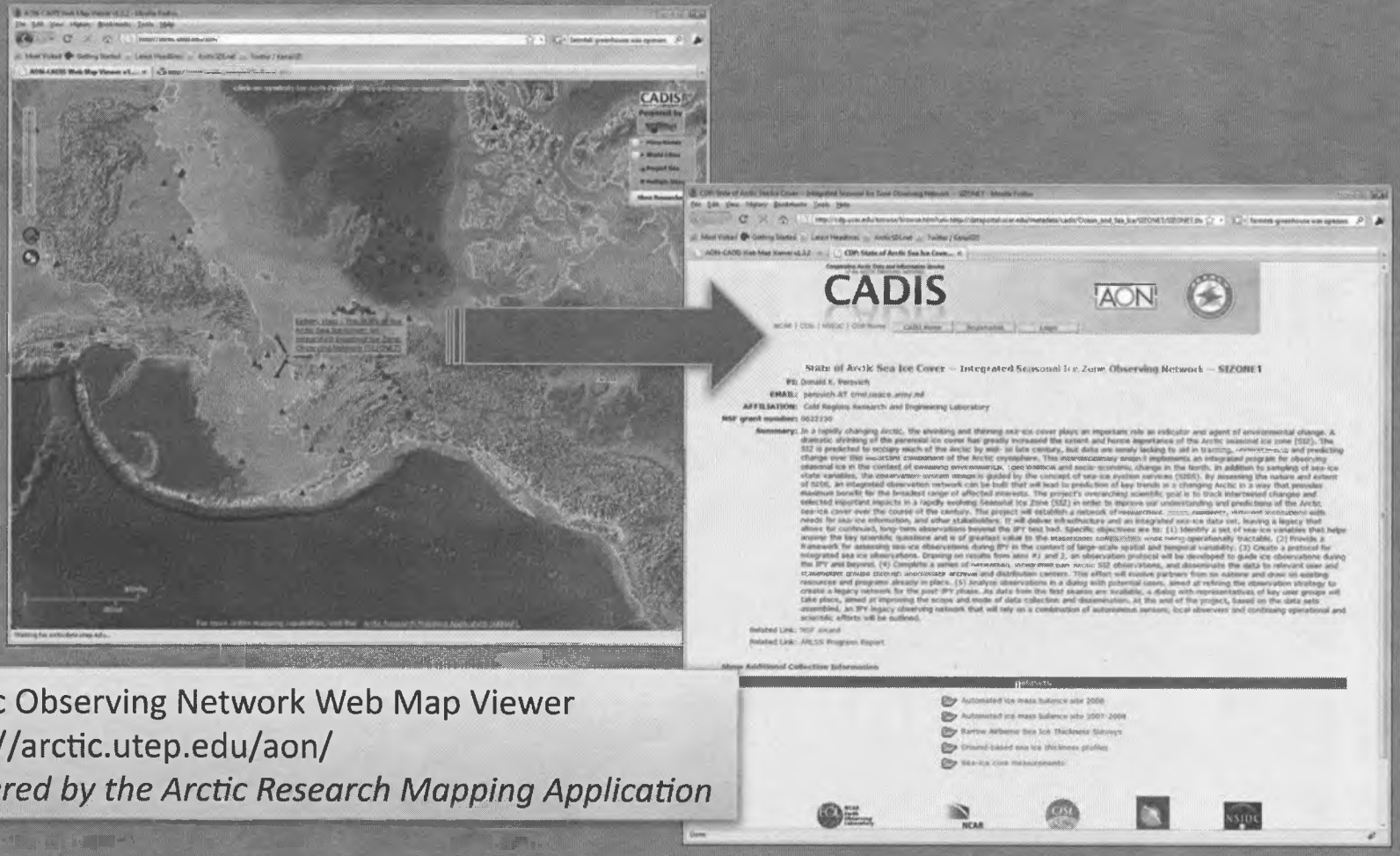
Alaska Data Integration Work Group
Project Tracking System Core Fields

- Project title
- Project start date
- Project end date
- Current status
- Last updated
- Keywords
- Place key words
- Primary Contact
- Information Contacts
- Conducting Entity
- Regions
- Boundaries (N,S,E,W)
- KML File Web Link
- Abstract
- Short Project Description
- Web Links
- Metadata Steward
- Note
- Data Availability
- Access Limitations
- Publications
- Global Unique ID
- Primary Agency Code
- Primary Agency Project ID
- Metadata Agency Code
- Metadata Agency Project ID
- Host Agency Code
- Host Agency Project ID


Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
Fly to e.g., 1600 Pennsylvania Ave, 20006
Places
Add Content
My Places
Temporary Places
Arctic Field Research Sites
RESEARCH BY AGENCY
RESEARCH BY DISCIPLINE
RESEARCH BY INITIATIVE
RESEARCH BY REGION
RESEARCH BY YEAR
ALL PROJECTS
Layers
76°35'17.27
http://www.polar...propnum=0732857
Arctic Field Projects
Project Title: Collaborative Research: IPY: Reconstruction of Human Genetic History Along the North Slope (Award# 0732857)
PI: Hayes, Geoffrey
Phone: (312) 503.4141
Institute/Department: Northwestern University, Feinberg School of Medicine
IPY Project? YES
Funding Agency: US\Federal\NSF\OD\OPP\ARC\ASSP
Program Manager: Dr. Anna Kerttula
Discipline(s): | Biology | Social and Human Sciences |
Project Web Site(s):
Data:
Data:
Data:
NSF_Award_Info:
Logistics:
Science Summary:
This grant funds a collaborative effort to document geographic patterns of genetic variation in both prehistoric and modern human populations along the North Slope of Alaska and to assess how the ancient residents of arctic Alaska are related to contemporary Inupiaq populations throughout the circumarctic region. The research team will characterize maternally inherited mitochondrial (mt)DNA sequences, paternally inherited Y-chromosome markers, as well as biparentally inherited autosomal genetic markers in both the archaeologically derived prehistoric samples and the contemporary populations of the North coast of Alaska. Direct comparison of patterns of genetic variation in prehistoric populations and their possible modern descendants, and the placement of this biological variation in archaeological (temporal) context, is a powerful tool for the reconstruction of population history. Although the prehistoric genetic data will come from well-known archaeological contexts (e.g., Nuvuk), the research team will also directly date a subsample of the prehistoric material to confirm the temporal placement of the samples. They will also generate stable isotope data from the ancient samples to facilitate reconstruction of prehistoric diets, paleoecology of the region, and contribute to the reconstruction of ancient migration/colonization events. The data to be generated by this project, on both extant and prehistoric populations, will afford a definitive genetic characterization of the Inupiat people of the northwestern American arctic, and permit testing several hypotheses regarding the origin of the eastern arctic Inuit population. Additionally, the research undertaken here will permit a much more detailed analysis and understanding of the Thule expansion across the North American high arctic, one of the last [illegible] migrations and colonization events. A fuller understanding of this human dispersal will permit us to identify genetic signatures of rapid colonization, replacement versus admixing colonization models, and help clarify the origin and history of North American arctic populations.
Logistics Summary:
For this IPY collaboration involving 0732846 (O'Rourke, U Utah. LEAD) and 0732857 (Hayes, Northwestern University), scientists will document geographic patterns of genetic variation in both prehistoric and modern human populations along the North Slope of Alaska; further, they will assess how the ancient residents of arctic Alaska are related to contemporary Inupiaq populations throughout the Arctic. Field work will begin in February 2008 and continue seasonally through 2010. Logistics details are carried under 0732846, O'Rourke.
Support details under 0732846.
Season | Field Site | Date In | Date Out | #People
2008 | Alaska - Atqasuk | | | 0
2008 | Alaska - Barrow | | | 0
2009 | Alaska - Anaktuvuk Pass | | | 0
2009 | Alaska - Barrow | | | 0
2009 | Alaska - Kaktovik | | | 0
2009 | Alaska - Nuiqsut | | | 0
2010 | Alaska - Anaktuvuk Pass | | | 0
2010 | Alaska - Barrow | | | 0
2010 | Alaska - Kaktovik | | | 0
2010 | Alaska - Nuiqsut | | | 0
2010 | Alaska - Point Hope | | | 0
2010 | Alaska - Point Lay | | | 0
Done

Project Tracking System (PTS)

Can be a means for linking to archived data



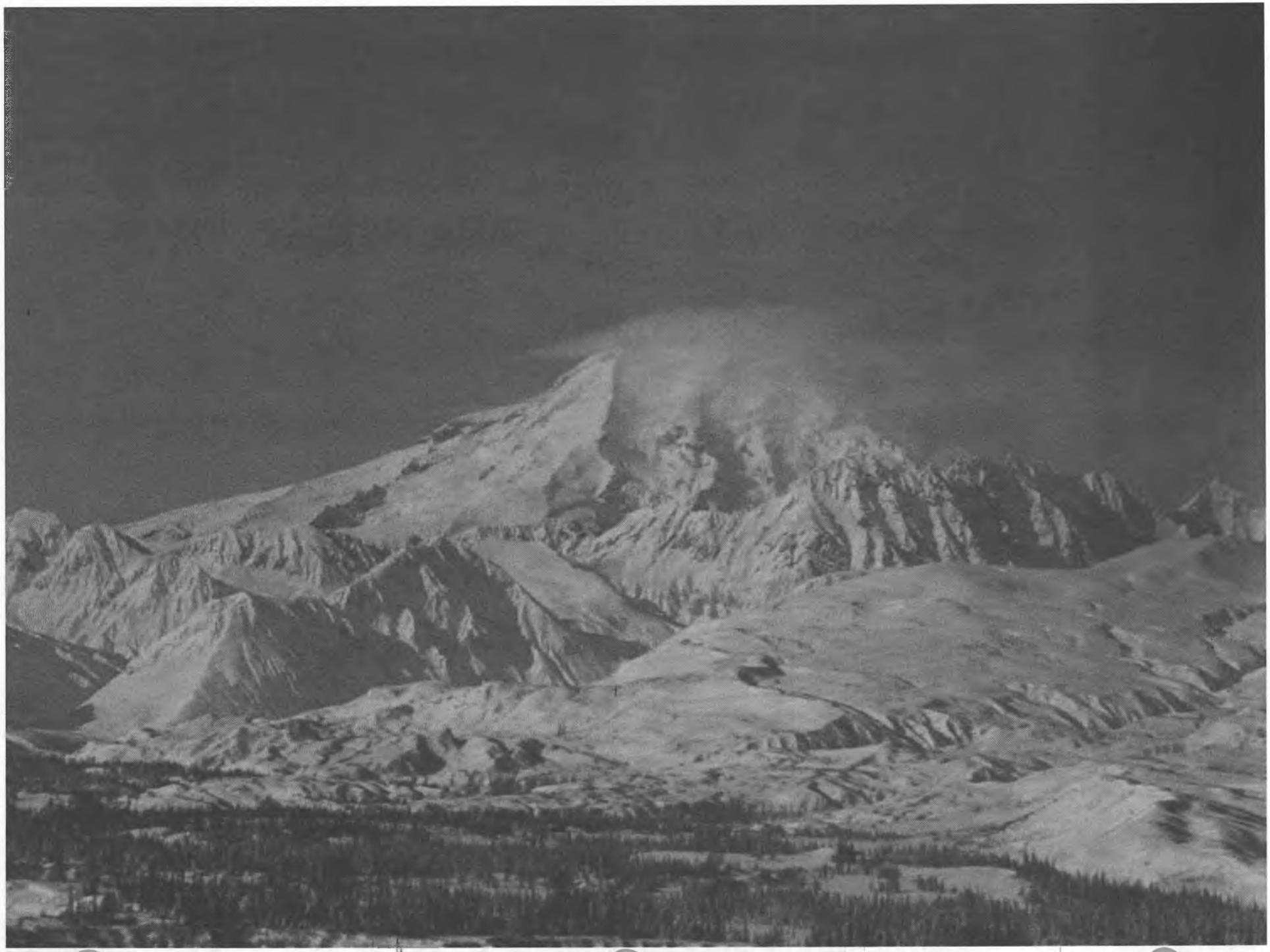
Arctic Observing Network Web Map Viewer
http://arctic.utep.edu/aon/
Powered by the Arctic Research Mapping Application

ACCER: The Future

- Coordination of Federal Agency Climate Center Efforts
- Research needs & issues being rolled into agency plans & budgets
- Development and coordination of a regional climate services involving all providers…HOW?

ACCER Issues

- Proliferation of Arctic and CC works groups & initiatives – agencies stretched thin
- New FWS/DOI Landscape Conservation Cooperatives & USGS/DOI Climate Research Center – moving forward in AK; ACCER to provide leadership role?
- What about NOAA Climate Center?
- What about CMSP?
- Is ACCER the right group?



Alaska's Climate Change Strategy: Addressing Impacts in Alaska
Executive Summary

INTRODUCTION

In Alaska, climate change has begun to touch almost every aspect of the natural world and the human systems that have evolved around, and rely on, a set of stable and predictable climatic conditions and seasons. It is a world where a warming environment has already begun to render ground and building foundations unstable, disrupt transportation routes, and trigger phenomena placing coastal communities in imminent danger from flooding and erosion. Impacts have resulted in myriad consequences to residents of the state, to subsistence livelihoods, to the wildlife and vegetation in Alaska's terrestrial and marine environments, and to the many industries that support the Alaskan economy.

While these changes are of critical import to Alaskans, they have also garnered attention of leaders in the United States and around the world. The primary driving force has been the accelerated retreat of Arctic sea ice, which has been a catalyst for multi-disciplinary planning and has underscored the need for increased domestic and international cooperation. A navigable Arctic Ocean presents opportunities for shipping and commerce in the Northwest Passage and has elevated interest in developing fisheries and mineral resources. Consequently, this creates a need for additional and improved weather and navigational tools, research to better understand and manage our strategic assets, and increased efforts to provide national, environmental, and economic security. Widespread interest in the Arctic has also been elevated by the important role that the Earth's polar region plays in influencing climate and oceans on a global scale. What happens in Alaska has far-reaching and long-lasting implications.

Box 1. Sectors Addressed by the AAG Report

Alaska's economy and the health and well-being of its residents will be affected by climate change. Key impacts being addressed include:

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Impacts of climate change on public, private, or cooperatively owned infrastructure for the public good including buildings, transportation, shoreline protection, water and sanitation systems, and defense facilities.

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Climatic changes and associated changes in natural systems are increasing the potential for health impacts from vector-, water-, and food-borne diseases and are beginning to cause stress on subsistence communities. Erosion, changes in permafrost, and extreme events are already impacting coastal communities, sanitation infrastructure, and archaeological sites and gravesites. Weather related injuries and detrimental effects on mental health have also been associated with rapidly changing conditions.

Natural Systems

Impacts of changing climate on marine, terrestrial, and freshwater ecosystems will have implications for Alaska's economy and subsistence communities. Changes in fisheries and forest resources, modes of travel, and the diversity and location of different plant and animal species have both beneficial and adverse impacts on natural systems and the services they provide.

Other Economic Activities

Changing climate may affect all sectors of Alaska's economy dependent on weather conditions and/or the natural environment or reliant on engineered infrastructure that is threatened by changes. This sector addresses their adaptation needs and also explores possibilities for new and/or expanding potential economic development created by a warming environment.

The adaptation component of Alaska's climate change strategy contains adaptation options designed to reduce the vulnerability of Alaska's natural and human systems to climatic changes and examine the potential growth of economic opportunities that might arise.

The *Arctic Climate Impact Assessment*, a comprehensive assessment conducted by hundreds of scientists and indigenous peoples, confirms that the Arctic is now experiencing some of the most rapid and severe climate changes on earth and is extremely vulnerable to both observed and projected climate change and its effects. To address the impacts of climate change on Alaska, Governor Sarah Palin signed Administrative

Order 238 on September 14, 2007, which established and charged the Alaska Climate Change Sub-Cabinet to advise the Office of the Governor on the preparation and implementation of a comprehensive Alaska Climate Change Strategy (AO 238). This document represents the recommendations of the Adaptation Advisory Group (AAG), which was charged with evaluating and developing options to adapt to climate change. The report also provides additional background on projected climate and impacts for Alaska.

The types of recommendations contained in this report vary. The options range from new systems approaches and institutional structures to adoption of new or revised policies, initiatives, and other actions. The Sub-Cabinet will consider these, as well as recommendations from the Immediate Action Work Group, the Mitigation Advisory Group, and the Research Needs Work Group in the context of other complementary efforts. A comprehensive Climate Change Strategy for Alaska will then be drafted for consideration by the Governor. While no one report or event can set a definitive course of action in the dynamic and uncertain set of circumstances created by a changing climate, the work of the Adaptation Advisory Group establishes a foundation from which to make progress towards improving our individual and societal ability to adapt.

Impacts on Human and Natural Systems in Alaska

Over the past three decades, Alaska has experienced a sharp reduction in snow-cover extent and duration, shorter river- and lake-ice seasons, melting of mountain glaciers, sea-ice retreat and thinning, permafrost retreat, and increased depth of summer thaw. These changes are in turn affecting human and natural systems. The AAG, with the support of four Technical Working Groups, has developed options to adapt to these changes, i.e., to reduce the adverse impacts or take advantage of the opportunities presented by climate change (see Box 1).

Permafrost Thawing and Sea Ice Melting

Permafrost underlies most of Alaska. Air temperature, snow cover, and vegetation affect the temperature of the frozen ground and the depth of seasonal thawing. Recent decades of warmer temperatures have produced extensive thawing, which has resulted in increased coastal erosion, landslides, and sinking of the ground surface, as well as consequent disruption and damage to forests, buildings, infrastructure, and coastal communities. In addition, many industrial activities depend on frozen ground surfaces, and many northern communities rely on ice roads for transport of groceries and other materials. Continued warming will further impair transport by shortening the seasonal use of ice roads. Thawing is projected to accelerate under future warming, with as much as the top 10 to 30 feet of discontinuous permafrost thawing by 2100.

Sea ice off the Alaskan Coast is retreating and thinning, with widespread effects on marine ecosystems, coastal climate, human settlements, and subsistence activities. Recent studies estimate arctic-wide reductions in annual average sea-ice extent of about 5-10% and a reduction in average thickness of about 10-15% over the past few decades. Retreat of sea ice allows larger storm surges to develop, increasing the risk of inundation and increasing erosion on coasts already made vulnerable by permafrost thawing. Loss of sea ice also causes large scale changes in marine ecosystems, and threatens populations of marine mammals and polar bears that depend on ice. At the same time, the continued reduction of sea ice is very likely to increase the navigation season, and within several decades a seasonal opening of the Northern Sea Route is likely to make trans-arctic shipping feasible during summer months, although increasing ice movement will initially make shipping more difficult in some channels of the Northwest Passage.

Threats to Coastal Communities, Habitats, and Infrastructure

Alaska has more coastline than the other 49 states combined. Increases in the frequency and intensity of storm surges have triggered increased coastal erosion that is threatening a number of coastal villages. A recent report from the Government Accountability Office (GAO) indicated that 31 villages face imminent threats. Storm surges have also reduced the protection that barrier islands and spits provide to coastal habitats. Both coastal and inland infrastructure face threats due to the climate change. Thawing permafrost threatens water and sanitation infrastructure, and roads, buildings, pipelines, power lines and other infrastructure are threatened by coastal erosion and degrading permafrost.

Forest and Vegetation Changes

The Arctic region, particularly Alaska, is already experiencing major ecological impacts as a consequence of warming. Rising temperatures have caused northward expansion of boreal forest in some areas, significant increases in fire frequency and intensity, and unprecedented insect outbreaks. Current projections suggest that, due to increases in burn area per decade, the tundra-dominated landscape on Seward Peninsula will eventually be replaced by deciduous forest. In other areas, forested areas are likely to convert to bogs as permafrost thaws. Growing-degree days have increased by 20%, with benefits for agriculture and forest productivity on some sites, and reduced growth on others.

Sensitivity of Marine Ecosystems and Fisheries

The Gulf of Alaska and Bering Sea support marine ecosystems of great diversity and productivity as well as the nation's largest commercial fishery. Perhaps one of the most daunting threats lies in increasing acidification of the cold Alaskan waters. This would affect all organisms that possess calcifying shells, and these organisms play an integral role in the food web. Recent climate-related impacts observed in the Bering Sea include significant reductions in seabird and marine mammal populations, unusual algal blooms, abnormally high water temperatures, and low harvests of salmon on their return to spawning areas. Future projections for the Bering Sea suggest productivity increases at the base of the food chain, poleward shifts of some cold-water species, and negative effects on ice-dwelling species. Warmer temperatures will also affect commercial fisheries by inducing large northward shifts of fish and shellfish species. This would result in decreased harvesting of cold-water species such as salmon and pollock, and increased harvesting of other species.

Changes In the Diversity, Ranges, and Distributions of Species

The Arctic sub-region that includes Alaska, Chukotka, and the Western Canadian Arctic is home to over 70 percent of the rare plant species that occur only in the Arctic and a number of plant and animal species already classified as "threatened." Species concentrated in small areas, such as Wrangell Island, are particularly vulnerable to the direct effects of climate change combined with competition from migrating non-native species.

Increased Stress on Subsistence Livelihoods and Lifestyles

Subsistence makes an important contribution to livelihood in many isolated rural communities, especially but not exclusively for native peoples. Livelihoods that sustain indigenous communities include hunting, trapping, gathering, and fishing. These activities not only make significant contributions to the diet and health of many indigenous populations, but also play large and important social and cultural roles. Reduced or displaced populations of marine mammals, seabirds, and other wildlife, together with continuing thinning of sea-ice, have affected the safety and the dietary and economic well-being of subsistence communities.

ALASKA'S APPROACH TO ADAPTATION: RECOMMENDED OPTIONS

Climate change presents both potential impacts and opportunities for Alaskans and the Alaska economy. Developing a viable set of policies and actions to adapt to climate change requires recognizing the decentralized nature of government decision making, and the role of all levels of government. Successful adaptation will require engaging not only governments, but also private business, communities and community leaders, and individual households. Developing information on climate and other information needed for adaptation and making this information accessible is key to enabling these public and private entities to take action. Finally, an adaptation strategy must recognize both the need for immediate action to address observed effects of climate change (in some cases) as well as the importance of developing a foundation of data, policies, and knowledge about adaptation strategies that will enable successful adaptation over the long term.

The options recommended by the AAG are summarized below. These are actions that the state of Alaska, sometimes in partnership or cooperation with other agencies or organizations, can take to adapt to climate change. The options include actions such as increased coordination within and outside the state, data collection or assessment, regulatory or programmatic changes, capacity building and education, capital improvements, and financial assistance. In some cases the options may require new institutions or new legislative authority, but in many cases they have been designed to build on existing programs and staff.

Public Infrastructure

These options address the observed and projected impacts of climate change on Alaska's infrastructure, and include priority adaptation actions that the State of Alaska should take to address the impacts and their associated vulnerabilities. Public infrastructure is defined to include essential facilities and utilities under public, cooperative, or private ownership that deliver goods and services to communities. Such infrastructure includes infrastructure related to road, air, water, and other transportation (ranging from highways to landing strips); public buildings; seawalls and river shoreline protection; power, water, communication, and other utilities and their supporting structures; and national defense infrastructure. The goal of these options is to develop a system that increases the likelihood that Alaska has sustainable infrastructure to support communities in an uncertain environment.

The options developed for public infrastructure are designed to address three critical problems. First, the vulnerability of, and risk to, public infrastructure is growing. In some locations, entire Alaskan villages are at immediate risk; in other locations, critical roads and public buildings are at risk. Second, adaptive capacity for existing infrastructure is low, so new construction provides an opportunity for adaptation. Most public infrastructure is hard and fixed (for example, roads and buildings) and cannot easily alter its alignment, elevations, or structural foundation to accommodate coastal erosion or increased flood risk. Third, increased communication and coordination is critical. Increased communication and coordination across agencies, communities, and scientific and applied researchers is needed to adapt Alaska's public infrastructure.

The AAG is recommending a systems approach to reduce the impacts of climate change on Alaska's public infrastructure by accomplishing actions under three policies/programs.

PI-1 Create a Coordinated and Accessible Statewide System for Key Data Collection, Analysis, and Monitoring

Baseline data on the condition of current infrastructure and on regional and local environmental conditions needs to be collected, so that decision makers can identify what the problems are and where they occur, and what approaches are and are not working. Decision making also requires that projections of climate and other

information be based on the best science and collected empirical data. The Environmental Atlas of Alaska should be updated. The resulting information needs to be available to all interested parties.

PI-2 Promote Improvements that Use the Current Best Practice

Managing the risks and/or reducing the uncertainties associated with climate change will take time. Promoting sustainability, reducing operating costs, and protecting/extending the service life of existing infrastructure is always worthwhile. Simultaneously with PI-1, improvements to existing infrastructure that are worth doing regardless of climate change effects should be undertaken.

PI-3 Build to Last; Build Resiliency into Alaska's Public Infrastructure

As PI-1 and PI-2 are enacted and our knowledge base expands, new and upgraded infrastructure needs to be sited, planned, designed, and built to be resilient and sustainable in an uncertain environment. Systematic feedback with a performance review and analysis needs to be integrated into the public infrastructure funding, development, construction, and operations, so that planners and builders use "what works" and codes and standards are assessed and improved as needed to achieve the best results.

Natural Systems

The Natural Systems sector addresses the observed and projected impacts of climate change on Alaska's ecosystems and the services they provide. The AAG recommends priority adaptation actions that the state of Alaska should take to address the impacts and vulnerabilities associated with these impacts. Key impacts for Alaska include:

- those on marine ecosystems in the seas around Alaska and the communities and industries reliant on marine-based fisheries;
- changes in terrestrial ecosystems and in species' diversity, ranges, distribution, and abundance, with consequences for forestry and subsistence harvest of fish and wildlife; and
- changes to freshwater ecosystems, with consequences for freshwater appropriates and for freshwater species and the people who access and harvest the fish and wildlife.

The goal of the options below is to sustain natural ecosystem services in Alaska that meet society's essential needs, through adaptation to changing environmental conditions.

The five adaptation options recommended for this sector are targeted to sustaining the natural ecosystem services that meet Alaska's essential needs for food, water, renewable resource economies, community stability and safety, and cultural well-being. The recommendations build on existing state authorities and programs, and will move Alaska forward substantially in its ability to adapt to climate change impacts. Implementation of these options will require leadership and policy direction, as well as a moderate investment in staffing and funding to complete priority tasks. Through this work, the State will take a major step forward in integrating adaptive management to long-term climate change into the State's resource management programs and practices, so that it becomes a way of doing business and not a suite of separate initiatives.

NS-1 Fisheries Management

This option incorporates climate change into fisheries assessment and management and assists fishing communities and users in adaptation. This option includes several key elements: (1) review of the state's fishing-related statutes; (2) a comprehensive assessment of existing habitat, fish species, and stock

monitoring programs; (3) development of a centralized source of information on climate effects; and (4) development of a long-term strategy to work with fishing-reliant communities and business.

NS-2 Wildland Fire

This option would review and modify as appropriate Alaska's wildland fire policy and programs to address potential climate-induced increases in wildland fire frequency, size, and geographic location. Key elements include: (1) increasing the capacity of communities to initiate, complete, and implement Community Wildfire Protection Plans (CWPP); (2) reviewing selected wildland fire management practices for lands in Alaska; and (3) developing a comprehensive fuels management program to treat high-risk areas.

NS-3 Freshwater Management

This option addresses the effects of climate change on Alaska's freshwater resources through adaptive management, supported by improved hydrologic data. This option includes data collection, coordination, and protection. It also includes a review and adjustment as necessary of water management laws, policies, and practices in order to improve adaptive capacity.

NS-4 Invasive and Eruptive Species

Under this option, the state would expand its efforts to be an active partner with all levels of government and with other entities in addressing the problem of invasive and eruptive species in Alaska. The goal is to reduce introduction and spread of invasive species and eruptive species in the context of climate change.

NS-5 Fish and Wildlife

Under this option, the state would improve its capability to manage fish and wildlife species adaptively in Alaska to assure sustainable management of these important resources. The option includes two specific actions: (1) develop and adopt a more timely regulatory process for the harvest of wildlife; and (2) develop a coordinating framework that documents existing fish and wildlife monitoring efforts, identifies priorities for monitoring, and identifies gaps and potential for collaboration.

NS-6 Sustainable Agriculture

Under this option, the state would support and expand sustainable agriculture production and marketing in Alaska. This option recognizes the importance of local agriculture to Alaska's food security and seeks to develop an Alaska food policy and strategic plan that increases reliance on locally produced agricultural products. The option includes three specific actions: (1) encourage community-based agriculture and practices that optimize the use of the land and resources available; (2) research the magnitude and composition of food consumption in the state; and (3) research the sources of food supply and the risk associated with high reliance on imported foods.

Other Economic Activities

Some of Alaska's major economic activities, such as tourism and shipping, are highly dependent on weather conditions and/or the natural environment, both of which can be significantly affected by climate change. Some activities, such as mining and oil and gas exploration, rely on engineered infrastructure that is also potentially affected by climate, weather, and underlying environmental conditions. At the same time, climate change could create economic development opportunities in existing and new sectors. The options developed for this sector identify adaptive actions and options that contribute to the ability of sectors of the Alaska

economy not directly supported by living systems (e.g., fishing) to adapt to the effects of climate change and ensure the sustainability of a robust Alaska economy.

The recommendations in this sector focus on broad issues relevant to the economy as a whole, rather than actions designed to address the concerns of a particular economic group or industry. Three options are recommended.

EA-1 Evaluate Capability Needs for Potential Expansion of Arctic Economic Activities

This option recommends that the State recognize and address the potential for increased Arctic economic activities and identify gaps in infrastructure and the ability to provide an adequate presence in the Arctic coastal region to protect environmental resources, human health, and safety.

EA-2 Develop and Evaluate Scenarios for the Alaskan Economy

Components of the Alaska economy will experience varying impacts due to potential effects of climate change. An assessment of economic strengths, weaknesses, opportunities, and threats by sector is needed to better understand current and potential future components of the economy. This understanding will aid state agencies and other stakeholders in identifying and acting on optimum adaptive strategies and policies to help address future conditions. This option recommends conducting and managing a project to develop and evaluate possible economic scenarios for the State, based on potential climate change effects.

EA-3 Improve Availability of Mapping, Surveying, Charting and Imagery Data

Accurate, timely information about the distribution and magnitude of changes is needed to better address economic challenges and opportunities. This option recommends improving the availability of data, specifically real-time mapping, digital elevation model, and imagery, to better track and understand the impacts of climate change. This option would build on the work of the Statewide Digital Mapping Initiative and aid in transitioning between locations at the water-land interface.

Health and Culture

Climate change is being linked to increases in the geographic range and incidence of certain infectious and non-infectious diseases, new problems in sanitation and solid waste management, contaminant exposures, and diseases related to diet as well as mental health. Current programs are insufficient to identify and control these changes. To protect the health of humans, domesticated animals, and wildlife from the effects of climate change in Alaska, existing programs and activities need to be augmented to address these emerging concerns by developing new methods for surveillance and reporting of human and animal diseases.

The goal of the options recommended for this sector is to Improve adaptive capacity to maintain human health and healthy ways of life, reduce current and likely future increases in disease due to a changing climate, and prevent the destruction of gravesites, archaeological sites, and historic sites due to accelerated coastal and river erosion. Four options are recommended.

HC-1 Augment Surveillance and Control Programs for Vector-, Water-, and Food-borne Diseases

This option augments surveillance and control programs for vector-, water-, and food-borne diseases likely to become greater threats because of climate change. In addition, it develop educational programs for the public, health care providers, environmental staff, and others on approaches to reduce emerging disease threats.

HC-2 Community Health Impact Evaluations

This option develops a tiered approach to evaluate recommended adaptation and mitigation options to determine whether they could result in adverse health impacts and, if so, recommends approaches to reduce these risks.

HC-3 Assess Sanitation and Infrastructure Risks from Climate Change

This option assesses sanitation infrastructure and practices at risk from flooding, thawing permafrost, and other risks, or that are otherwise subject to changing conditions that significantly reduce performance in environmental health protection. This option would consider modification, rebuilding, or relocation of sanitation infrastructure to protect human and environmental health.

HC-4 Assess, Protect, and Develop Plans for Archaeological Sites and Gravesites

In cooperation with appropriate local, regional, and statewide entities, the state would assess archaeological sites and gravesites at risk from accelerated coastal and river erosion; convene archaeologists, anthropologists, Alaska Native elders, and others to discuss how best to address and prioritize sites at risk; and develop a plan for the protection or recovery of important at-risk sites. This option would also assist in identifying and opening new gravesites; convening a respectful discussion about gravesites while exploring best practices; and providing assistance for the relocation of existing at-risk gravesites.

Common Themes

Across the sectors, a number of common themes emerge for types of actions that will be needed to assist Alaska in adapting to climate change. These themes include needs for improving access to data, for community assistance, for coordination, and for education. Most of these themes are as relevant to mitigation as they are to adaptation. The recommendations fill a variety of needs that will greatly assist Alaskan efforts to address and respond to climate change. Four options that represent common themes across the sectors were developed.

CT-1 Establish an Alaska Climate Change Knowledge Network

This option recommends establishing an Alaska Climate Change Knowledge Network (ACCKN) to provide an effective, collaborative means to manage data and foster its use for adaptation. Where appropriate, the ACCKN would organize, consolidate, integrate, and archive data, information, and knowledge related to climate change. The network would serve as a point of coordination for National Oceanic and Atmospheric Administration's (NOAA's) proposed Regional Climate Center in Alaska.

CT-2 Coordinate Implementation of Alaska's Efforts to Address Climate Change

This option recommends that Alaska's efforts to address climate change continue to be coordinated internally to ensure synergy among State agency efforts, unified and strategic interaction with federal agencies, and effective outreach and education.

CT-3 Community Climate Impact Assistance

An array of state, federal, and regional entities are responsible for delivering services to Alaskan villages, rural communities, and urban centers, but specific policies and regulatory constraints produce conflicting directives that prevent the coordinated delivery of vital services that will enable endangered villages, traditional culture, and vulnerable communities to adapt in the face of climate change. There is a need to establish a coordinating

entity with the ability to navigate these multiple bureaucracies and to leverage their resources to support vulnerable communities in emergency response, relocation, subsistence concerns, and other priorities.

CT-4 Promote Climate Change Science through K-12 Education

This option promotes development of curriculum and training to support climate change education in grades K-12.

Reference Material (File 4)

<TARGET><BILL></BILL><SUBJECT>Reference Material (File 4)</SUBJECT><COMM>ANW27</COMM></TARGET>

15.

Governor's Subcabinet on Climate Change Reports

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Over the past three decades, Alaska has experienced a sharp reduction in snow-cover extent and duration, shorter river- and lake-ice seasons, melting of mountain glaciers, sea-ice retreat and thinning, permafrost retreat, and increased depth of summer thaw. These changes are in turn affecting human and natural systems. The AAG, with the support of four Technical Working Groups, has developed options to adapt to these changes, i.e., to reduce the adverse impacts or take advantage of the opportunities presented by climate change (see Box 1).

Permafrost Thawing and Sea Ice Melting

Permafrost underlies most of Alaska. Air temperature, snow cover, and vegetation affect the temperature of the frozen ground and the depth of seasonal thawing. Recent decades of warmer temperatures have produced extensive thawing, which has resulted in increased coastal erosion, landslides, and sinking of the ground surface, as well as consequent disruption and damage to forests, buildings, infrastructure, and coastal communities. In addition, many industrial activities depend on frozen ground surfaces, and many northern communities rely on ice roads for transport of groceries and other materials. Continued warming will further impair transport by shortening the seasonal use of ice roads. Thawing is projected to accelerate under future warming, with as much as the top 10 to 30 feet of discontinuous permafrost thawing by 2100.

Sea ice off the Alaskan Coast is retreating and thinning, with widespread effects on marine ecosystems, coastal climate, human settlements, and subsistence activities. Recent studies estimate arctic-wide reductions in annual average sea-ice extent of about 5-10% and a reduction in average thickness of about 10-15% over the past few decades. Retreat of sea ice allows larger storm surges to develop, increasing the risk of inundation and increasing erosion on coasts already made vulnerable by permafrost thawing. Loss of sea ice also causes large scale changes in marine ecosystems, and threatens populations of marine mammals and polar bears that depend on ice. At the same time, the continued reduction of sea ice is very likely to increase the navigation season, and within several decades a seasonal opening of the Northern Sea Route is likely to make trans-arctic shipping feasible during summer months, although increasing ice movement will initially make shipping more difficult in some channels of the Northwest Passage.

Threats to Coastal Communities, Habitats, and Infrastructure

Alaska has more coastline than the other 49 states combined. Increases in the frequency and intensity of storm surges have triggered increased coastal erosion that is threatening a number of coastal villages. A recent report from the Government Accountability Office (GAO) indicated that 31 villages face imminent threats. Storm surges have also reduced the protection that barrier islands and spits provide to coastal habitats. Both coastal and inland infrastructure face threats due to the climate change. Thawing permafrost threatens water and sanitation infrastructure, and roads, buildings, pipelines, power lines and other infrastructure are threatened by coastal erosion and degrading permafrost.

Forest and Vegetation Changes

The Arctic region, particularly Alaska, is already experiencing major ecological impacts as a consequence of warming. Rising temperatures have caused northward expansion of boreal forest in some areas, significant increases in fire frequency and intensity, and unprecedented insect outbreaks. Current projections suggest that, due to increases in burn area per decade, the tundra-dominated landscape on Seward Peninsula will eventually be replaced by deciduous forest. In other areas, forested areas are likely to convert to bogs as permafrost thaws. Growing-degree days have increased by 20%, with benefits for agriculture and forest productivity on some sites, and reduced growth on others.

Sensitivity of Marine Ecosystems and Fisheries

The Gulf of Alaska and Bering Sea support marine ecosystems of great diversity and productivity as well as the nation's largest commercial fishery. Perhaps one of the most daunting threats lies in increasing acidification of the cold Alaskan waters. This would affect all organisms that possess calcifying shells, and these organisms play an integral role in the food web. Recent climate-related impacts observed in the Bering Sea include significant reductions in seabird and marine mammal populations, unusual algal blooms, abnormally high water temperatures, and low harvests of salmon on their return to spawning areas. Future projections for the Bering Sea suggest productivity increases at the base of the food chain, poleward shifts of some cold-water species, and negative effects on ice-dwelling species. Warmer temperatures will also affect commercial fisheries by inducing large northward shifts of fish and shellfish species. This would result in decreased harvesting of cold-water species such as salmon and pollock, and increased harvesting of other species.

Changes In the Diversity, Ranges, and Distributions of Species

The Arctic sub-region that includes Alaska, Chukotka, and the Western Canadian Arctic is home to over 70 percent of the rare plant species that occur only in the Arctic and a number of plant and animal species already classified as "threatened." Species concentrated in small areas, such as Wrangell Island, are particularly vulnerable to the direct effects of climate change combined with competition from migrating non-native species.

Increased Stress on Subsistence Livelihoods and Lifestyles

Subsistence makes an important contribution to livelihood in many isolated rural communities, especially but not exclusively for native peoples. Livelihoods that sustain indigenous communities include hunting, trapping, gathering, and fishing. These activities not only make significant contributions to the diet and health of many indigenous populations, but also play large and important social and cultural roles. Reduced or displaced populations of marine mammals, seabirds, and other wildlife, together with continuing thinning of sea-ice, have affected the safety and the dietary and economic well-being of subsistence communities.

ALASKA'S APPROACH TO ADAPTATION: RECOMMENDED OPTIONS

Climate change presents both potential impacts and opportunities for Alaskans and the Alaska economy. Developing a viable set of policies and actions to adapt to climate change requires recognizing the decentralized nature of government decision making, and the role of all levels of government. Successful adaptation will require engaging not only governments, but also private business, communities and community leaders, and individual households. Developing information on climate and other information needed for adaptation and making this information accessible is key to enabling these public and private entities to take action. Finally, an adaptation strategy must recognize both the need for immediate action to address observed effects of climate change (in some cases) as well as the importance of developing a foundation of data, policies, and knowledge about adaptation strategies that will enable successful adaptation over the long term.

The options recommended by the AAG are summarized below. These are actions that the state of Alaska, sometimes in partnership or cooperation with other agencies or organizations, can take to adapt to climate change. The options include actions such as increased coordination within and outside the state, data collection or assessment, regulatory or programmatic changes, capacity building and education, capital improvements, and financial assistance. In some cases the options may require new institutions or new legislative authority, but in many cases they have been designed to build on existing programs and staff.

Public Infrastructure

These options address the observed and projected impacts of climate change on Alaska's infrastructure, and include priority adaptation actions that the State of Alaska should take to address the impacts and their associated vulnerabilities. Public infrastructure is defined to include essential facilities and utilities under public, cooperative, or private ownership that deliver goods and services to communities. Such infrastructure includes infrastructure related to road, air, water, and other transportation (ranging from highways to landing strips); public buildings; seawalls and river shoreline protection; power, water, communication, and other utilities and their supporting structures; and national defense infrastructure. The goal of these options is to develop a system that increases the likelihood that Alaska has sustainable infrastructure to support communities in an uncertain environment.

The options developed for public infrastructure are designed to address three critical problems. First, the vulnerability of, and risk to, public infrastructure is growing. In some locations, entire Alaskan villages are at immediate risk; in other locations, critical roads and public buildings are at risk. Second, adaptive capacity for existing infrastructure is low, so new construction provides an opportunity for adaptation. Most public infrastructure is hard and fixed (for example, roads and buildings) and cannot easily alter its alignment, elevations, or structural foundation to accommodate coastal erosion or increased flood risk. Third, increased communication and coordination is critical. Increased communication and coordination across agencies, communities, and scientific and applied researchers is needed to adapt Alaska's public infrastructure.

The AAG is recommending a systems approach to reduce the impacts of climate change on Alaska's public infrastructure by accomplishing actions under three policies/programs.

PI-1 Create a Coordinated and Accessible Statewide System for Key Data Collection, Analysis, and Monitoring

Baseline data on the condition of current infrastructure and on regional and local environmental conditions needs to be collected, so that decision makers can identify what the problems are and where they occur, and what approaches are and are not working. Decision making also requires that projections of climate and other

information be based on the best science and collected empirical data. The Environmental Atlas of Alaska should be updated. The resulting information needs to be available to all interested parties.

PI-2 Promote Improvements that Use the Current Best Practice

Managing the risks and/or reducing the uncertainties associated with climate change will take time. Promoting sustainability, reducing operating costs, and protecting/extending the service life of existing infrastructure is always worthwhile. Simultaneously with PI-1, improvements to existing infrastructure that are worth doing regardless of climate change effects should be undertaken.

PI-3 Build to Last; Build Resiliency into Alaska's Public Infrastructure

As PI-1 and PI-2 are enacted and our knowledge base expands, new and upgraded infrastructure needs to be sited, planned, designed, and built to be resilient and sustainable in an uncertain environment. Systematic feedback with a performance review and analysis needs to be integrated into the public infrastructure funding, development, construction, and operations, so that planners and builders use "what works" and codes and standards are assessed and improved as needed to achieve the best results.

Natural Systems

The Natural Systems sector addresses the observed and projected impacts of climate change on Alaska's ecosystems and the services they provide. The AAG recommends priority adaptation actions that the state of Alaska should take to address the impacts and vulnerabilities associated with these impacts. Key impacts for Alaska include:

- those on marine ecosystems in the seas around Alaska and the communities and industries reliant on marine-based fisheries;
- changes in terrestrial ecosystems and in species' diversity, ranges, distribution, and abundance, with consequences for forestry and subsistence harvest of fish and wildlife; and
- changes to freshwater ecosystems, with consequences for freshwater appropriates and for freshwater species and the people who access and harvest the fish and wildlife.

The goal of the options below is to sustain natural ecosystem services in Alaska that meet society's essential needs, through adaptation to changing environmental conditions.

The five adaptation options recommended for this sector are targeted to sustaining the natural ecosystem services that meet Alaska's essential needs for food, water, renewable resource economies, community stability and safety, and cultural well-being. The recommendations build on existing state authorities and programs, and will move Alaska forward substantially in its ability to adapt to climate change impacts. Implementation of these options will require leadership and policy direction, as well as a moderate investment in staffing and funding to complete priority tasks. Through this work, the State will take a major step forward in integrating adaptive management to long-term climate change into the State's resource management programs and practices, so that it becomes a way of doing business and not a suite of separate initiatives.

NS-1 Fisheries Management

This option incorporates climate change into fisheries assessment and management and assists fishing communities and users in adaptation. This option includes several key elements: (1) review of the state's fishing-related statutes; (2) a comprehensive assessment of existing habitat, fish species, and stock

monitoring programs; (3) development of a centralized source of information on climate effects; and (4) development of a long-term strategy to work with fishing-reliant communities and business.

NS-2 Wildland Fire

This option would review and modify as appropriate Alaska's wildland fire policy and programs to address potential climate-induced increases in wildland fire frequency, size, and geographic location. Key elements include: (1) increasing the capacity of communities to initiate, complete, and implement Community Wildfire Protection Plans (CWPP); (2) reviewing selected wildland fire management practices for lands in Alaska; and (3) developing a comprehensive fuels management program to treat high-risk areas.

NS-3 Freshwater Management

This option addresses the effects of climate change on Alaska's freshwater resources through adaptive management, supported by improved hydrologic data. This option includes data collection, coordination, and protection. It also includes a review and adjustment as necessary of water management laws, policies, and practices in order to improve adaptive capacity.

NS-4 Invasive and Eruptive Species

Under this option, the state would expand its efforts to be an active partner with all levels of government and with other entities in addressing the problem of invasive and eruptive species in Alaska. The goal is to reduce introduction and spread of invasive species and eruptive species in the context of climate change.

NS-5 Fish and Wildlife

Under this option, the state would improve its capability to manage fish and wildlife species adaptively in Alaska to assure sustainable management of these important resources. The option includes two specific actions: (1) develop and adopt a more timely regulatory process for the harvest of wildlife; and (2) develop a coordinating framework that documents existing fish and wildlife monitoring efforts, identifies priorities for monitoring, and identifies gaps and potential for collaboration.

NS-6 Sustainable Agriculture

Under this option, the state would support and expand sustainable agriculture production and marketing in Alaska. This option recognizes the importance of local agriculture to Alaska's food security and seeks to develop an Alaska food policy and strategic plan that increases reliance on locally produced agricultural products. The option includes three specific actions: (1) encourage community-based agriculture and practices that optimize the use of the land and resources available; (2) research the magnitude and composition of food consumption in the state; and (3) research the sources of food supply and the risk associated with high reliance on imported foods.

Other Economic Activities

Some of Alaska's major economic activities, such as tourism and shipping, are highly dependent on weather conditions and/or the natural environment, both of which can be significantly affected by climate change. Some activities, such as mining and oil and gas exploration, rely on engineered infrastructure that is also potentially affected by climate, weather, and underlying environmental conditions. At the same time, climate change could create economic development opportunities in existing and new sectors. The options developed for this sector identify adaptive actions and options that contribute to the ability of sectors of the Alaska

economy not directly supported by living systems (e.g., fishing) to adapt to the effects of climate change and ensure the sustainability of a robust Alaska economy.

The recommendations in this sector focus on broad issues relevant to the economy as a whole, rather than actions designed to address the concerns of a particular economic group or industry. Three options are recommended.

EA-1 Evaluate Capability Needs for Potential Expansion of Arctic Economic Activities

This option recommends that the State recognize and address the potential for increased Arctic economic activities and identify gaps in infrastructure and the ability to provide an adequate presence in the Arctic coastal region to protect environmental resources, human health, and safety.

EA-2 Develop and Evaluate Scenarios for the Alaskan Economy

Components of the Alaska economy will experience varying impacts due to potential effects of climate change. An assessment of economic strengths, weaknesses, opportunities, and threats by sector is needed to better understand current and potential future components of the economy. This understanding will aid state agencies and other stakeholders in identifying and acting on optimum adaptive strategies and policies to help address future conditions. This option recommends conducting and managing a project to develop and evaluate possible economic scenarios for the State, based on potential climate change effects.

EA-3 Improve Availability of Mapping, Surveying, Charting and Imagery Data

Accurate, timely information about the distribution and magnitude of changes is needed to better address economic challenges and opportunities. This option recommends improving the availability of data, specifically real-time mapping, digital elevation model, and imagery, to better track and understand the impacts of climate change. This option would build on the work of the Statewide Digital Mapping Initiative and aid in transitioning between locations at the water-land interface.

Health and Culture

Climate change is being linked to increases in the geographic range and incidence of certain infectious and non-infectious diseases, new problems in sanitation and solid waste management, contaminant exposures, and diseases related to diet as well as mental health. Current programs are insufficient to identify and control these changes. To protect the health of humans, domesticated animals, and wildlife from the effects of climate change in Alaska, existing programs and activities need to be augmented to address these emerging concerns by developing new methods for surveillance and reporting of human and animal diseases.

The goal of the options recommended for this sector is to Improve adaptive capacity to maintain human health and healthy ways of life, reduce current and likely future increases in disease due to a changing climate, and prevent the destruction of gravesites, archaeological sites, and historic sites due to accelerated coastal and river erosion. Four options are recommended.

HC-1 Augment Surveillance and Control Programs for Vector-, Water-, and Food-borne Diseases

This option augments surveillance and control programs for vector-, water-, and food-borne diseases likely to become greater threats because of climate change. In addition, it develop educational programs for the public, health care providers, environmental staff, and others on approaches to reduce emerging disease threats.

HC-2 Community Health Impact Evaluations

This option develops a tiered approach to evaluate recommended adaptation and mitigation options to determine whether they could result in adverse health impacts and, if so, recommends approaches to reduce these risks.

HC-3 Assess Sanitation and Infrastructure Risks from Climate Change

This option assesses sanitation infrastructure and practices at risk from flooding, thawing permafrost, and other risks, or that are otherwise subject to changing conditions that significantly reduce performance in environmental health protection. This option would consider modification, rebuilding, or relocation of sanitation infrastructure to protect human and environmental health.

HC-4 Assess, Protect, and Develop Plans for Archaeological Sites and Gravesites

In cooperation with appropriate local, regional, and statewide entities, the state would assess archaeological sites and gravesites at risk from accelerated coastal and river erosion; convene archaeologists, anthropologists, Alaska Native elders, and others to discuss how best to address and prioritize sites at risk; and develop a plan for the protection or recovery of important at-risk sites. This option would also assist in identifying and opening new gravesites; convening a respectful discussion about gravesites while exploring best practices; and providing assistance for the relocation of existing at-risk gravesites.

Common Themes

Across the sectors, a number of common themes emerge for types of actions that will be needed to assist Alaska in adapting to climate change. These themes include needs for improving access to data, for community assistance, for coordination, and for education. Most of these themes are as relevant to mitigation as they are to adaptation. The recommendations fill a variety of needs that will greatly assist Alaskan efforts to address and respond to climate change. Four options that represent common themes across the sectors were developed.

CT-1 Establish an Alaska Climate Change Knowledge Network

This option recommends establishing an Alaska Climate Change Knowledge Network (ACCKN) to provide an effective, collaborative means to manage data and foster its use for adaptation. Where appropriate, the ACCKN would organize, consolidate, integrate, and archive data, information, and knowledge related to climate change. The network would serve as a point of coordination for National Oceanic and Atmospheric Administration's (NOAA's) proposed Regional Climate Center in Alaska.

CT-2 Coordinate Implementation of Alaska's Efforts to Address Climate Change

This option recommends that Alaska's efforts to address climate change continue to be coordinated internally to ensure synergy among State agency efforts, unified and strategic interaction with federal agencies, and effective outreach and education.

CT-3 Community Climate Impact Assistance

An array of state, federal, and regional entities are responsible for delivering services to Alaskan villages, rural communities, and urban centers, but specific policies and regulatory constraints produce conflicting directives that prevent the coordinated delivery of vital services that will enable endangered villages, traditional culture, and vulnerable communities to adapt in the face of climate change. There is a need to establish a coordinating

entity with the ability to navigate these multiple bureaucracies and to leverage their resources to support vulnerable communities in emergency response, relocation, subsistence concerns, and other priorities.

CT-4 Promote Climate Change Science through K-12 Education

This option promotes development of curriculum and training to support climate change education in grades K-12.

IMMEDIATE ACTION WORKGROUP

RECOMMENDATIONS TO THE GOVERNOR'S SUBCABINET ON CLIMATE CHANGE

MARCH 2009

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Commissioner Hartig and Members of the Governor's Subcabinet on Climate Change:

The Immediate Action Workgroup (IAWG) is pleased to provide its recommendations regarding the actions and policies that we believe should be implemented in 2009 and 2010. This is the second report provided to the Climate Change Subcabinet and follows up on recommendations and actions taken as a result of our April 17, 2008 report to the Subcabinet.

The IAWG has continued at the request of Commissioner Hartig, chairman of the Climate Change Subcabinet, to collaboratively examine the needs of communities that are under imminent threat from conditions that may be attributed to climate change phenomena.

The membership of the Immediate Action Workgroup has remained consistent from the previous year with one exception. Added to the IAWG is a representative from the National Oceanic and Atmospheric Administration, Amy Holman, Lead for NOAA's Alaska Regional Collaboration Team. Her participation has contributed greatly to our understanding of the data and research that is needed in the near future. The IAWG would likely benefit from additional agency participation. The spirit of cooperation and serious collaboration has infused our meetings and we believe resulted in meritorious recommendations for near-term actions by the Subcabinet and the State of Alaska.

Last year we described our recommendations in terms of a *recipe for success*. The members and others participating with the Immediate Action Workgroup have now worked together for over a year, both directly on the Immediate Action Workgroup's tasks and on leveraging resources and ideas resulting from the Workgroup's collaboration. From this experience, we are more certain about the value of this *recipe for success.* The ingredients are a diversity of resources. The recipe brings together organizations to address climate change issues and impacts. Therefore, we wish to repeat the recipe originally stated in last year's report.

Immediate Action Workgroup's Recipe for Success

Step 1: ***Begin by developing a collaborative organizational structure that can focus the combined capabilities of local, regional, state, and federal stakeholders on the problems at hand.*** Identify what expertise is available; which organization has the authority, capability, and potential funding to lead the combined effort; and, identify where functional gaps exist that need to be filled. Local communities severely affected by impacts most likely from climate change should be encouraged to establish a project coordinator position to interact with all other organizations and be an advocate for funding through grants and other means to implement needed evaluations and action plans.

Team work is essential. Relying on one agency to carry out the mission risks both waste and lack of action. These problems, which primarily affect small, isolated communities are difficult to address and because of this are easily ignored. Only through continual focus and intelligent decision making can we adequately address their problems.

Step 2: ***Discuss the nature and extent of the potential climate change impacts and create an applied approach to addressing significant impacts, as described in Step 3.*** A scenario analysis could compare community impacts with the full range of plausible future conditions (minor sea level rise to significant rise this century, continuation of historical storms to increased intensity of storms, gradual thawing of permafrost to quick melt of permafrost, historical trend of subsistence species populations to reduced availability of subsistence resources, etc.).

Step 3: ***Identify the communities at risk, timeframe, and the true needs to address climate change impacts.*** Once, communities at risk are identified and the timeframe established before major damages/losses occur, recognize that communities in jeopardy under all plausible scenarios warrant special consideration. ***Develop a methodology for prioritization of needs based on the risk to lives, health, infrastructure, homes, businesses, subsistence harvests, significant cultural attributes, and the quality of life.*** Villages with declining populations, which already cannot support continuation of vital services such as a school, would likely be a lower priority than those which are likely to sustain viable communities during the foreseeable future.

Next, determine the true needs of coastal communities subjected climate change impacts. Do they require additional land for population growth; are coastal storm damages increasing to potentially catastrophic levels; is melting permafrost destroying the foundation for structures in the community; will sufficient numbers of future subsistence resources be available to sustain the community at its current location; when will key facilities (airport, power, school, water supply, etc.) be lost so the community could not continue to function with dignity; and, is the community frequently needing emergency declarations to cope with disasters and impending disasters?

Step 4: ***Develop measures that meet the stated needs and combine those measures into alternative plans for comparison.*** Document the pros and cons of each alternative, obtain local input on community values, evaluate the environmental effects of each plan, and provide estimated costs for implementing each alternative. Determine the challenges of concurrent budgeting and meeting regulatory requirements where a collaborative effort with other agencies and organizations is proposed to implement the alternatives. Select the plan that provides the best overall balance to meet local needs and is cost effective, sustainable, engineered soundly, and environmentally acceptable. Above all, be action oriented and recognize that communities need immediate action to address what is in some cases inevitable, severe impact to infrastructure and community well being.

Michael Black, State Co-Chair
Deputy Commissioner
Department of Commerce, Community
and Economic Development

Patricia Opheen, Federal Co-Chair
Chief of Engineering – Alaska District
U.S. Army Corps of Engineers

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NEAR TERM FOCUS FOR IMMEDIATE ACTION WORKGROUP

The Immediate Action Workgroup of the Governor's Executive Subcabinet on Climate Change was established to address known threats to communities caused by coastal erosion, thawing permafrost, flooding, and fires.

Objective: Close a planning and execution gap identified by Governor Palin and the Congressional delegation by creating a unifying mechanism to assist the communities of Newtok, Shishmaref, Kivalina, Koyukuk, Unalakleet, and Shaktoolik[1]. These communities face imminent threats of loss of life, loss of infrastructure, loss of public and private property, or health epidemics caused by coastal erosion, thawing permafrost and flooding.

Plan of Action: The Immediate Action Workgroup will do the following:

- ***Conduct Workgroup meetings involving community leaders from the threatened villages to build a common understanding of the relative risks*** in each community using the following four criteria which individually or collectively create an urgent situation:
  - Safety of life during a reasonably foreseeable storm or flood event;
  - Potential loss of infrastructure critical for community viability (school, fuel tanks, power plant, water / sewer provisions);
  - Health threats to the community as defined by CDC or the Health Department (disease, reoccurring illnesses, unusually high frequency of illnesses); and
  - Potential loss of 10 percent or more of residential dwellings.
- ***Prioritize projects or actions to mitigate the community's most urgent risks*** through protecting or relocating threatened buildings and structures, affecting an emergency evacuation plan, or to address present or imminent health threats.
- ***Prepare recommendations for an oversight planning body and its authorities to provide successful coordination between each of these communities and all appropriate state and federal agencies*** to ensure the successful completion of projects or other actions identified by this effort.
- ***If warranted, make recommendations on the scope of additional assessments of protective seawall designs for the purpose of examining whether particular engineering designs may be successful*** in 1) providing a window to protect a community, enabling it to develop a multi-year relocation plan; or 2) provide long-term protection of the community such that a relocation may not be necessary in the foreseeable future.
- ***Identify and propose changes to laws and policies*** (state and federal) ***that currently impede the ability of agencies to timely execute appropriate actions*** necessary for imminent threat circumstances in these and other communities.

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[1] The IAWG used the GAO 2004 report, which identified 9 highly threatened communities (Shishmaref, Newtok, Kivalina, Koyukuk, Unalakleet, Barrow, Bethel, Kaktovik, and Point Hope) to initially examine the nature of imminent threats at its November 6, 2007 meeting. Based upon the November 6 meeting and a November 19 / 20, 2007 Roundtable meeting conducted by then Senator Stevens, the IAWG focused its work with the communities of Shishmaref, Newtok, Kivalina, Koyukuk, Unalakleet and Shaktoolik.

EXECUTIVE SUMMARY
IMMEDIATE ACTION WORKGROUP:
ACCOMPLISHMENTS AND RECOMMENDATIONS

This executive summary is a consolidated list of Accomplishments, Immediate Actions and required Strategic and Community Assistance Recommendation Policies and budget estimates developed by the Immediate Action Workgroup of the Governor's Alaska Climate Change Subcabinet. The policies have been expanded from last year's report to help identify a strategic approach for addressing climate change, which has a likelihood of impacting every community in Alaska. The policies have also been detailed by adding definitions and interpreting the meanings of terms used in various policy statements.

These collective recommendations represent an intensive collaborative effort undertaken in an open public forum to address the immediate needs of the State, with a specific focus on six communities in peril: Newtok, Shishmaref, Kivalina, Koyukuk, Unalakleet, and Shaktoolik. We have attempted to expand our focus beyond the six communities originally accepted as imminently threatened last year, and have determined the likelihood that additional communities are in need of assistance in coping with similar problems.

These recommendations will help the Subcabinet develop a State Climate Change Strategy. This executive summary can be used as a reference point, but should be read within the context of the entire report, which summarizes the state of the six communities in peril, immediate and near-term actions to protect them, along with the policies and implementation recommendations and accompanying rationale.

These immediate actions combined with the policy recommendations were developed to serve as a template and model to assist other Alaska communities in an effective manner as they may become or are impacted by erosion and other natural hazards that seem to be increasing in number and severity.

Detailed community descriptions can be found in the Community Profiles section beginning on page 13.

Photo 1: Undercutting of river bank in Newtok. (Credit: Stanley Tom)

ACCOMPLISHMENTS OF IMMEDIATE ACTION WORKGROUP: FY 08 SUPPLEMENTAL AND FY09 FUNDING

The IAWG brings an important element to the State's response to the changing Arctic. Unlike other workgroups, the IAWG is tasked with advising the Governor's Climate Change Subcabinet and the Legislature on what actions are needed in the next 12 – 18 months to prevent disasters that would likely result in loss of human life and infrastructure. These potential disasters are most likely to impact small, remote villages and are easiest to see from that community level.

The IAWG was started under the leadership of Commissioner Hartig as a way to initiate actions without awaiting a lengthy planning and analysis phase by recognizing actions to be taken now, to minimize impacts affecting these remote communities sitting on the edge of the changing environment.

The IAWG used several tools:

- A very preliminary list of the most impacted communities;
- A mission given by Commissioner Hartig;
- A small group of relevant and focused agencies;
- A determination to do something as we all agreed something was worth doing;
- An invitation to the communities and others to participate in identifying the solutions through local initiatives, ideas and effort; and
- Recognition of fiscal realities.

The process employed was innovative and included:

- Meetings every two weeks;
- Focus on only 6 communities identified as imminently threatened;
- Identify actions that were needed to prevent loss of life and infrastructure;
- Determine resources – funding, information and coordination – needed to advance those actions;
- Recommend to Legislature and Administrative decision makers to take actions by applying resources to the most immediate needs;
- Learn lessons from the IAWG's experiences;
- Incorporate and encourage local initiatives;
- Keep focused and invite collaboration;
- Demonstrate results; and
- Don't foreclose options if at all possible.

The key messages the IAWG would like to convey to the Subcabinet are:

- The IAWG has been successful. This success is largely due to leveraging the State's resources through coordination and collaboration with other State and Federal agencies, and with regional and community organizations.(See Accomplishments section page 27.

- The IAWG has not addressed or decided whether a community should relocate, as that is not within the authorization of the Workgroup and for each community, it is an issue that needs data, analysis and substantial coordination that is well beyond the IAWG's scope.

  IAWG Guiding Principle: *Immediate actions should preserve the widest range of options available to communities. To do this substantial coordination is needed to identify, collect and analyze data to make the most effective decisions for long-term viability and sustainability.*

- The IAWG has not defined nor relied on definitions of what climate change is, but rather has identified phenomena from which communities are being threatened and impacted. The likelihood these phenomena are from climate change is believed to be high.

The key findings from the 2009 IAWG's efforts are:

- **Immediate recommended actions are to protect what we have** – including infrastructure and human life.

- Replace the IAWG, which is an ad-hoc body, with a formal, standing committee or workgroup embedded in the State's administrative operations. This will ensure continued success of leveraging the State's resources through coordination and collaboration with other State and Federal agencies, and with regional and community organizations.

- Many potentially affected communities have been identified (See Appendix A). This requires an analysis process to determine the seriousness of the potential impact and to then act in a methodical fashion to prevent loss of life and infrastructure and protect what is already in place. (See Policies 1 -4)

- Construction standards have long been to build bigger and stronger, but building resilient structures that can be relocated may be the more important principle to successfully meet the challenges that climate change brings.

Summary of Accomplishments for Kivalina, Koyukuk, Newtok, Shaktoolik, Shishmaref and Unalakleet

Develop Suite of Emergency Plans and Training/Drills ($500,000 State leveraged $100,000 Federal)

State resources were provided to the Alaska DHS&EM to work jointly with each community and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion. All community efforts are underway.

Funding was also provided to DNR/Division of Forestry for a Community Wildfire Protection Plan (CWPP) for Koyukuk, which will be accomplished by Division of Forestry in conjunction with the community, Tanana Chiefs Conference, Inc. and the Alaska Fire Service.

Anticipated Completion of Suite of Emergency Plans for All Six Communities - Calendar Year End 2009.

In addition, DHS&EM, based on its efforts from 2008 -09, has developed a sub-regional approach to create, train and conduct community drills for the suite of emergency management plans. It is now anticipated that this sub-

regional approach will reduce the cost by almost half of the initial appropriation in FY09. DHS&EM will focus its efforts on the Y-K Delta, Western and Northern Regions of Alaska.

Community Mitigation and Relocation Planning and Coordination

DCCED/DCRA staff is working with local governments, whether City, Tribes or both in each of the communities to develop proposals for the community planning grants that addresses both the IAWG's recommended immediate actions for the communities, while striving to incorporate each of their specific needs.

- **Kivalina** – community planning needs to work through issues given that the Community has identified a site it wishes to move to, but that the USACE does not believe is an adequate site, e.g. it is underlain with permafrost which would require many feet of fill material to provide a good foundation for buildings and insulate the permafrost from thawing under the new village location.
- **Koyukuk** – community planning needs to work through confusion in the community and among agencies about what the options for the current community site are if relocation does occur. The community will also likely benefit from a planning effort that considers the three primary options communities have: staying in place -and what structural changes would need to happen to make that possible, migrating – having access to higher elevations of land and what infrastructure is needed to provide that opportunity so that when both private and public decisions are made options exist to ensure safety for both the investment and community members and if necessary – relocating, which is a longer-term, complex effort.
- **Newtok** – through the collaborative efforts of the Newtok Planning Group – which is a model for local community, state and federal partnerships to address complex issues – the community planning efforts have enabled the community to advance its already innovative successes by utilizing planning funds for:
  - The design of an evacuation shelter at Mertarvik as the Newtok Traditional Council hired the Cold Climate Housing Center;
  - Planning resources to conduct site suitability analysis and future community layout at the identified new community site of Mertarvik.
- **Shaktoolik** – community planning needs to address this community's highest threats, which is its precarious location when sea surges occur. The surges result in the community becoming an island, and then it is doubly threatened by storms throwing logs that are naturally beached on the shore at Shaktoolik. During this past year a reconnaissance study for an evacuation road was completed through the joint cooperative effort of the Shaktoolik community, Kawerak, and the Denali Commission. The State is being requested to fund $500k, for a road design. Development of an evacuation shelter within the existing community is also being considered as a cost effective and near-term action
- **Shishmaref** – community planning needs to coordinate with the various organizations to effectively plan for the needs of an entire community. Here too, Shishmaref will likely benefit from a planning effort that considers the three primary options communities have: staying in place -and what structural changes would need to happen to make that possible, migrating – having access to higher land and what infrastructure is needed to provide that opportunity so that when both private and public decisions are made options exist to ensure safety for both the investment and community members, and if necessary – relocating, which is a longer-term, complex effort.
- **Unalakleet** – community planning needs to coordinate with the various organizations in Unalakleet. However, given the strength of the community, its support from Kawerak, DOT/PF and USACE projects that were being constructed and/or ready to bid, the community planning effort hasn't had the level of critical need as with the other 5 communities. However, Unalakleet has the same issues as Shaktoolik with storm surges – the community may become an island, or mostly an island and the threats of logs being thrown due to the storms is a deadly threat.

Anticipated Planning Grant Awards to All Communities – By Calendar Year End 2009.

Reduce State Capital Budget Expenditures by Leveraging State Funding

Last year the IAWG received advice from the USACE that State participation in erosion control projects for Alaska could improve funding from federal sources. USACE, as a member of the IAWG, commented that the strategy to align and coordinate state funding to receive Corps federal funds worked well. Moreover, the USACE-Alaska received at least $40 million in a supplemental for Alaskan projects from a $60 million fund for projects nationwide. This was in large part a result of a commitment of the State's funding to 35% of project costs.

- **Kivalina** – $3.3 million from the State to the Northwest Arctic Borough leveraged $12.5 million from USACE for revetments and another $500,000 from USACE for design of additional revetment for Phase 1-Ocean-side revetment.
- **Koyukuk** – No State construction funds were appropriated in FY 2009. However the USACE has been conducting a feasibility study for the Community and the Community Planning Grant will help to coordinate this study with the Community's needs and ideas to protect its infrastructure and community members.
- **Newtok** – During the past year relationships between the community and DOD's Innovative Readiness Team Program (IRTP) has been established. This program offers military assets for community projects that are used as training opportunities for military units. With the FY10 recommended funding of $2 million for materials, the IRT brings $5 million of resources to help construct the evacuation shelter, and develop a materials site for roads and an airstrip. In FY09 DOT/PF received a combined state/federal funding of $1.7 million for constructing the evacuation road
- **Shaktoolik** – No State construction funds were appropriated in FY 2009. However, Kawerak and the Denali Commission have completed a road reconnaissance study, which if funding from state is forth coming would be leveraged 5-fold.
- **Shishmaref** – No State construction funds were appropriated in FY 2009. However, the USACE has been diligent and consistent in its efforts to design and construct revetment, and for FY 2010 $3 million is recommended by the IAWG to fund revetment work in Shishmaref. In the past 2 years the USACE has provided $11 million of construction and design work.
- **Unalakleet**– $5 million in State funds was appropriated in FY 2009 to leverage an additional $18.5 million from USACE to build necessary revetment structures. In addition, by coordinating with DOT/PF mobilization and demobilization costs were saved on this project as the project will use the heavy equipment already in the community.

ADOT/PF Preliminary Engineering & Early Coordination

State resources were provided to ADOT/PF for early coordination and its participation with the USACE to design and develop shoreline protection measures. Coordination resulted in working with community, DCCED and USACE to utilize existing data and identify missing data.

Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans will result from early coordination.

DOT/PF believes these activities may lead to reduced long-term capital construction costs as material sites closer to construction activities are identified and developed. Cost savings can be expected by reducing barging charges and increased competition to provide materials, such as armor rock for revetments.

Specifically for Newtok, ADOT/PF has been actively reviewing the USACE road design and provided appropriate design standards. The ADOT/PF Facilities Division is also serving as a reviewer for the evacuation building design.

FY 10 Funding Recommendations

Communities	Description	Recommended Amount
For the NW and Western regions of Alaska that have suffered the most number of declared disasters over the last 30 years.	Continue Developing Suite of Emergency Plans to ensure no loss of life during disasters. Conduct trainings, planning workshops on sub-regional basis, thereby reducing costs.	$500,000 (Not in Governor's Budget) DHS&EM will explore other funding opportunities, e.g. Denali Commission and CIAP for the most threatened regions in Alaska.
Unidentified, but those Communities in Need of Planning to Prevent Loss of Infrastructure and/or Life	Alaska Climate Change Impact Mitigation Program – Community Planning DCCED/DCRA	$300,000 ($300,000 in Governor's Budget)
Unknown – Communities where USACE is actively addressing erosion and maybe flooding issues	DOT/PF Preliminary Engineering and Early Coordination	$500,000 ($100,000 in Governor's Budget)
Kivalina	DNR – DGGS Geologic and Hazardous Mapping to identify sites acceptable for evacuation road, site and identifying relocation sites.	$180,000 Funded through Federal CIAP. Funds now available at DGGS, but hiring freeze precludes having human resource capacity needed to do the work.
	Revetment work and community planning will continue from funds appropriated in FY 08 Supplemental and FY 09	$0
Koyukuk	DOT/PF for Evacuation Road and Upgrade Existing Road. Conduct reconnaissance, engineering studies, preliminary engineering and environmental work and final design.	$800,000 ($400,000 in Governor's Budget0
Newtok	Material for evacuation shelter road from barge landing and building materials for evacuation shelter.	$2,000,000 Leveraging more than $5,000,000 from Federal agencies – IRT and USACE

Communities	Description	Recommended Amount
Shaktoolik	State funding for partial funding of Evacuation Road design and engineering. This will leverage funds from Kawerak, Denali Commission and BIA.	$500,000 (Not in Governor's Budget) Leverages $2,500,000 from other cooperating organizations
	Shaktoolik should request from Congress to be added to the Alaska Coastal Erosion Program under authority of Section 117.	IAWG reaffirms Shaktoolik should make this request.
	DNR – DGGS Geologic and Hazardous Mapping to identify sites acceptable for evacuation road, site and identifying relocation sites.	$180,000 Funded through Federal CIAP Program. Funds now available at DGGS, but hiring freeze precludes having human resource capacity needed to do the work.
Shishmaref	Construction to complete the additional 550 feet of ocean-side rock revetment or protect the northeastern edge of the community including the sewage lagoon and washeteria. Another $3,500,000 is needed for this section. USACE and others are working together to identify sources for this needed funding.	$3,000,000 This leverages USACE $500,000 for design of this section (Phase 3), and augments the $10.5 million USACE has already expended for design and construction of 1,350 feet.
	Feasibility Studies and Hazardous and Geologic Mapping Studies are needed. Without the siting and design work of evacuation road, airport, port and other community infrastructure sites cannot be done.	No funding has been identified.
Unalakleet	Funding from FY09 from State and USACE should be sufficient to build the revetment. Coordination with community entities, USACE, DCCED, DOT/PF is needed.	IAWG affirms meetings to develop funding strategy should be scheduled. Unalakleet should take the lead to bring agencies together to develop a funding strategy.
	Old high school gym is scheduled to be torn down. It could be moved to higher ground and serve as an emergency evacuation community center	$1,000,000 (Not in Governor's Budget – funding request received after deadline.)

Strategic and Community Assistance Recommendation Policies

The following summarizes IAWG's policy recommendations, which are further detailed in the Policy section of this report as well as in Appendix A. The IAWG has created working relationships that can help to advance these recommendations in a meaningful and cost-effective manner, which is why the IAWG is *recommending that the Subcabinet refer the next steps to advance these policies back to the IAWG.*

Based on the IAWG's 2009 efforts where we brought together information and data from various agencies to identify the next six communities in need of immediate action, we found:

- There is no consistency in criteria, timeline, weighting, data acquisition technique or analysis to determine if impacts are from climate change.
- No framework exists for the comprehensive identification, analysis, and dissemination of current data or the methodical acquisition of new research to support new policy options.
- Without new policy options state and federal agencies are severely limited in their ability to integrate or identify data, research, programs or projects necessary to mitigate or prevent impacts to communities.
- We were unable to, with confidence; identify the next six communities for immediate action.

The IAWG then combined these findings with what most in public service already know, and that is many capital projects need years of planning, engineering, design and time to identify complementary federal funding.

From this, the IAWG recommends:

- **An integrated, multi-agency and inter-governmental approach to effectively identify and address the needs of communities that are potentially in peril.**

The outcome and benefit of this integrated approach has:

- Significant potential to save money on public infrastructure, avoid costly delays, save funds through economies of scale and combining mobilization, mitigate the effects and costs of disaster relief and recovery.

POLICY 1: ESTABLISH A STATEWIDE SYSTEM TO DOCUMENT, ASSESS, AND ANALYZE CURRENT AND PLANNED PUBLIC INFRASTRUCTURE IN ORDER TO PROTECT EXISTING AND FUTURE INVESTMENTS AND PREVENT THREATS TO LIFE IN AN UNCERTAIN ENVIRONMENT

The Immediate Action Workgroup offers a model for a statewide system that integrates information from all state departments, local entities, and federal agencies on current and planned public infrastructure and capital projects in communities currently or potentially affected by climate change. This system will enable a more rapid identification of community needs and vulnerabilities, and more informed decisions on the future repair, retrofit, replacement, or relocation of critical infrastructure. Further, the IAWG believes, this statewide system will create a more cost-effective means to make decisions about public infrastructure needed to ensure community safety and economic viability.

IAWG Recommended Action to Subcabinet: Adopt Policy 1 and provide the IAWG with guidance to develop implementation options for this policy. At a minimum the guidance should instruct that options should include identifying benefits, challenges, and effective organizational structures for implementation. This integrated system

will create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance should also include melding the relevant Adaptation and Mitigation Advisory Groups' products with this statewide system to reach a desired outcome of integrated actions in order to address what seems to be increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective statewide system.

POLICY 2: SUNSET THE IMMEDIATE ACTION WORKGROUP AND DIRECT THE RELEVANT STATE AGENCIES TO ESTABLISH AN INTERAGENCY COLLABORATION WITH EACH OTHER, ALONG WITH RELEVANT FEDERAL AGENCIES AND COMMUNITIES. THIS COLLABORATIVE REQUIRES REGULARLY SCHEDULED MEETINGS TO COORDINATE INFORMATION, PLANNING, EVALUATION AND DECISIONS ON PUBLIC INFRASTRUCTURE FOR THOSE COMMUNITIES IMPACTED BY CLIMATE CHANGE PHENOMENA.

The Immediate Action Workgroup believes that the outcomes and results of its ad hoc collaborative efforts over the past year have been exceedingly useful and should be integrated into agencies' operational efforts. This policy recommendation should be viewed as an interim step to implementing Policy 1 above. Once Policy 1 is established as a strategic operational mechanism, then this Interagency Collaborative should be integrated, reformulated or discontinued, depending on the structure and needs of the statewide system.

IAWG Recommended Action to Subcabinet: Adopt Policy 2 and provide the IAWG with guidance to develop options to accommodate the transition described in Policy 2. At a minimum the guidance should instruct that options include identifying benefits, challenges, and effective organizational structures for implementation. This precursor to an integrated system will set the framework to create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance to the IAWG should also include melding the relevant Adaptation and Mitigation Advisory Groups' products into options for Policy 2. This would be in an effort to reach the desired outcome of taking integrated actions to address the increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective interagency collaborative while a statewide integrated system is being established.

POLICY 3: ASSISTANCE TO COMMUNITIES IN PERIL MUST UTILIZE COMPREHENSIVE INTEGRATED PLANNING AND VIABLE, FUTURE-ORIENTED SOLUTIONS WITH FUNDING THAT ALLOWS FOR SUSTAINABILITY WHETHER THE COMMUNITY REMAINS IN PLACE, USES A MIGRATION STRATEGY OR NEEDS TO RELOCATE.

The Immediate Action Workgroup believes that comprehensive integrated planning must be used to implement solutions for communities in peril. The planning process must integrate the expertise and resources available from the various state and federal agencies as well as community and regional stakeholders. Flexible funding streams should be sought; and may need to be created, to accommodate the needs associated with preserving the options available for protecting public infrastructure and preventing loss of life. These options range from staying in a community's current location, to a migration strategy, to full relocation. All of these options should integrate the concepts of sustainability into the design, location, and attributes of projects, and if relocating, into future settlements. (See IAWG Sustainability Considerations in Appendix B) Existing and new funding mechanisms for responding to climate change hazards should also provide for adaptation and mitigation measures. In seeking funds for adaptation and mitigation, an examination of current federal and State statutes needs to be conducted to identify

limitations in addressing these measures. The Stafford Act, for example, limits the ability of the State to deal effectively with communities in peril.

IAWG Recommended Action to Subcabinet: Adopt Policy 3 and provide the IAWG with guidance to develop implementation options for this policy. At a minimum the guidance should instruct that options should include identifying benefits, challenges, and effective organizational structures for implementation. This comprehensive planning system is a key component to create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance to the IAWG should also include melding the relevant Adaptation and Mitigation Advisory Groups' products with comprehensive integrated planning to reach a desired outcome of integrated actions in order to address what seems to be increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective comprehensive integrated planning system, which also must be a key component of the statewide system identified in Policy 1.

POLICY 4: THE STATE OFALASKA WILL LEAD A COORDINATING EFFORT TO DEVELOP A COMPREHENSIVE STATEWIDE DATA COLLECTION AND EVALUATION SYSTEM THAT PROVIDES FOUNDATIONAL INFORMATION FOR COMMUNITY AND BUSINESS DECISIONS AND SOLUTIONS LEADINGTO EFFECTIVE RESPONSES AND ADAPTATION STRATEGIES TO ADDRESS CLIMATE CHANGEIMPACTS.

Through the Subcabinet Climate Change Strategy process, various components of a statewide data collection and evaluation system have been identified, yet components need to be coordinated in order to understand and use the information effectively. The phenomena of climate-related impacts are not well understood and the impacts themselves are also uncertain. The State of Alaska, playing the coordinating role, will bring together state agencies, university resources, and federal and local stakeholders to develop an effective data collection and evaluation system. The likely outcomes of this effort will be to identify what data exists in order to build forward from existing data and maps; what format it is in and what technology is needed for the systems to "talk" with each other; what data is needed but missing; and what funding is needed to identify, collect, analyze and disseminate data in order to address impacts from climate change phenomena. Response strategies should be developed through adaptation impact analysis and modeling to identify near-term scenarios for options ranging from protecting what's in place, migration and full relocation.

IAWG Recommended Action to Subcabinet: Adopt Policy 4 and provide the IAWG with guidance to develop implementation options for this policy. At a minimum the guidance should instruct that options should include identifying benefits, challenges, and effective organizational structures for implementation. This comprehensive data system is another key component to create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance to the IAWG should also include melding the relevant Adaptation and Mitigation Advisory Groups' products with this statewide data collection and evaluation system to reach a desired outcome of integrated actions in order to address what seems to be increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective integrated data system. This system must also be a key component of the statewide system identified in Policy 1.

COMMUNITY PROFILES

COMMUNITY INFRASTRUCTURE INVESTMENT

The IAWG determined from the DCCED/DCRA – RAPIDS Database that the public infrastructure investment in the six communities for which the IAWG has focused a good deal of its efforts over the past year stands at $293 million.

One of the IAWG's foundational principles is identify and recommend immediate actions that can be taken to protect the infrastructure and public investment that is already in place.

Based on this, the investment levels for the six communities are included here.

Public Investment Based on Information from DCCED/DCRA RAPIDS Database		
Community	Years	Public Infrastructure Investment
Kivalina	1992-2009	$ 25,606,507
Koyukuk	1987-2009	$ 27,213,704
Newtok	1985-2009	$ 21,733,479
Shaktoolik	1988-2012	$ 16,616,589
Shishmaref	1988-2011	$ 56,096,483
Unalakleet	1989-2011	$ 145,721,705
		$ 292,988,467

KIVALINA

Location and Climate

Kivalina is at the tip of an 8-mile barrier reef located between the Chukchi Sea and Kivalina River. It lies 80 air miles northwest of Kotzebue. The community lies at approximately 67.726940° North Latitude and -164.533330° (West) Longitude. (Sec. 21, T027N, R026W, Kateel River Meridian.) Kivalina is located in the Kotzebue Recording District. The area encompasses 1.9 sq. miles of land and 2.0 sq. miles of water. Kivalina lies in the transitional climate zone which is characterized by long, cold winters and cool summers. The average low temperature during January is -15; the average high during July is 57. Temperature extremes have been measured from -54 to 85.

Snowfall averages 57 inches, with 8.6 inches of precipitation per year. The Chukchi Sea is ice-free and open to boat traffic from mid-June to the first of November.

Photo 2: Work crew at eroded shoreline in Kivalina. (Credit: Colleen Swan)

History, Culture and Demographics

Kivalina has long been a stopping-off place for seasonal travelers between arctic coastal areas and Kotzebue Sound communities. It is the only village in the region where people hunt the bowhead whale. At one time, the village was located at the north end of the Kivalina Lagoon. It was reported as "Kivualinagmut" in 1847 by Lt. Zagoskin of the Russian Navy. Lt. G.M. Stoney of the U.S. Navy reported the village as "Kuveleek" in 1885. A post office was established in 1940. An airstrip was built in 1960. Kivalina incorporated as a City in 1969. During the 1970s, new houses, a new school and an electric system were constructed in the village. Prior to 1976, high school students from Noatak would attend school in Kivalina, and board with local families.

Severe erosion and wind-driven ice damage have forced the community to explore options related to safety, mitigation and relocation. A federally-recognized tribe is located in the community -- the Native Village of Kivalina. The population of the community consists of 96.6 percent Alaska Native or part Native. Kivalina is a traditional Inupiat Eskimo village. Subsistence activities, including whaling, provide most food sources. The sale or importation of alcohol is banned in the village. During the 2000 U.S. Census, total housing units numbered 80, and vacant housing units numbered 2. U.S. Census data for Year 2000 showed 82 residents as employed. The unemployment rate at that time was 25.45 percent, although 65.11 percent of all adults were not in the work force. The median household income was $30,833, per capita income was $8,360, and 26.4 percent of residents were living below the poverty level.

Facilities, Utilities, Schools, and Health Care

Wells have proven unsuccessful in Kivalina. Water is drawn from the Wulik River via a 3-mile surface transmission line, and is stored in a 700,000-gallon raw water tank. It is then treated and stored in a 500,000-gallon steel tank. Water is hauled by residents from this tank. One-third of residents have tanks which provide running water for the kitchen, but homes are not fully plumbed. The school and clinic have individual water and sewer systems. Residents haul their own honeybuckets to bunkers. A new landfill and honeybucket disposal site were recently completed. A Master Plan is underway to examine sanitation alternatives at the new community site.

Electricity is provided by AVEC. There is one school located in the community, attended by 127 students. Local hospitals or health clinics include Kivalina Clinic.

Kivalina is classified as an isolated village, it is found in EMS Region 4A in the Maniilaq Association Region. Emergency Services have coastal and air access. Emergency service is provided by volunteers and a health aide

Economy and Transportation

Kivalina's economy depends on subsistence practices. Seal, walrus, whale, salmon, whitefish, and caribou are utilized. The school, City, Maniilaq Association, village council, airlines, and local stores provide year-round jobs. The Red Dog Mine also offers some employment. Six residents hold commercial fishing permits. Native carvings and jewelry are produced from ivory and caribou hooves. The community is interested in developing an Arts and Crafts Center that could be readily moved to the new community site.

The major means of transportation into the community are plane and barge. A State-owned 3,000' long by 60' wide gravel airstrip serves daily flights from Kotzebue. Crowley Marine Services barges goods from Kotzebue during July and August. Small boats, ATVs, and snowmachines are used for local travel. Two main hunting trails follow the Kivalina and Wulik Rivers.

Photo 3: Coastal storm threatens critical infrastructure in Kivalina. (Credit: Colleen Swan)

KOYUKUK

Location and Climate

Koyukuk is located on the Yukon River near the mouth of the Koyukuk River, 30 miles west of Galena and 290 air miles west of Fairbanks. It lies adjacent to the Koyukuk National Wildlife Refuge and the Innoko National Wildlife Refuge. The community lies at approximately 64.880930° North Latitude and -157.701030° (West) Longitude. (Sec. 17, T007S, R006E, Kateel River Meridian.) Koyukuk is located in the Nulato Recording District. The area encompasses 6.2 sq. miles of land and 0.1 sq. miles of water. The area experiences a cold, continental climate with extreme temperature differences. The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10 to below zero. Sustained temperatures of -40 degrees are common during winter. Extreme temperatures have been measured from -64 to 92. Annual precipitation is 13 inches, with 60 inches of snowfall annually. The River is ice-free from mid-May through mid-October.

Photo 4: Runway located in the floodplain in Koyukuk. (Credit Cynthia Pilot)

History, Culture, and Demographics

The Koyukon Athabascans traditionally had spring, summer, fall, and winter camps, and moved as the wild game migrated. There were 12 summer fish camps located on the Yukon River between the Koyukuk River and the Nowitna River. Friendships and trading between the Koyukon and Inupiat Eskimos of the Kobuk area has occurred for generations. A Russian trading post was established at nearby Nulato in 1838. A smallpox epidemic, the first of several major epidemics, struck the Koyukon in 1839. A military telegraph line was constructed along the north side of the Yukon around 1867, and Koyukuk became the site of a telegraph station. A trading post opened around 1880, just before the gold rush of 1884-85. The population of Koyukuk at this time was approximately 150. Missionary activity was intense along the Yukon, and a Roman Catholic Mission and school opened downriver in Nulato in 1887. A post office operated from 1898 to 1900. Steamboats on the Yukon, which supplied gold prospectors, peaked in 1900 with 46 boats in operation. A measles epidemic and food shortages during 1900 tragically reduced the Native population by one-third. Gold seekers left the Yukon after 1906, but other mining activity, such as the Galena lead mines, began operating in 1919. The first school was constructed in 1939. After the school was built, families began to live at Koyukuk year-round. The City was incorporated in 1973.

A federally-recognized tribe is located in the community -- the Koyukuk Native Village. The population of the community consists of 91.1 percent Alaska Native or part Native. Residents are primarily Koyukon Athabascans with a subsistence lifestyle. During the 2000 U.S. Census, total housing units numbered 55, and vacant housing units numbered 16. Vacant housing units used only seasonally numbered 16. U.S. Census data for Year 2000 showed 40 residents as employed. The unemployment rate at that time was 23.08 percent, although 41.18 percent of all adults were not in the work force. The median household income was $19,375, per capita income was $11,342, and 35.11 percent of residents were living below the poverty level.

The community has experienced increased flooding from both the Yukon and Koyukuk Rivers and residents are considering moving to higher ground.

Facilities, Utilities, Schools, and Health Care

The City provides treated well water at the washeteria. Households are not plumbed, and residents use honeybuckets. The school and washeteria use City water, with sewage disposal into a lagoon. As of May 2003 seven households are on the flush/haul system. The landfill is newly-completed. Electricity is provided by City of Koyukuk. There is one school located in the community, attended by 22 students. Local hospitals or health clinics include Koyukuk Health Clinic. Koyukuk is classified as an isolated village, it is found in EMS Region 1C in the Central Region. Emergency Services have river and air access, and are within 30 minutes of a higher-level satellite health care facility. Emergency service is provided by volunteers and a health aide.

Economy and Transportation

There are few full-time jobs in the community; the city, tribe, clinic, school, and store provide the only year-round employment. BLM fire fighting, construction work, and other seasonal jobs often conflict with subsistence opportunities. Two residents hold commercial fishing permits. Trapping and beadwork supplement incomes. Subsistence foods include salmon, whitefish, moose, waterfowl and berries.

The State-owned 2,645' long by 60' wide lighted gravel runway provides year-round transportation. The river is heavily traveled when ice-free, from mid-May through mid-October. Cargo is delivered by barge about four times each summer. Numerous local trails and winter trails to Chance and Nulato are used by residents. Snowmachines, ATVs, and riverboats are used for local transportation.

NEWTOK

Location and Climate

Newtok is on the Ninglick River north of Nelson Island in the Yukon-Kuskokwim Delta Region. It is 94 miles northwest of Bethel. The community lies at approximately 60.942780° North Latitude and -164.629440° (West) Longitude. (Sec. 24, T010N, R087W, Seward Meridian.) Newtok is located in the Bethel Recording District. The area encompasses 1.0 sq. miles of land and 0.1 sq. miles of water. Newtok is located in a marine climate. Average precipitation is 17 inches, with annual snowfall of 22 inches. Summer temperatures range from 42 to 59, winter temperatures are 2 to 19.

Photo 5: Flooding during coastal storm in Newtok. (Credit: Stanley Tom)

History, Culture, and Demographics

The people of Newtok share a heritage with Nelson Island communities; their ancestors have lived on the Bering Sea coast for at least 2,000 years. The people from the villages of Nelson Island and Newtok are known as Qaluyaarmiut, or "dip net people." Only intermittent outside contact occurred until the 1920s. In the 1950s the Territorial Guard found volunteers from Newtok while they were traveling to Bethel. Tuberculosis was a major health problem during this period. In the late 1950s, the village was relocated from Old Kealavik ten miles away to its present location to escape flooding. A school was built in 1958, although high school students were required to travel to Bethel, St. Mary's, Sitka or Anchorage for their education. This was often their first exposure to the outside, and students returned with a good knowledge of the English language and culture. A high school was constructed in Newtok in the 1980s. A City was incorporated in 1976, but it was dissolved on Jan. 28, 1997. Due to severe erosion, the village wants to relocate to a new site called Mertarvik, approximately 5 miles away on Nelson Island. In November 2003, the 108th Congress passed S. 924, allowing the village to relocate to Nelson Island, authorizing an exchange of lands between the U.S. Fish and Wildlife Service and the Newtok Native Corporation, allowing the relocation.

A federally-recognized tribe is located in the community -- the Newtok Traditional Council. The population of the community consists of 96.9 percent Alaska Native or part Native. Newtok is a traditional Yup'ik Eskimo village, with an active subsistence lifestyle. Relative isolation from outside influences has enabled the area to retain its traditions and customs; more so than other parts of Alaska. The sale or importation of alcohol is banned in the village. During the 2000 U.S. Census, total housing units numbered 67, and vacant housing units numbered 4. U.S. Census data for Year 2000 showed 101 residents as employed. The unemployment rate at that time was 24.63 percent, although 52.13 percent of all adults were not in the work force. The median household income was $32,188, per capita income was $9,514, and 30.99 percent of residents were living below the poverty level.

Facilities, Utilities, Schools, and Health Care

Water is pumped from a lake into a water treatment plant, then hauled from a storage tank. In winter, melted ice is used when water in the storage tank runs dry or freezes. Households are not plumbed, and honeybuckets are used. A washeteria is available. The health clinic uses flush/haul tanks and the schools have individual wells. Refuse collection is provided, and a new landfill has been completed, but ADOT/PF has determined that it is too close to the airport. The community needs to relocate and rebuild facilities on Nelson Island in order to ensure its safety and way of life. A community Master Plan is being developed. Electricity is provided by Unqusrag Power Company. There is one school located in the community, attended by 107 students. Newtok Health Clinic was recently completed by the Denali Commission. Newtok is classified as an isolated village, it is found in EMS Region 7A in the Yukon/Kuskokwim Region. Emergency Services have coastal and air access. Emergency service is provided by a health aide.

Economy and Transportation

The school, clinic, village services, and commercial fishing provide employment. Subsistence activities and trapping supplement income. Twenty-seven residents hold commercial fishing permits. A State-owned 2,202' long by 35' wide gravel airstrip provides chartered or private air access year-round; major improvements are under construction. A seaplane base is also available. Boats, skiffs, and snowmachines are used for local transportation and subsistence activities. Winter trails are marked to Chevak (50 mi.), Tununak, Toksook Bay, Nightmute, and Manaryarapiaq (33.8 mi.) Barges deliver cargo during the summer months.

Photo 6: Flooding during coastal storm in Newtok. (Credit: Stanley Tom)

SHAKTOOLIK

Location and Climate

Shaktoolik is located on the east shore of Norton Sound. It lies 125 miles east of Nome and 33 miles north of Unalakleet. The community lies at approximately 64.333890° North Latitude and 161.153890° (West) Longitude. (Sec. 23, T013S, R013W, Kateel River Meridian.) Shaktoolik is located in the Cape Nome Recording District. The area encompasses 1.1 sq. miles of land. Shaktoolik has a subarctic climate with maritime influences when Norton Sound is ice-free, usually from May to October. Summer temperatures average 47 to 62; winter temperatures average -4 to 11. Extremes from -50 to 87 have been recorded. Average annual precipitation is 14 inches, including 43 inches of snowfall.

Photo 7: Lot inundation at Shaktoolik. (Credit: Steve Ivanoff)

History, Culture, and Demographics

Shaktoolik was the first and southernmost Malemiut settlement on Norton Sound, occupied as early as 1839. Twelve miles northeast, on Cape Denbigh, is "Iyatayet," a site that is 6,000 to 8,000 years old. Reindeer herds were managed in the Shaktoolik area around 1905. The village was originally located six miles up the Shaktoolik River, and moved to the mouth of the River in 1933. This site was prone to severe storms and winds, however, and the village relocated to its present, more sheltered location in 1967. The current site in increasingly threatened by storms and ocean surges and residents are considering relocation to higher ground. The City was incorporated in 1969.

A federally-recognized tribe is located in the community -- the Native Village of Shaktoolik. The population of the community consists of 94.8 percent Alaska Native or part Native. It is a Malemiut Eskimo village with a fishing and subsistence lifestyle. The sale or importation of alcohol is banned in the village. During the 2000 U.S. Census, total housing units numbered 66, and vacant housing units numbered 6. Vacant housing units used only seasonally numbered 1. U.S. Census data for Year 2000 showed 68 residents as employed. The unemployment rate at that time was 27.66 percent, although 56.69 percent of all adults were not in the work force. The median household income was $31,875, per capita income was $10,491, and 6.09 percent of residents were living below the poverty level.

Facilities, Utilities, Schools, and Health Care

Water is pumped three miles from the Togoomenik River to the pumphouse, where it is treated and stored in a 848,000-gallon insulated tank adjacent to the washeteria. A piped water and sewage collection system serves most homes. Seventy-five percent of households have complete plumbing and kitchen facilities. The school is connected to City water, and has received funding to develop a sewage treatment system to serve the entire community. The City burns refuse in an incinerator. The landfill needs to be relocated; the current site is not permitted. Electricity is provided by AVEC. There is one school located in the community, attended by 57 students. Local hospitals or health clinics include Shaktoolik Clinic. Shaktoolik is classified as an isolated village, it is found in EMS Region 5A in the Norton Sound Region. Emergency Services have coastal and air access. Emergency service is provided by a health aide.

Economy and Transportation

The Shaktoolik economy is based on subsistence, supplemented by part-time wage earnings. Thirty-three residents hold commercial fishing permits. Development of a new fish processing facility is a village priority. Reindeer herding also provides income and meat. Fish, crab, moose, beluga whale, caribou, seal, rabbit, geese, cranes, ducks, ptarmigan, berries, greens and roots are also primary food sources.

Shaktoolik is primarily accessible by air and sea. A State-owned 4,000' long by 75' wide gravel airstrip is available. The Alex Sookiayak Memorial Airstrip allows for regular service from Nome. Summer travel is by 4-wheel ATV, motorbike, truck, and boat; winter travel is by snowmachine and dog team. Cargo is barged from Nome, then lightered to shore. The community has no docking facilities.

Photo 8: Log inundation at Shaktoolik. (Credit: Steve Ivanoff)

SHISHMAREF

Location and Climate

Shishmaref is located on Sarichef Island, in the Chukchi Sea, just north of Bering Strait. Shishmaref is five miles from the mainland, 126 miles north of Nome and 100 miles southwest of Kotzebue. The village is surrounded by the 2.6 million-acre Bering Land Bridge National Reserve. It is part of the Beringian National Heritage Park, endorsed by Presidents Bush and Gorbachev in 1990. The community lies at approximately 66.256670° North Latitude and -166.071940° (West) Longitude. (Sec. 23, T010N, R035W, Kateel River Meridian.) Shishmaref is located in the Cape Nome Recording District. The area encompasses 2.8 sq. miles of land and 4.5 sq. miles of water. The area experiences a transitional climate between the frozen arctic and the continental Interior. Summers can be foggy, with average temperatures ranging from 47 to 54; winter temperatures average -12 to 2. Average annual precipitation is about 8 inches, including 33 inches of snow. The Chukchi Sea is frozen from mid-November through mid-June.

Photo 9: Erosion near Shishmaref homes. (Credit: Brice Eningowuk)

History, Culture, and Demographics

The original Eskimo name for the island is "Kigiktaq." In 1816, Lt. Otto Von Kotzebue named the inlet "Shishmarev," after a member of his crew. Excavations at "Keekiktuk" by archaeologists around 1821 provided evidence of Eskimo habitation from several centuries ago. Shishmaref has an excellent harbor, and around 1900 it became a supply center for gold mining activities to the south. The village was named after the Inlet and a post office was established in 1901. The City government was incorporated in 1969. During October 1997, a severe storm eroded over 30 feet of the north shore, requiring 14 homes and the National Guard Armory to be relocated. Five additional homes were relocated in 2002. Other storms have continued to erode the shoreline, an average of 3 to 5 feet per year on the north shore. In July 2002, residents voted to relocate the community. The U.S. Army Corps of Engineers and the State of Alaska have cooperated in an effort to stabilize the shoreline. This effort is continuing.

Photo 10: Failed sea wall. (Credit: Brice Eningowuk)

A federally-recognized tribe is located in the community -- the Native Village of Shishmaref. The population of the community consists of 94.5 percent Alaska Native or part Native. It is a traditional Inupiat Eskimo village with a fishing and subsistence lifestyle. The sale or importation of alcohol is banned. During the 2000 U.S. Census, total housing units numbered 148, and vacant housing units numbered 6. Vacant housing units used only seasonally numbered 4. U.S. Census data for Year 2000 showed 173 residents as employed. The unemployment rate at that time was 16.43 percent, although 51.81 percent of all adults were not in the work force. The median household income was $30,714, per capita income was $10,487, and 16.27 percent of residents were living below the poverty level.

Facilities, Utilities, Schools, and Health Care

Water is derived from a surface source, is treated and stored in a new tank. Shishmaref is undergoing major improvements, with the construction of a flush/haul system and household plumbing. Nineteen HUD homes have been completed, and 71 homes remain to be served. The new system provides water delivery, but the unserved homes continue to haul water. Honeybuckets and the new flush tanks are hauled by the City. The school, clinic, Friendship Center, City Hall and fire hall are connected to a sewage lagoon. A new landfill is planned for the City; an access road is under construction. Electricity is provided by AVEC. There is one school located in the community, attended by 173 students. Local hospitals or health clinics include Katherine Miksruaq Olanna Health Clinic. The clinic is a qualified Emergency Care Center. Shishmaref is classified as an isolated village, it is found in EMS Region 5A in the Norton Sound Region. Emergency Services have coastal and air access. Emergency service is provided by a health aide. Auxiliary health care is provided by the City Volunteer Fire Department/Emergency Services.

Economy and Transportation

The Shishmaref economy is based on subsistence supplemented by part-time wage earnings. Two residents hold a commercial fishing permit. Year-round jobs are limited. Villagers rely on fish, walrus, seal, polar bear, rabbit, and other subsistence foods. Two reindeer herds are managed from here. Reindeer skins are tanned locally, and meat is available at the village store. The Friendship Center, a cultural center, and carving facility, was recently completed for local artisans.

Shishmaref's primary link to the rest of Alaska is by air. A State-owned 5,000' long by 70' wide paved runway is available. Charter and freight services are available from Nome. Most people own boats for trips to the mainland.

Photo 11: School teacher housing before rip rap revetment was installed. (Credit: Brice Eningowuk)

UNALAKLEET

Location and Climate

Unalakleet is located on Norton Sound at the mouth of the Unalakleet River, 148 miles southeast of Nome and 395 miles northwest of Anchorage. The community lies at approximately 63.873060° North Latitude and -160.788060° (West) Longitude. (Sec. 03, T019S, R011W, Kateel River Meridian.) Unalakleet is located in the Cape Nome Recording District. The area encompasses 2.9 sq. miles of land and 2.3 sq. miles of water. Unalakleet has a subarctic climate with considerable maritime influences when Norton Sound is ice-free, usually from May to October. Winters are cold and dry. Average summer temperatures range 47 to 62; winter temperatures average -4 to 11. Extremes have been measured from -50 to 87. Precipitation averages 14 inches annually, with 41 inches of snow.

Photo 12: Log inundation at Unalakleet. (Credit: Steve Ivanoff)

History, Culture, and Demographics

Archaeologists have dated house remnants along the beach ridge from 200 B.C. to 300 A.D. The name Unalakleet means "from the southern side." Unalakleet has long been a major trade center as the terminus for the Kaltag Portage, an important winter travel route connecting to the Yukon River. Indians on the upper river were considered "professional" traders who had a monopoly on the Indian-Eskimo trade across the Kaltag Portage. The Russian-American Company built a post here in the 1830s. In 1898, reindeer herders from Lapland were brought to Unalakleet to establish sound herding practices. In 1901, the Army Signal Corps built over 605 miles of telegraph line from St. Michael to Unalakleet, over the Portage to Kaltag and Fort Gibbon. The City was incorporated in 1974.

A federally-recognized tribe is located in the community -- the Native Village of Unalakleet. The population of the community consists of 87.7 percent Alaska Native or part Native. Unalakleet has a history of diverse cultures and trade activity. The local economy is the most active in Norton Sound, along with a traditional Unaligmiut Eskimo subsistence lifestyle. Fish, seal, caribou, moose, and bear are utilized. The sale of alcohol is prohibited in the community, although importation and possession are allowed. During the 2000 U.S. Census, total housing units numbered 242, and vacant housing units numbered 18. Vacant housing units used only seasonally numbered 6. U.S. Census data for Year 2000 showed 258 residents as employed. The unemployment rate at that time was 14.57 percent, although 48.61 percent of all adults were not in the work force. The median household income was $42,083, per capita income was $15,845, and 11.04 percent of residents were living below the poverty level.

Facilities, Utilities, Schools, and Health Care

Water is derived from an infiltration gallery on Powers Creek, is treated and stored in a million-gallon steel tank. The water source is not sufficient during extremely cold weather, and a feasibility study is underway. One hundred ninety households are connected to the piped water and sewer system and have complete plumbing. Only two households haul water and honeybuckets. Residents haul refuse to the baler facility for transportation to the landfill. Refuse collection is available for commercial customers. Matanuska Electric Association owns and operates the electrical system in Unalakleet, through the Unalakleet Valley Electric Cooperative. Electricity is provided by Unalakleet Valley Electric Cooperative. There is one school located in the community, attended by 210 students. Local hospitals or health clinics include Euksavik Clinic. The clinic is a qualified Emergency Care Center. Unalakleet is classified as an isolated town/Sub-Regional Center, it is found in EMS Region 5A in the Norton Sound Region. Emergency Services have river and air access. Emergency service is provided by volunteers and a health aide.

Economy and Transportation

Both commercial fishing for herring, herring roe, and subsistence activities are major components of Unalakleet's economy. One hundred nine residents hold commercial fishing permits. Norton Sound Economic Development Council operates a fish processing plant. Government and school positions are relatively numerous. Tourism is becoming increasingly important; there is world-class silver salmon fishing in the area.

Unalakleet has a State-owned 6,004' long by 150' wide gravel runway which recently underwent major improvements; and a gravel strip that is 2,000' long and 80' wide. There are regular flights to Anchorage. Cargo is lightered from Nome; there is a dock. Local overland travel is mainly by ATVs, snowmachines and dogsleds in winter.

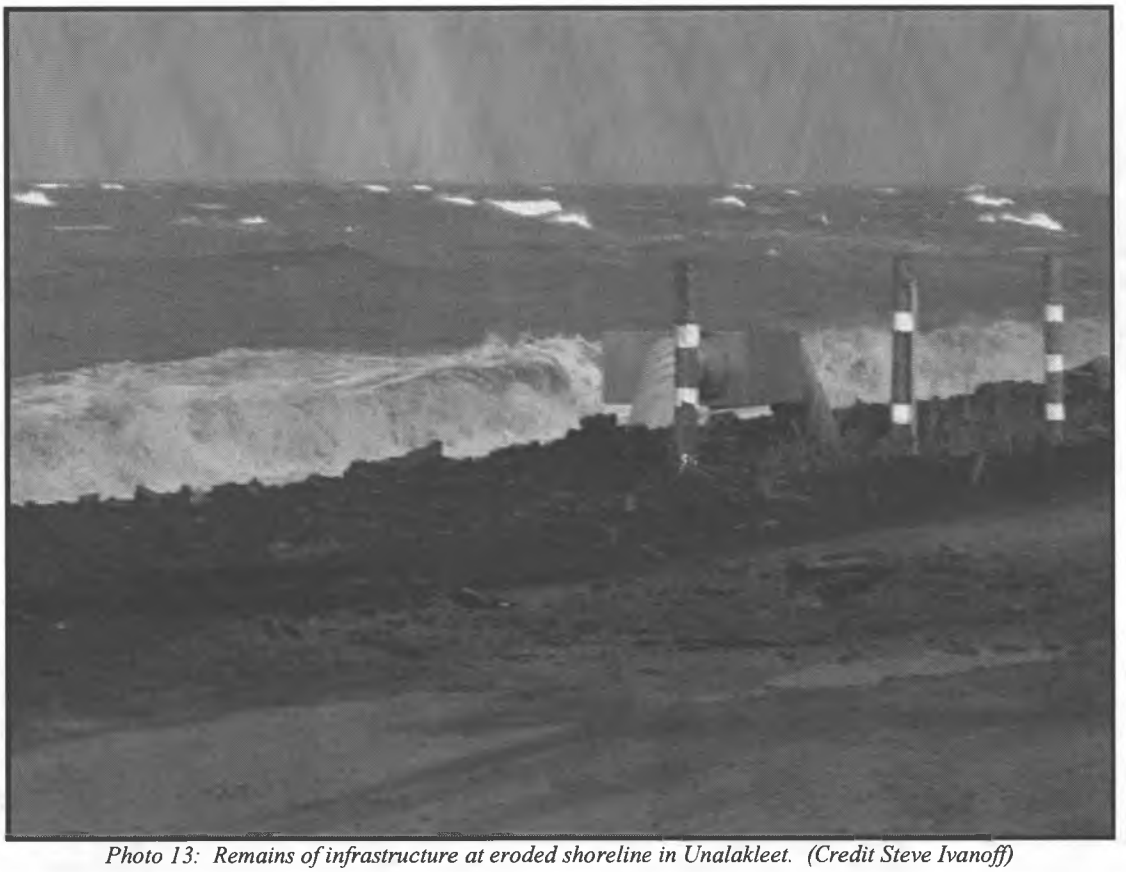


Photo 13: Remains of infrastructure at eroded shoreline in Unalakleet. (Credit Steve Ivanoff)

ACCOMPLISHMENTS

KIVALINA	
IAWG Recommendation and Agency Actions	**Status**
Develop Suite of Emergency Plans and Training/Drills State resources were provided to the Alaska DHS&EM to work jointly with Kivalina and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion.	Developing plans, trainings and drills will begin in February and will be completed by end of 2009.
Community Mitigation and Relocation Planning and Coordination DCCED/DCRA staff is working with both the City and Tribe to develop a proposal for a community planning grant that addresses the IAWG's recommended immediate actions for the community through the Alaska Climate Change Impact Mitigation Program.	Discussions and collaborations are in progress between DCRA and the City and Tribe of Kivalina. It's likely a community planning grant/contract will be in place in June 2009.
Reduce State Capital Budget Expenditures by Leveraging Other Resources State provided $3.3 million to the Northwest Arctic Borough to begin construction of a revetment to protect vulnerable shoreline of community USACE engineers obtained a supplemental appropriation from Congress in 2008 to complete the revetment protection of the Oceanside shoreline of Kivalina thereby securing the shore for a minimum of 15 years.	Phase 1-Ocean-side revetment: USACE constructed 400 ft of revetment in 2008; 1200 in 2009. Cost: $12.5 mm. NWAB will construct 400 ft with $3.3mm. Phase 2 - Lagoon-side revetment: USACE began design during the Winter 2009.
ADOT/PF Preliminary Engineering & Early Coordination State resources were provided to ADOT/PF for early coordination and its participation with the USACE to design and development of shoreline protection measures. Coordination resulted in working with community, DCCED and USACE to utilize existing data and identify missing data. Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans will result from early coordination.	See DOT's accomplishments later in this section.

KOYUKUK	
IAWG Recommendation and Agency Actions	**Status**
Develop Suite of Emergency Plans and Training/Drills State resources were provided to the Alaska DHS&EM to work jointly with Koyukuk and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion. Funding was also provided to DNR/Division of Forestry for a Community Wildfire Protection Plan (CWPP). Work on this project will be accomplished by Division of Forestry in conjunction with the community, Tanana Chiefs Conference, Inc. and the Alaska Fire Service. Project will identify fuel types in conjunction with community infrastructure to determine levels of risk. Fuel reduction projects will be designed and ranked for treatments. FY09 budget was $25K for this project.	Developing plans, trainings and drills has been initiated and will be completed by end of 2009. Initial work is under-way with a Reimbursable Services Agreement (RSA) in place between DOF and DMVA. Community meetings will begin in February-09, risk assessment summer-09, draft plan fall-09, completion by spring 2010.
Community Mitigation and Relocation Planning and Coordination DCCED/DCRA staff is working with Koyukuk to develop a proposal for a community planning grant that addresses the recommended immediate actions for the community through the Alaska Climate Change Impact Mitigation Program.	Discussions and collaborations are in progress between DCCED/DCRA and the Village of Koyukuk. It's likely a community planning grant/contract will be in place in June 2009.
Reduce State Capital Budget Expenditures by Leveraging Other Resources FY 10 Governor's budget includes $400k to DOT/PF to design village evacuation road to higher ground USACE and others are working with Koyukuk to complete an expedited erosion/flooding assessment and held two public meetings to discuss alternative plans and receive input. A draft feasibility report is currently being prepared but the community remains divided on the acceptability of identified alternative plans.	USACE has conducted and led a feasibility study on alternative flood damage reduction planning for the Village. DCCED/DCRA and others are now assisting the community in its review and identifying options and actions.
ADOT/PF Preliminary Engineering & Early Coordination State resources were provided to ADOT/PF for early coordination and its participation with the USACE. Coordination resulted in working with community, DCCED and USACE to utilize existing data and identify missing data. Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans, will result from early coordination.	See DOT's accomplishments later in this section.

NEWTOK	
IAWG Recommendation and Agency Actions	**Status**
Develop Suite of Emergency Plans and Training/Drills State resources were provided to the Alaska DHS&EM to work jointly with Newtok and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion.	Developing plans, trainings and drills has been initiated and will be completed by end of 2009.
Community Mitigation and Relocation Planning and Coordination Newtok received a community planning grant through the DCCED/DCRA's new, legislatively created Alaska Climate Change Impact Mitigation Program. These funds are being used for: • The design of an evacuation shelter. The community hired the Cold Climate Housing Center; • Planning resources to conduct site suitability analysis and future community layout at the identified new community site- Mertarvik.	The Village of Newtok has a fully executed community planning grant for the preparation of a design analysis report and 35% design drawings for an emergency evacuation center that will be built at Mertarvik, on Nelson Island. Cold Climate Housing Research Center has been hired by the Village of Newtok to design a sustainable and energy efficient emergency shelter and carry out the project.
Reduce State Capital Budget Expenditures by Leveraging Other Resources - ADOT/PF received $3.3 million from the State Legislature for Newtok. $1.8 million of this appropriation is being combined with an $800,000 grant from the Federal Economic Development Administration (EDA). DCCED is the grantee to EDA to build a barge landing and upland staging area to allow for landing of supplies, equipment and personnel at the Mertarvik site. - ADEC secured resources to drill and develop water well at the Mertarvik site. - AEA secured funds to build a fuel pipeline to allow fuel offloading from the Newtok River to fuel tanks at the generator site in Newtok - Commitment received from the Innovative Readiness Training Program in the U.S. Department of Defense to conduct a military training effort at Mertarvik with the intention of helping the community build roads, an emergency shelter and a quarry for material at Mertarvik. - Community members and the tribal council have financed and built 3 homes at Mertarvik.	Completed by July 2009. DCCED and DOT signed their project agreement 3/15/2008. Treated well water will be available by August 2009. **To be completed** in Spring/Summer 2009. $2 million in Governor's FY2010 Budget for materials to construct evacuation shelter. $5 million estimated for FY2011. Materials being contributed by federal IRT Program for roads, evacuation shelter and quarry development. IRT effort will

NEWTOK	
IAWG Recommendation and Agency Actions	**Status**
- USACE prepared designs for the road from the barge landing to the proposed evacuation center at Mertarvik in cooperation with ADOT. Corps is working with the IRT to provide NEPA documentation, obtain a Coastal Zone Consistency Determination, and Water Quality Certification. This should help expedite processing of needed permits when it is determined which agency will provide funding and staff for construction support of the IRT building a base camp in 2009.	commence Summer 2009. USACE road design was completed by March 1, 2009. Corps signed a Project Partnering Agreement with the Newtok Tribal Council in Jan 09 to enable construction of a road and evacuation center at Mertarvik if/when Federal funding is received.
ADOT/PF Preliminary Engineering & Early Coordination Newtok community and airport relocation alternatives (approx $70k) and Mertarvik Barge Landing Project design (approx $150k) ADOT/PF received state resources and used approximately $70,000 to survey the Newtok/Mertarvik Village Relocation site and surrounding airport relocation alternatives. The DOT Contractor acquired aerial mapping utilizing existing photography previously acquired by the Army Corps of Engineers, which had been aerotriangulated, and by flying a new series of more detailed photography. Products included digital topography files at 5' contours, and 1 inch = 200 feet planimetric detail maps. These products will help with further evaluation of airport relocation alternatives for the community. The level of surveying provided will also help with actual design efforts for the airport, and will reduce the need for additional survey work during the design phase of the project. Approximately $1.8 million is being used to help complete the Mertarvik Barge Landing Project design. Coordination has resulted in working with community, DCCED and USACE to utilize existing data and identify missing data. Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans, will result from early coordination.	Barge landing project is scheduled for construction completion by July 15, 2009. See DOT accomplishments later in this section.

SHAKTOOLIK	
IAWG Recommendation and Agency Actions	**Status**
Develop Suite of Emergency Plans and Training/Drills State resources were provided to the Alaska DHS&EM to work jointly with Shaktoolik and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion.	Developing plans, trainings and drills has been initiated and will be completed by end of 2009.
Community Mitigation and Relocation Planning and Coordination DCCED/DCRA staff is working with the Village of Shaktoolik to develop a proposal for a community planning grant that addresses IAWG's recommended immediate actions for Shaktoolik through the Alaska Climate Change Impact Mitigation Program.	Discussions and collaborations are in progress between DCCED/DCRA and the Village of Shaktoolik. It's likely a community planning grant/contract will be in place in June 2009.
Reduce State Capital Budget Expenditures by Leveraging Other Resources Kawerak completed a preliminary design/reconnaissance report of the evacuation road and a route to a safe high ground site, and has identified multiple sources of funding for engineering and design for FY10.	In Dec. 2008, Kawerak with Denali Commission funding, completed a reconnaissance study for siting an evacuation road
ADOT/PF Preliminary Engineering & Early Coordination State resources were provided to ADOT/PF for early coordination and its participation with the USACE. The Corps initiated a shoreline protection study under Section 103 of its Continuing Authority Program to determine what alternatives would provide reasonable solutions to erosion and storm damage. Coordination resulted in working with community, DCCED and USACE to utilize existing data and identify missing data. Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans will result from early coordination.	See DOT's accomplishments later in this section.

SHISHMAREF	
IAWG Recommendation and Agency Actions	**Status**
Develop Suite of Emergency Plans and Training/Drills State resources were provided to the Alaska DHS&EM to work jointly with Shishmaref and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion.	Developing plans, trainings and drills has been initiated and will be completed by end of 2009.
Community Mitigation and Relocation Planning and Coordination DCCED/DCRA staff is working with Shishmaref to develop a proposal for a community planning grant that addresses the IAWG's recommended immediate actions for the community through the Alaska Climate Change Impact Mitigation Program.	Discussions and collaborations are in progress between DCRA and the City and Tribe of Shishmaref. It's likely a community planning grant/contract will be in place in June 2009.
Reduce State Capital Budget Expenditures by Leveraging Other Resources USACE engineers secured additional funding through the 2008 Federal Supplemental Appropriation from Congress for construction of rock revetments at $10.5 mm. IAWG recommends a $3 million request in FY10 Governor's budget to begin construction of a revetment to protect the most vulnerable shoreline of community. USACE is also expending $500k on design work for the additional revetment needed to protect the community. $3 million for final phase of revetment in Governor's Budget for FY10.	**Phase 1:** 600 feet of rock revetment completed in Sep 08. **Phase 2:** 750 feet of rock revetment under contract to be completed by Oct 09. **Phase 3:** 550 feet of rock revetment under design in 2009; construction funding needed. **Phase 4:** 1,225 feet to be surveyed in 2009; of this 325 feet will be new rock revetment and 900 feet will be raising existing revetments when funding is provided. Environmental studies were initiated for a programmatic EIS for community relocation with limited funding.
ADOT/PF Preliminary Engineering & Early Coordination State resources were provided to ADOT/PF for early coordination and its participation with the USACE to design and development of shoreline protection measures. Coordination resulted in working with community, DCCED and USACE to utilize existing data and identify missing data. Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans, will result from early coordination.	Geotech data collection and analysis completed in 2008 for assessment to site evacuation/relocation road. See DOT's accomplishments later in this section.

UNALAKLEET	
IAWG Recommendation and Agency Actions	**Status**
Develop Suite of Emergency Plans and Training/Drills State resources were provided to the Alaska DHS&EM to work jointly with Unalakleet and prepare a suite of emergency plans including Emergency Operations, Community Evacuation and Hazard Mitigation, along with training, and conducting community drills to provide readiness in case of a disaster, most likely flooding and/or erosion.	Developing plans, trainings and drills will begin in February and will be completed by end of 2009.
Community Mitigation and Relocation Planning and Coordination DCCED/DCRA staff is working with Unalakleet to develop a proposal for a community planning grant that addresses the IAWG's recommended immediate actions for the community through the Alaska Climate Change Impact Mitigation Program.	Discussions and collaborations are in progress between DCCED/DCRA and the City and Village of Unalakleet. It's likely a community planning grant/contract will be in place in June 2009.
Reduce State Capital Budget Expenditures by Leveraging Other Resources $5 million provided by the Alaska Legislature to the City of Unalakeet to build a section of a shoreline revetment designed by the Corps for a vulnerable portion of the beach USACE engineers obtained construction funding from the 2008 Supplemental Appropriation by Congress for a portion of the 1,500 foot rock revetment facing the ocean. This revetment is designed to provide long term protection for the Unalakleet waterfront ADOT/PF has secured resources from FAA to protect shoreline of the section of beach threatened by erosion adjacent to the airport.	USACE design work is complete and the construction contract is being advertised. Proposals were received Feb 20th and selection of a contractor is expected in April 2009. Construction could be completed in 2010 – if sufficient funds are available. Airport shoreline revetment completed.
ADOT/PF Preliminary Engineering & Early Coordination State resources were provided to ADOT/PF for early coordination and its participation with the USACE. Coordination resulted in working with community, DCCED and USACE to utilize existing data and identify missing data. Timely site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies, which all need to be conducted prior to developing erosion protection or relocation design plans will result from early coordination.	See DOT's accomplishments later in this section.

ACCOMPLISHMENTS BY AGENCY

Division of Homeland Security & Emergency Management
$400,000 State funding and $125,000 Federal funding

Based on the IAWG's April 17, 2008 Recommendations Report to the Governor's Subcabinet on Climate Change, the DHS&EM was funded to develop a suite of comprehensive emergency plans for the six communities in peril (Kivalina, Koyukuk, Newtok, Shaktoolik, Shishmaref, and Unalakleet). Each of the six communities will receive an emergency operations plan, continuity of operations plan, emergency evacuation plan, and the training to execute these plans. Since June 2008 DHS&EM representatives have made initial visits to each of the communities to develop a community planning team, initial hazard analysis, and a basic outline schedule on what is to come in the next year. Ecology & Environmental (E&E) was selected as the contractor to execute the comprehensive emergency planning. E&E has made their first string of visits to the communities. During these visits, members for the communities received ICS training, initial planning drafts, and community and emergency planning workgroup meetings were conducted. The contractor will be making a final visit at the end of Summer 2009/ Fall 2009, which will result in finalizing training, completed plans, and community adoption of the plans. The overall goal is to have comprehensive emergency plans for each of the 6 communities in peril by the Fall sea storm season of 2009.

Not only have the communities received ICS training and emergency plans, but they have been invited to DHS&EM tri-annual preparedness workshops with various themes ranging from before, during, and after a disaster, to creating a resilient community. Also during these workshops the communities are being exposed to the division SERC/LEPC (State Emergency Response Committee/ Local Emergency Planning Committee) meetings. Other workshops communities have attended include the Western Alaska Evacuation Workshop. This session brought communities from all over Western Alaska to work together on emergency planning issues, and mutual aid issues. The outcome of this training has helped the six communities in peril build better ties, relationships and communications with neighboring communities within their regions.

Since **Developing the Suite of Emergency Plans and Training/Drills began,** Alaskan communities are becoming more involved with hazard mitigation, emergency planning, response, and training in partnership with DHS&EM.

Alaska Department of Commerce Community and Economic Development –
Division of Community and Regional Affairs
$500,000

Alaska Climate Change Impact Mitigation Program
Alaska's Twenty Fifth Legislature established the Alaska Climate Change Impact Mitigation Program (ACCIMP) with funding to address the immediate planning needs of communities imminently threatened by climate change-related impacts such as erosion, flooding, storm surge, and thawing permafrost. The ACCIMP is being administered by the Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs (DCRA).

The ACCIMP is being delivered through grants to meet specific objectives. The program initially directs the majority of grant funds at communities identified as imminently threatened by the Governor's Subcabinet on Climate Change, Immediate Action Workgroup (IAWG). These communities are Shishmaref, Kivalina, Newtok, Koyukuk, Unalakleet and Shaktoolik.

The ACCIMP is providing non-competitive funding to these communities for Community Planning Grants to address the recommendations for immediate actions made by the IAWG in its Recommendations Report to the

Governor's Subcabinet on Climate Change, April 17, 2008. Development of community planning and/or hazard impact assessment grants for the six communities named above is currently underway.

The balance of ACCIMP funds will be offered as competitive mini-grants to eligible communities for hazard impact assessments to identify climate change-related natural hazards such as erosion, flooding, storm surge, thawing permafrost, and wildfires, and to provide recommendations for further action by the community.

Solicitation for the competitive mini-grant program opened January 12, 2009 and ended February 16, 2009.

Alaska Department of Transportation & Public Facilities
Infrastructure and Erosion Control Design and Environmental Permitting
$600,000

This funding is allowing the Department of Transportation and Public Facilities to begin early project coordination with the affected communities as well as other State and Federal Agencies. The US Army Corps of Engineers has conducted several studies regarding erosion control structures and other relocation options that the department needs to review and examine. The department also needs to begin to collect available engineering data and identify gaps in data for additional investigations.

Funding will also allow for preliminary engineering investigations to begin so that project development can move ahead in an orderly, timely, and efficient manner. Site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies will all need to be conducted prior to developing erosion protection or relocation design plans. Because all likely project scenarios will involve extensive environmental documentation and permitting, it is critical that the project development process start as early as possible.

Work to Date:

- Approximately $70,000 used for a survey of the Newtok/Mertarvik Village Relocation site and surrounding airport relocation alternatives;
- Approximately $150,000 for the Barge Landing Project design (both detailed in the Newtok Accomplishments); and
- Approximately $240,000 has been allocated to the Northern Region to begin early coordination with the affected communities as well as other State and Federal Agencies. Preliminary engineering and data collection efforts are currently underway. Project deliverables include:
    - *Unalakleet Project Coordination with USACE, ADCCED, and Denali Commission*
    - *Electronic Resource Library, including index*
    - *Data Gap Identification and Collection Plan*
    - *U.S. Corp of Engineer Plan Reviews and Coordination*
    - *Agency Stakeholder Contact List*
    - *Permitting Agency Contact List*
    - *Coastal Erosion Power Point Presentation*
    - *Community meeting notes and Summaries*
    - *DCRA Website Coordination*
    - *Report identifying existing coastal processes and alternatives as related to sediment transport for the affected communities, including a sediment budget for the communities*
    - *Other preliminary tasks, such as collecting environmental, geotechnical, and survey data are also scheduled to be performed this spring/summer*

Department of Natural Resources
Statewide Update on Community Wildfire Protection Planning Efforts and Funding

Appendix A also includes the list of communities with Community Wildfire Protection Plans (CWPP) completed or underway.

Funding for the completion of CWPP's has been sporadic and has come from several different sources and agencies. The Division of Forestry in conjunction with the Alaska Wildland Fire Coordination Group (AWFCG) has recognized the need for a National Fire Plan Coordinator position in Alaska to oversee the coordination, funding and implementation of the CWPP effort statewide. The agencies are working toward this goal, and in the meantime are completing work by utilizing various agency budgets and staff as time and funding permits.

The National Economic Stimulus Plan has allocations for Wildland Fire Management in both the House and Senate passed versions of the bill. While final funding levels will be established by the conference committee, significant funding will become available to complete new CWPPs and to implement hazard fuel reduction projects recommended by these plans. Funding will flow through established programs via the U.S. Forest Service, State and Private Forestry Programs to the State through the Division of Forestry.

In addition, under the Climate Change Subcabinet, both the Natural Systems Adaptation Technical Workgroup and the Forestry, Agricultural and Waste Mitigation Technical Workgroups have proposals for continuing CWPP work as part of their recommendations to their respective Advisory Groups.

U.S. Army Corps of Engineers Planning, Design and Construction

Funding for the Corps participation in IAWG identified projects in 2008 was provided by Congress from a Supplemental Appropriation ($40m), the Alaska Coastal Erosion Program ($5.4m), the Tribal Partnership Program ($689k), and the Continuing Authorities Program ($114k). This enabled construction contracts for rock revetment projects at Shishmaref, Kivalina and Unalakleet to be advertised and awarded at Shishmaref and Kivalina. Due to high initial bids at Unalakleet, the contract documents were revised and readvertised so construction proposals could be evaluated in March 09. Designs for additional phases of construction continued at Shishmaref, Kivalina, and Newtok under the Alaska Coastal Erosion program. Under the Tribal Partnership Program the Alaska Baseline Erosion report was drafted which evaluated the erosion risk at 179 communities and identified 26 Priority Action Communities. A final report is due in April 09. Studies were continued at Shaktoolik, Point Hope, Nome, Chefornak, Koyukuk, and Barrow regarding erosion and/or flooding problems.

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration is working with the IAWG to define priorities for the tide and water level stations, weather observations, geodetic control information and ice forecasting, called for in the IAWG April 2008 report.

In December 2008, the NOAA Alaska Regional Collaboration Team submitted a tide gauge priority list incorporating IAWG interests can be found at:
http://www.ppi.noaa.gov/NOAA_ARCTic/docs/AKTideGaugePriority_ARCTic.pdf This list will be used by the Center for Operational Oceanographic Products and Services to guide future deployments: The next step will be for the State to help NOAA identify facilities (e.g. pier) with communications and power in the priority areas where the gauges can be sited. The upcoming release of the National Wave Observation Plan will include

several new sites along the west coast, based on IAWG input, for buoys and other instrumentation. The plan will describe an ideal state and implementation of the proposed network will be affected by feasibility, availability of funding, and national prioritization.

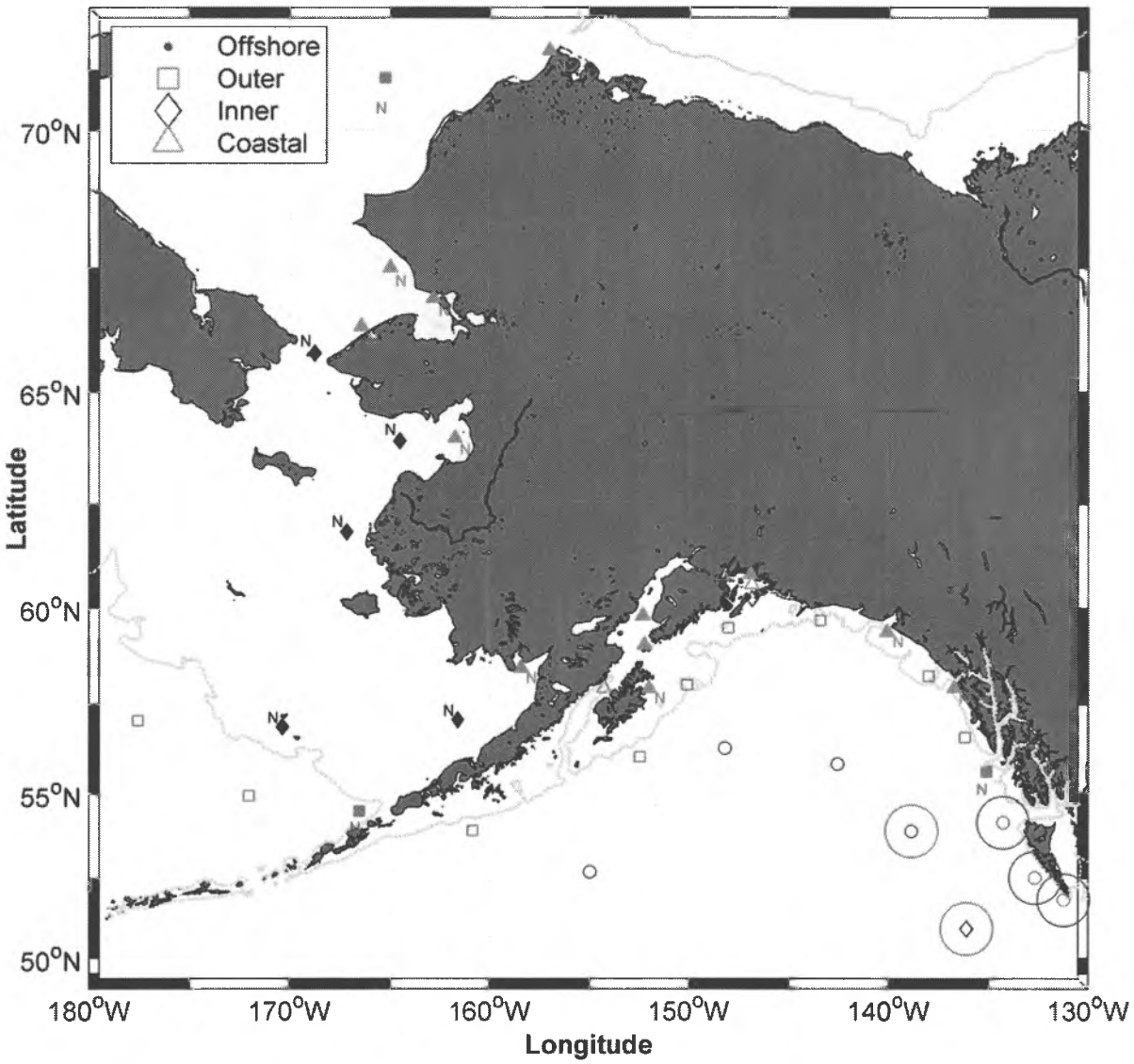


Figure 1: Proposed ideal locations of wave observing infrastructure - IAW input influnced the addition and location of the new sites along the west coast

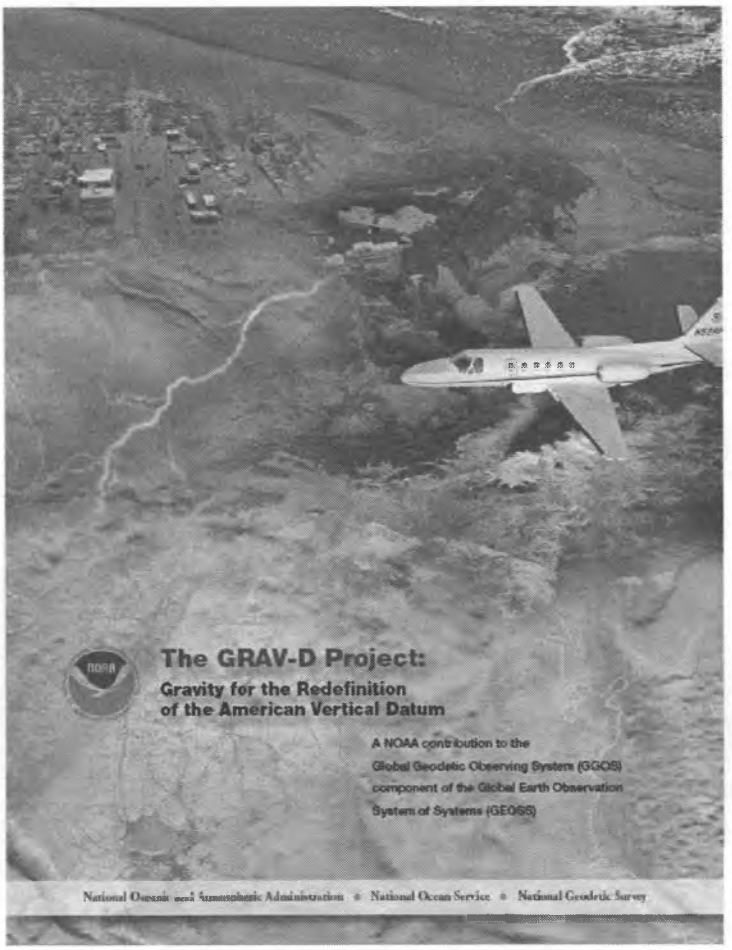


Figure 2: Alaskan Littoral Regions (excluding the Aleutians) and Southern Alaska are the first two areas of the country to be addressed.

Improved geodetic control will be achieved through the agency's "Gravity for the Re-definition of the American Vertical Datum" program which is awaiting appropriations. This program will reduce vertical positioning errors from ~2 meters to ~2 centimeters and will be complimented by the Alaska Statewide Digital Mapping Initiative.

Efforts are also underway to formally document the priorities for enhanced ice forecasting.

IMMEDIATE ACTIONS FOR COMMUNITIES

2009 Immediate Action Funding Recommendations			
Community	**Immediate Actions Identified to Prevent Loss of Life and Infrastructure**	**Past and Future Budget Notes**	**IAWG Action**
All Six Communities DHS&EM is advancing these Emergency Plans in each of the six communities. It anticipates all 6 to be completed by calendar end 2009.	**Develop Suite of Emergency Plans and Training/Drills** (Alaska DHS&EM is lead) Emergency Operations, Community Evacuation, Hazard Mitigation Fire Management (Koyukuk only-DNR is lead) Purpose: Best chance to reduce loss of life and property when natural disasters occur. Coordinate with community planning projects to ensure dollars go as far as possible.	**FY09 - $400,000 appropriated in Capital Budget to DHS&EM**. DHS&EM RSA $25,000 to DNR for Koyukuk Fire Management Plan. DHS&EM will also provide $100,000 federal funds match. **State's Return on Investment:** DHS&EM estimates for every $1 spent on preparation, $4 saved in response.	**FY10 IAWG Budget Recommendation: $500,000 (not included in Governor's Budget)** **IAWG continues to support this important and initial step to ensure preparedness for communities, and prevent harm to infrastructure.** **IAWG has identified over 150 communities as potentially in peril. See Appendix A.** **DHS&EM will explore other funding opportunities, e.g. Denali Commission and CIAP for the most threatened regions in Alaska.**
All Six Communities	**Community Climate Change Mitigation and Relocation Planning** Funding for future relocation planning efforts for each community require coordination and resources both at the community and agency levels. Communities need funding and technical assistance to support/augment local capacities. Rational and collaborative planning needs to examine alternatives (e.g. shoreline	**FY 08 Supplemental** - Initial funding was included in this Budget bill to develop relocation planning resources. IAWG 2009 Policy Recommendations addresses how to identify communities, assess and analyze their mitigation and relocation needs due to impacts likely caused by climate change phenomena.	**FY10 IAWG Budget Recommendation: $300, 000 ($300,000 included in Governor's Capital Budget)**

2009 Immediate Action Funding Recommendations			
Community	**Immediate Actions Identified to Prevent Loss of Life and Infrastructure**	**Past and Future Budget Notes**	**IAWG Action**
	stabilization/protection vs. relocation) and identify the opportunities for implementation. **Cost Effective:** When coordinated, Emergency Preparedness, Community Relocation and other community project planning and project developments have cost-effective results.		
All Six Communities	**Reduce Capital Budget Expenditures** - Through inter-agency and local coordination identify capital cost savings by aligning timing of projects requiring heavy equipment. - State should establish co-sponsorship funding to ensure Alaska attracts federal funds for its priority projects. - Find/develop Western Alaska rock source to reduce costs. **35% Funding Co-Sponsorship:** Based on recommendations from former Senator Stevens at recent roundtables and other meetings.	**Immediate and Near Term Capital Budget Estimates: Former Senator Ted Stevens suggested that the** State should be prepared to match/augment federal funds with a target of 35% of erosion control and mitigation capital costs.[2] This will ensure the highest likelihood that federal funds will be allocated to Alaska, given the competitive nature of these funds.	**2009 - IAWG Reaffirms this recommendation of 35%, or at least at a level that encourages State-Federal partnership funding to protect existing communities and infrastructure from threats by climate related impacts.**

[2] March 24, 2008 Email from P. Opheen, USACE Alaska District: Water Resources Development Act of 1986: the following sections set the basis for the USACE cost sharing policies including in both the Planning Guidance Notebook and the Digest of Water Resources Policies and Authorities. Section 103 mandated cost sharing for construction of flood control and other purposes. Section 104 mandated cost sharing for feasibility studies, and preliminary engineering design (PED). It states in part that (para (a)(1)) "The Secretary shall not initiate any feasibility study for a water resources project after the date of enactment of this act unto; appropriate non-Federal interests agree, by contract to contribute 50 percent of the cost for such study...". It further states in paragraph (b) Planning and Engineering: "The Secretary shall not initiate any planning of engineering authorized by this Act for a water resources project until appropriate non-Federal interest agree, by contract to contribute 50 percent of the cost ...".

Although Senator Stevens has sponsored authorizing legislation to conduct coastal erosion projects for Alaskan Native Villages at 100 percent federal cost the authorization did not change budgetary policy or procedures, or the Administration's policies on mandating cost sharing for Civil Works studies, PED or construction. The budget guidance addresses non-budgetable (policy non-compliant) studies and projects by addressing them in what is known as increment 9 of the budget submission reflecting our capability to perform the work.

2009 Immediate Action Funding Recommendations			
Community	**Immediate Actions Identified to Prevent Loss of Life and Infrastructure**	**Past and Future Budget Notes**	**IAWG Action**
All Six Communities	**Preliminary Engineering and Early Coordination** Funding will allow for preliminary engineering investigations to begin so that project development can move ahead in an orderly, timely, and efficient manner. Site surveys, material source investigations, hazard mapping, geotechnical and hydrologic studies, and environmental documentation and permitting studies will all need to be conducted prior to developing erosion protection or relocation design plans. Because all likely project scenarios will involve extensive environmental documentation and permitting, it is critical that the project development process start as early as possible. Will also allow for early coordination between agencies and affected communities and a review of existing data, reports, and plans.	**FY09 - $600,000 appropriated in Capital Budget to ADOT** USACE, ADOT, HS&EM, DCCED have all identified Shishmaref, Kivalina, Shaktoolik and Unalakleet as of significant risk where - a phased and coordinated approach to project development is needed to ensure infrastructure and community-wide safety.	**FY10 IAWG Budget Recommendation $500,000 ($100,000 included in Governor's Capital Budget)**
All Six Communities – and to Address What will Likely Become a Statewide Need	**Identify and Develop a Data Strategy** to support government, community and business decisions. IAWG 2009 Policy #4 further details its Data Collection and Coordination Strategy originally presented in its 2008 Report.	**IAWG did not provide any budget estimates for this Strategy in FY 09.** **IAWG reaffirms its support for this important element.**	**FY 10 IAWG Budget Recommendation $0** **Some funding for travel for community participants may be useful.**
All Six Communities	**Data Needed to Advance IAWG Recommendations** - Data for developing emergency and other community plans. (EM is familiar with the data needed.) - Horizontal and vertical control data for establishing plans for relocation and evacuation routes based on what flood levels have	IAWG has been working with NOAA and providing input on priorities for data and informational needs in Alaska. Until a Data Strategy (interagency effort) is conducted, identifying and collecting the data needed will likely not be done in a systematic way to ensure projects can move forward as needed.	**Some funds for data collection may be used through the various activities identified in IAWG Recommendations.**

2009 Immediate Action Funding Recommendations			
Community	**Immediate Actions Identified to Prevent Loss of Life and Infrastructure**	**Past and Future Budget Notes**	**IAWG Action**
	historically happened - note there is good horizontal and vertical control data at the Red Dog Port which is directly applicable to Kivalina). - Weather observation stations should be established and tied into the current, closest data collection sites for monitoring weather-related storm data whether from ice jams, seasonal river rise, storms, storm surges or floods. - A template to develop a Continuity of Operations (COOP) Plan is available on DMVA/DHSEM's website - Yukon River Intertribal Watershed Council model may be useful too. - Integrate with Western Communities Evacuation Plan. -Work with NOAA to document ice forecasting requirements, and - To reduce vertical control errors from 2 m to 2 cm.		**IAWG recommends the state work with NOAA to 1) identify suitable locations for tide and water level stations in the IAWG's priority areas (see Appendix B) and 2) develop an viable implementation plan and schedule. These stations should include a meteorological sensor suite.** **IAWG recommends that the state support the appropriation of federal funds to implement the Gravity for the Re-definition of the American Vertical Datum program.**
All Six Communities and to Address Statewide Need	**IAWG Recommendations: Identify and conduct coordinated strategy.** - Through inter-agency and local coordination identify cost savings, such as - Align timing of projects requiring heavy equipment. - State needs to establish a fund to ensure co-sponsorship is available if/when federal funds.	**Described in Recommended Policy 1 and 2**	**No Budget Identified**

2009 Immediate Action Funding Recommendations			
Community	Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	IAWG Action
	- Find/develop Western Alaska rock source to reduce costs. - Local coordination is needed to assist with planning efforts and project alignment. - Local capacity building and augmenting community's administrative capacity is required.		

KIVALINA

Situation Description: Ongoing erosion and flooding concerns have caused problems for a number of years. The recently installed seawall was ineffective at arresting erosion and was severely damaged with sections completely destroyed during the minor storm events of 2006. The USACE has an approved project for 3,300 linear feet of rip rap revetment with a current estimated cost of $26 million. With the recent fluctuations in fuel costs this estimate is still likely low. The USACE constructed 400 ft of revetment in 2008 and plans to construct another 1200 ft in 2009, at a contract cost of $12.5 million. The NW Arctic Borough intends to construct the last 400 ft in 2010. Erosion is threatening the waste storage containment area located at the dump site. This is a potential environmental catastrophe for the surrounding water bodies. It will contaminate the area where subsistence activities are still practiced i.e. fishing and storage of fish on the lagoon side of the island.

Description of Immediate Need: 2000 LF is needed to *provide interim protection* for critical structures and residences on the ocean-side of the island while long-term plans for Kivalina are worked through. Anticipated contract cost is $16M[3]. USACE awarded 1,600 feet of revetment at a cost of $12.5 million (400 ft constructed in 2008 nd 1200 ft to be constructed in 2009). NW Arctic Borough intends to fund construction of the last 400 ft in 2010.

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	IAWG Action
Revetment/Erosion Control Project **Near-term (next 18-24 months):** Construction of 2000 LF linear feet of rip rap revetment with a current estimated cost of $16 M .to protect critical structures and residences on the ocean-side of the island where catastrophic erosion is taking place. **Intermediate-term:** Construction of 1300 LF of rip rap revetment to provide interim protection to critical structures and residences at the lagoon side of the island. Estimated cost is $10 M. Total anticipated revetment project is $26 M. (protection for both ocean-side and lagoon-side of island).	**FY09 - $3.3 million appropriated in Capital Budget, to the NW Arctic Borough** Phase 1: USACE – 400ft built in 2008 and 1200 ft in 2009. Another 400 ft ($3.3 from NWAB) will be built in Summer 2010. Phase 2: Lagoon-side 1300 ft revetment: USACE began design during Winter 2009. Intermediate-term Estimated State Capital Funding needed – $5.8 million.	**FY10 –** **NWAB and USACE will complete Phase 1 with funds appropriated in FY09 timeframe.**

[3] The base bid for the project is $3.9 M for constructing 400 LF of rock revetment, with a total cost of $4.5 million. This contract includes four options to construct 400 LF each at approximately $2.4 million each, if funds are received before Mar 09. A contractor mobilization cost of $375,000 would also be required for the second year of construction.

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	IAWG Action
State of Alaska should serve as 3rd Party Reviewer for geologic aspects of USACE (Relocation) Assessment Reports Alaska DGGS as lead.	**FY09 Budget Estimate:** $12,000[4] DGGS was only able to conduct a preliminary in-house review of USACE reports; full review awaits. (Unable to complete due to staffing levels.)	**Late FY 09/FY10 – IAWG recommends DGGS conduct using CIAP funding already in hand. Hiring freeze will be a hindrance to this action.**
Relocation Feasibility Study Geologic Mapping (Alaska DGGS as lead).	**Budget Estimate:** $180,000	**Late FY09/FY10 - Funding for mapping approved through CIAP funds for 1 or 2 communities only. If hiring freeze lifted, study may begin in 2009.**
Evacuation Road Feasibility Study: NWAB and Denali Commission – leads	DGGS/Geologic Mapping is needed first	

[4] This budget estimate is only for DGGS review of geologic aspects of the USCOE's relocation assessment reports. Broader, full review would involve many more participants and may not be appropriate for DGGS to lead. For review of all aspects, I suggest DCCED take the lead and draw on DGGS as well as other appropriate agencies. A larger budget estimate is needed if this is the intent. (Rod Combellick, DGGS edits to March 20, 2008 draft IAWG Recommendations Report).

KOYUKUK		
Situation Description: There are three types of serious threats/impacts facing Koyukuk –erosion, flooding, and fires. The entire village of Koyukuk lies within the floodplain of the Yukon River. Erosion occurs during anytime the river is open and specifically during high flow events on the Yukon River. These events happen throughout the year, including floods during spring breakup ice jam events; spring/ summer/fall significant rainfall events; wind, and permafrost melt at Koyukuk and upstream. These floods are often severe, inundating a majority of the Village and sometimes requiring evacuation of citizens to other villages. These problems have been persistent and serious enough – often flood warnings provide only a 2 hour window to evacuate – that the community has begun planning efforts to relocate themselves to higher ground above the floodplain of the Yukon River upon nearby Koyukuk Mountain.		
Overarching Problem: No definite timeline or authorities for erosion control and/or relocation makes it difficult to plan for needed erosion control projects and relocation. It's difficult to coordinate and focus resources.		
Immediate Actions Identified to Prevent Loss of Life and Infrastructure	**Past and Future Budget Notes**	**IAWG Action**
FY10 Immediate Action and capital budget recommendation is for DOT/PF to conduct Engineering Studies: reconnaissance study, preliminary engineering and environmental work, and final design for an evacuation road. **Upgrade Existing Road:** Ensure road is passable during flooding. Tribal Administrator believes that riprap along the lower part of the road near the river is all that's needed. Portions of the airport were done in 2006. **Review Feasibility/Options Report:** Koyukuk, DGGS, ADOT/PF, and DCCED should review the USACE Recommendations Report to provide feedback/reality check to the USACE Report was recently provided to Koyukuk community. USACE representatives travel to Koyukuk to meet with community. USACE draft report proposes relocation of the community to higher ground because 11 structures are at risk from erosion and most other structures are in the flood plain. *Regulatory issues identified to allow current community to remain as a fish camp or the like.* **Coordination Among:** Koyukuk, USACE, ADOT/PF, DCCED, DHS&EM for preliminary engineering, planning, and funding strategy.	**FY09 Capital Budget included funding for Feasibility Review.** Coordination and reviews during FY08 & FY09 were covered in FY08, FY08-Supplemental, or FY 09 Capital Budget (with Community Planning grants and DHS&EM Emergency Planning/Training).	**FY10 IAWG Budget Recommendation $800,000 ($400,000 included in Governor's Capital Budget)**

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	IAWG Action
Elevate Current Structures: Koyukuk has identified this action as a means to prevent damage to infrastructure from floods. The community will work through existing organizations, such as Tanana Chiefs Conference, DCRA, AHFC, Interior Housing Authority to seek technical assistance and funding.		Provided Koyukuk with organizations and agencies to contact for assistance.
Build Evacuation/Emergency Center: Ensure Koyukuk has an emergency shelter. Need to address issues in Feasibility Report and identify decisions acceptable to community and funders. **IAWG Comments:** Recommended actions/next steps for the Shelter have been provided to the Community by the USACE in the report identified in Project 2. If Koyukuk wants to move forward with the USACE recommendation, then studies (geological, etc.) need to be conducted to ensure the selected site is satisfactory. A project cooperation agreement will need to be signed between the community and the USACE. Recent experience with similar projects shows this is not a significant effort. A clear process for site assessment, etc. along with a funding strategy will need to be developed. Permitting and environmental coordination is ongoing. No significant issues have arisen for ESA, wetlands, or SHPO, though coordination will continue.	**FY11 or Future Capital Budget: Evacuation Center Construction Estimate:** $4.5 million.	

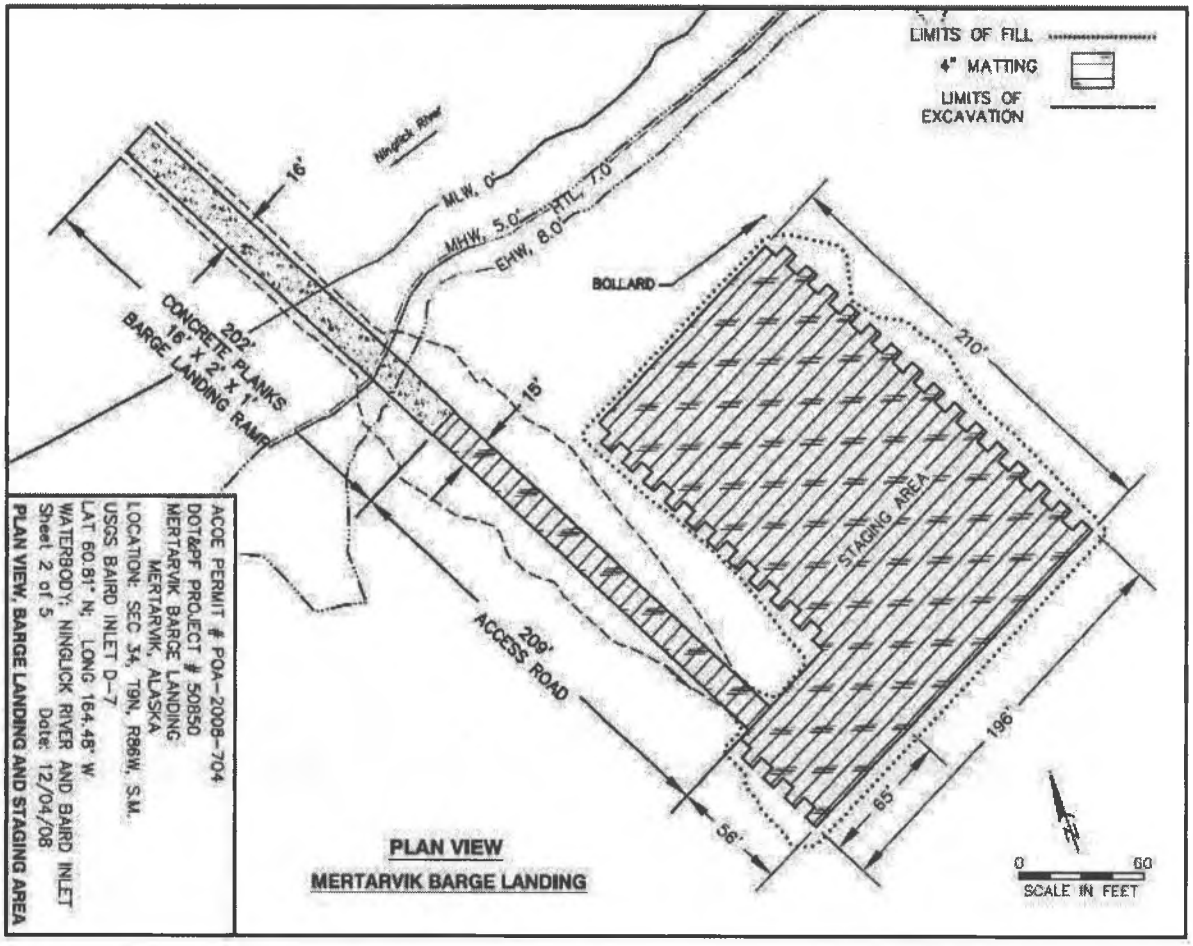
NEWTOK

Situation Description: Newtok facilities – both public and private – have already been severely damaged by erosion and storm surge flooding due to lack of sea ice, and it's anticipated that continued erosion and destruction of public and private facilities are imminent. Problems endemic to many rural Alaska communities, such as a lack of adequate drinking water and sanitary sewage disposal, have been worsened by the erosion and flooding.
Overarching Problem: No definite timeline or authorities for erosion control and/or relocation makes it difficult to plan for needed erosion control projects. It's difficult to coordinate and focus resources without funding sources and timeline.

USACE Status: Designs are underway for the road from the barge landing to the evacuation center at the new town site for Newtok. USACE does not currently have funding to construct the road, which is estimated at $15 million.

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	IAWG Action
Build Staging Area for Barge Landing – Ensure ability to receive supplies. **FY 10 Capital Budget** of $2mm will develop material site and produce rock for **construction of barge staging area, evacuation center road**, and IRT camp facility construction staging area. Construction will be completed through an Innovative Readiness Training exercise, estimated at $3.5-$5 Million, beginning in summer 2009. In the 2009 construction season the barge landing and staging area will be completed at the Mertarvik site. A **fuel distribution header and pipe** will be built at the Newtok existing town site that will allow for barges to offload fuel to supply fuel for electrical generation. In 2009 the Innovative Readiness Training program in the Department of Defense has agreed to begin development of the Mertarvik site as a military training exercise. U.S. Navy has located an office at ADEC to coordinate this project. **Build Road to Evacuation Site** – Ensure community has access to shelter (1.5 miles). **Build Evacuation Center/Shelter** – Ensure community has an emergency shelter (approx 4,000 sq ft + 2,000 sq ft equipment shelter).	**FY09 Capital Budget includes partial funding to DOT&PF combined with an $800k EDA grant to complete barge landing and staging area at Mertarvik by July 15, 2009.** IRT Road project will be worked on from July 15-Sept. 1, 2009 with Newtok Project as its national top project. CCHRC design of evacuation shelter significantly reduced costs. FY08 Supplemental Capital Budget included $279,000 coordination and planning funds for staging, landing, road and shelter. **Coordination Among** Newtok, USACE, ADOT/PF, DCCED, and the Newtok Planning Group have determined what road standards are needed and how to leverage resources to build the road and shelter. USACE and Newtok Tribal Council entered into a Project Partnering Agreement in Jan 09. Coordination was expanded to Navy in FY2009 and it was determined that building the Evacuation Shelter	**FY10 IAWG Budget Recommendation: $2,000,000 (included in Governor's Capital Budget- and will leverage Federal IRT funding of $3.5-$5 million.)** **FY 11 funding recommendation: $5 million to develop quarry for materials use by IRT**

	can be used as a training exercise for IRT. ADEC-Village Safe Water completed new well at current site.	
Airport Planning - Step 1 – Site Selection ADOT/PF recently received approval for a second year of wind and geotechnical studies by FAA. Four runway alternatives are being studied. Selection of a preferred alternative is expected by spring 2009.	**IAWG Comment:** Scenarios should be identified for a new airport with various functionalities that can then be reflected in different cost structures.	



Conceptual design of Mertarvik Barge Landing and Staging Area. ADOT/PF

SHAKTOOLIK		
Situation Description: The community is vulnerable to erosion when fall storms hit the sand and gravel spit upon which the community resides. There is no breakwater to protect the community from destructive waves from Norton Sound when storms come from the southwest. In severe storms, the community becomes an island. The beaches have historically been susceptible to damage and erosion from storm conditions, tidal surges, and from the sea ice conditions. Logs that float down the Yukon change from being protective to becoming destructive during storms surges. Several areas along the coastline used by the people in Shaktoolik are vulnerable to erosion and flooding during the storm season Over the past three floods natural barriers have eroded substantially. **Overarching Problem:** No definite timeline or authorities for erosion control and/or relocation makes it difficult to plan for needed erosion control projects and relocation. It's difficult to coordinate and focus resources.		
Immediate Actions Identified to Prevent Loss of Life and Infrastructure	**Past and Future Budget Notes**	**IAWG Action**
Preliminary Relocation Site Assessment for relocating village. **Corps Section 103 Storm Damage Reduction Study** Initiated and progressing to evaluate protection of strategic locations in the community and the water supply. **Evacuation Road – Approx 8.5 miles** **Step 1:** FY 09: Reconnaissance Study, funded by Denali Commission (completed) **Step 2:** FY 10: Road Design and Engineering The recon study is adequate to begin the permit process for coastal engineering. **Step 3:** Unknown timing for Construction **Coordination Among Shaktoolik, Kawerak, Federal, and State Agencies:** Funding, design, etc.	FY08 Supplemental included funds (estimate is $150,000) for preliminary relocation site assessment. (DCRA Community Planning Grant – in 2009.) Land Exchange (12a) for identified relocation site is needed. Local Community, Village Corporation, and Regional (Kawerak) are working on this. GPS coordinates identified in 2008. **Road Budget Estimate:** Reconnaissance Study estimates road design at $3mm. Current commitments from Denali Commission for $1mm, Kawerak for $1mm, and BIA- IRR $500k pending, high priority projects. Shaktoolik/Kawerak are requesting State for $500k "match". Funding should be pursued and coordinated to develop both the permits and road design, concurrently.	**FY 10 IAWG Recommendation: $500k from state to leverage other funding for design of Shaktoolik relocation road. (Not in Governor's Capital Budget)** **Village of Shaktoolik needs to request Congress it be added to the Alaska Coastal Erosion Program under authority of Section 117.** **Examine shorter term solution of constructing evacuation shelter in existing community to allow safe shelter in case of flooding.**
Hazard Mapping Study Geologic Mapping (Alaska DGGS as lead)	**DGGS Budget Estimate:** $180,000 **USACE CAP limit:** $3 million Federal with 35 % local match required for construction. Current funds: $70,000 available for study.	**FY10 IAWG Recommendation: ~$180,000 DGGS will only be able to study 1 or 2 communities in 2009 due to funding. Hiring Freeze is a hurdle.**
Cabins and 30kw Generator Shaktoolik identified that Cabins built for emergency use.	Community is moving forward with this project for emergency housing along new Evacuation Road route.	

SHISHMAREF

Situation Description: Shishmaref has been threatened by erosion for many years with recent increases due to the lack of sea ice during the fall storm season. A partially completed USACE project is providing protection for portions of the shoreline.

USACE Description of Need: The washeteria and lagoon are not protected, but 750 LF is under contract by USACE to install by Oct 09. The length was determined by funds availability. USACE anticipates the contractor will mobilize for the Summer 2009 to complete that segment. This increment of rock revetment was awarded for $10.5 million for construction cost, which would protect homes and a church. Another 550 feet of rock revetment for the northeastern area is under design and needed to protect the washeteria and the sewage lagoon at an estimated cost of $7.75mm – funding is still needed. Revetment needs to be extended for the protection of the southern end of the Village by 325 ft and raise the other 900 existing ft – funding is needed.

Overarching Problem: No definite timeline or authorities for erosion control and/or relocation makes it difficult to plan for needed erosion control projects. It's difficult to coordinate and focus resources without funding sources and timeline.

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	Action Taken
Funding Strategy Coordination: Shishmaref, USACE, ADOT/PF, and DCCED **<u>Revetment/Beach Erosion Control Project</u>** **Phase 1: 600 feet of rock revetment completed in Sep 08.** **Phase 2: 750 feet of rock revetment under contract to be completed by Oct 09.** **Phase 3: 550 feet of rock revetment under design in 2009; construction funding needed.** **Phase 4: 1,225 feet to be surveyed in 2009; of this 325 feet will be new rock revetment and 900 feet will be raising existing revetments when funding is provided.** 750 ft section will provide protection to the North shore including the washeteria and sewage lagoon. USACE construction contract: $10.5 million for 750 ft.; $25 million for remaining project. **FY10 State/Federal Coordination:** USACE will provide revetment design (at a cost of $500k) for Phase 3 of erosion control revetments. State may provide $3 million for construction.	**For FY08 & FY09:** Coordination covered in current and/or FY08 Supplemental. **As of April 2008: FY10 and FY11 Recommendation for Capital Budget** (Estimate) was $8.5 million or 35% of $25 million based on USACE estimates for revetment/erosion protection funding. USACE secured funding in 2008 Federal Supplemental.	**FY 10 IAWG Recommendation: $3 million (included in Governor's Capital Budget) and leverages USACE funding)** **The State identified $3 million was needed to complete the additional 550 feet of Oceanside rock revetment to protect the northeastern edge of Shishmaref, including the sewage lagoon and washeteria.**

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	Action Taken
Relocation Planning – Road, Geologic Site, Airport and Port Site Master Plan, Community Planning **Relocation Road Reconnaissance Assessment** ($500k for assessment - Road from mainland) **Lead:** ADOT/PF and Shishmaref **Shishmaref Relocation Feasibility Study** Tin Creek has been identified as the Community's choice, but without Feasibility Study, a decision can't be made whether it is a satisfactory relocation site. **Community Relocation Planning** – Funded in 08/09 continuing effort **New Airport Master Plan and Site Location for Port**	**Community Comment:** Potential Gravel Haul Road to new Airport. Geotech data (being done Mar-April 2008). The USACE has been approved to perform a feasibility study at full Federal expense to analyze the relocation options for the community of Shishmaref. No funds are currently available. NRCS did some site identification previously. *Environmental studies were initiated for a programmatic EIS of community relocation with limited funding.* **IAWG Comments:** **Scenarios Needed** for A/P and Port should be identified for a new airport with various functionalities that can then be reflected in different cost structures. **Coordination Needed:** Shishmaref – city, tribe school, DCCED/DCRA USACE, ADOT/PF Having local capacity and a coordinator is needed to assist with these planning efforts and projects at the local level – capacity and administrative capacity building. **Completion Date:** Dates can't be determined until funding source identified/authorized.	**IAWG recommends community meetings and joint collaboration with state and federal agencies that can bring resources in terms of technical capability and funding to support these efforts.**

UNALAKLEET

Situation Description: Unalakleet is susceptible to erosion damages along various locations in the community. Particularly along an NRCS gabion revetment that has been damaged by storms. The recommended project is a 1,500 foot long rock revetment which would be constructed along the alignment of the existing NRCS gabion basket revetment. The NRCS project would be removed or covered by the USACE project. $20-30 million is the most current estimate available. Another threat is the logs that float down the Yukon, in that they change from being protective to becoming destructive during storms surges.

USACE Status: Design for 1500 ft of rock revetment is complete and is being advertised for construction and proposals due by Feb 20, 2009.

Overarching Problem: No definite timeline or authorities for erosion control and /or relocation makes it difficult to plan for needed erosion control projects. Difficult to coordinate and focus resources without funding sources and timeline.

Immediate Actions Identified to Prevent Loss of Life and Infrastructure	Past and Future Budget Notes	Action Taken
USACE has completed design work and is evaluating contractor proposals for a construction contract. Construction is scheduled for completion in 2010 if sufficient funds are available. **FY10 Unalakleet identified the opportunity to move Old School Gym to higher ground for use as an Emergency Shelter. –** Assessing sites for higher ground evacuation identified as immediate need in 2008 along with design and location of evacuation road (and shelter). **Gym Move Capital Budget Estimate is $1mm** Cost estimates were identified after Governor's Budget was submitted to Legislature.	**FY 09 Capital Budget funding of $5mm obtained for revetment and erosion control project and leveraged USACE funds from Congressional Supplemental** (35% of $13.5 million project), and coordinate this project with ADOT/PF's 2008 Airport Erosion control project. Construction completed in 2010 if sufficient funds available. 2008 funding was critical if take advantage of heavy equipment in 2009 season that will already be in place for ADOT/PF – Airport projects. Estimated cost savings: Based on discussions throughout the IAWG process, cost savings could be substantial if the same heavy equipment is used for multiple projects, thereby minimizing mobilization/demobilization costs. Based on input from ADOT/PF and USACE, the most effective means to achieve cost savings will be to synchronize state and federal projects so they can be jointly advertised but awarded separately. Local Street Projects cost benefits using equip while in place – forego additional mob/de-mobilization costs.	**IAWG Recommendation: Need funding strategy to ensure erosion/revetment project is done in 2009/2010. (Unalakleet/DCCED/USACE.)** **FY10 IAWG recommendation: Community should pursue funding for Gym Move with the Legislature and Alaska Delegation. Estimated budget is $1million**

POLICIES

Strategic and Community Assistance Recommendation Policies

Last year, the IAWG recommended policies to advance comprehensive integrated planning and a comprehensive statewide data collection and evaluation system. In this 2009 report, we carry those recommendations forward as Policy Recommendations 3 & 4, and include additional detail to them, which the IAWG believes will help to effectively initiate and implement those policies.

IAWG adds two new policy recommendations, and because they are more strategic and overarching in nature, those policies are identified as Policies 1 & 2. Policy 1 addresses how Alaska could create an integrated system of information, analysis and evaluation to make cost-effective decisions on public infrastructure, and Policy 2 addresses the role of the Immediate Action Workgroup and helps to advance Policy 1.

IAWG's policy recommendations, for which the justification is further detailed in Appendix A, are described in this section. The IAWG has created working relationships that can help to advance these recommendations in a meaningful and cost-effective manner, which is why the IAWG is *recommending that the Subcabinet refer the next steps to advance these policies back to the IAWG.*

One of the anticipated outcomes of the IAWG's 2009 efforts was to identify the "next six" communities in need of immediate action, due to impacts from climate change phenomena.

Climate change phenomena have been identified as:

- Lack of sea ice
- Change in extent of sea ice
- Timing of sea ice
- Increased effects of storm surges unbuffered by shorefast ice
- Erosion due to flooding or permafrost melt
- Flooding
- Permafrost melt
- Wild fires

The various IAWG participating agencies were able to identify over 150 communities of concern based on their mission-specific programs. ***However, not one agency had analyzed their actions, nor responded to community needs based on climate change.***

Based on the IAWG's 2009 efforts where we brought together information and data from various agencies to identify the next six communities in need of immediate action, we found:

- There is no consistency in criteria, timeline, weighting, data acquisition technique or analysis to determine if impacts are from climate change.
- No framework exists for the comprehensive identification, analysis, and dissemination of current data or the methodical acquisition of new research to support new policy options.
- Without new policy options state and federal agencies are severely limited in their ability to integrate or identify data, research, programs or projects necessary to mitigate or prevent impacts to communities.
- We were unable to, with confidence, identify the next six communities for immediate action.

- Many state and federal agencies and academia are researching potential projects, programs and research efforts to assist communities that are impacted, or potentially impacted by climate change phenomena. However, each agency is working from differing sets of assumptions, approaches and timelines.

- State and federal agencies are severely limited by this lack of integration for data, research, and program or project development.

- This environment of uncertainly increases the risk of many communities of facing extreme risks from the unknown effects of natural disasters.

- The traditional "stove-piped" approach of creating and managing government programs ensures a narrow, myopic view of community needs and places the individual programs in competition for approval and funding.

- This segregated approach increases the uncertainty of funding but decreases the potential for meaningful and comprehensive assistance.

- The State of Alaska, just as the federal government, plans for and manages programs primarily through individual departments. The priorities are set usually during budget formulation for the next budget cycle. However, many capital projects need years of planning for engineering study and design and for the identification of federal funding. These funding decisions occur for each individual agency and often are without consideration of other state or federal projects that may be in potential conflict for the same community or region.

From these findings, the IAWG recommends:

- **An integrated, multi-agency and inter-governmental approach to effectively identify and address the needs of communities that are potentially in peril.**

The outcome and benefit of this integrated approach has:

- Significant potential to save money on public infrastructure, avoid costly delays, save funds through economies of scale and combining mobilization, mitigate the effects and costs of disaster relief and recovery.

POLICY 1: ESTABLISH A STATEWIDE SYSTEM TO DOCUMENT, ASSESS, AND ANALYZE CURRENT AND PLANNED PUBLIC INFRASTRUCTURE IN ORDER TO PROTECT EXISTING AND FUTURE INVESTMENTS AND PREVENT THREATS TO LIFE IN AN UNCERTAIN ENVIRONMENT

The Immediate Action Workgroup offers a model for a statewide system that integrates information from all state departments, local entities, and federal agencies on current and planned public infrastructure and capital projects in communities currently or potentially affected by climate change. This system will enable a more rapid identification of community needs and vulnerabilities, and more informed decisions on the future repair, retrofit, replacement, or relocation of critical infrastructure. Further, the IAWG believes, this statewide system will create a more cost-effective means to make decisions about public infrastructure needed to ensure community safety and economic viability.

1) **A statewide system to make timely and cost effective decisions for both the public and private sectors must include:**
    a. Identifying all data on public and critical infrastructure from:
        i. State agencies
        ii. Federal agencies
        iii. Denali Commission
        iv. Local governmental entities, including tribal entities
        v. Non-governmental organizations
        vi. Private sector
        vii. Academia
    b. Consolidating and linking together data to:
        i. Enable queries for agencies and communities
        ii. Improve quality of data and databases
    c. Analyzing data to:
        i. Identify and fill gaps in data
        ii. Determine status and capability of current infrastructure
        iii. Determine useful life and future plans for repair, renovate, retrofit, replacement, or relocation
        iv. Determine vulnerabilities to climate/weather and other environmental/economic factors
        v. Identify all funding and budget streams
        vi. Identify conflicts between agency plans
        vii. Resolve conflicts for timely implementation
    d. Integrating policy to:
        i. Improve policy coordination between agencies – timing, impacts, integration
        ii. Determine effects of proposed policies
        iii. Test assumptions of climate, economic trends and strategic directions
        iv. Determine effects of non-state policies and budgets
        v. Update analyses for new data information
            1. Weather patterns/flood plains/mapping
            2. Economic assumptions
            3. Changes in demographics
        vi. Document out-year O&M costs
        vii. Calculate life cycle costs
        viii. Contribute data to budget formulation

2) **A statewide system to make timely and cost effective decisions for both the public and private sectors must be based on a collaborative decision making model that consistently includes:**
    a. Key stakeholders
    b. Identified timelines and outcomes
    c. Streamlined process to minimize unnecessary effort and transaction costs of developing and carrying out the statewide system

3) **A statewide system to make timely and cost effective decisions for both the public and private sectors must be based on an organizational structure that likely possesses the following characteristics:**
    a. Executive order to establish and create structure
    b. Senior State Executive as manager
    c. Small staff

d. Non-centralized and non-bureaucratic system
e. Implementation (planning and building capital projects) is through existing agencies/authorities
f. Monitor to make sure things progress in proper order
g. Identify and integrate new opportunities, such as the likelihood of cap and trade
h. Identify and integrate old challenges, such as timely processing of permits and integrating sustainability into communities and economies in remote Villages

Rationale:

- The number of communities potentially impacted by climate change phenomena is growing
- The locations of these communities are spread across the entire state of Alaska.
- The ability to identify which community or piece of infrastructure is most at risk cannot effectively be done given current procedures that are not linked and coordinated.
- Coordinating and linking procedures, organizational structures and leveraging budgets will be most effective if a collaborative approach is used to identify, assess, and make and implement decisions.

Implementation – Initial Steps

IAWG Recommended Action to Subcabinet: Adopt Policy 1 and provide the IAWG with guidance to develop implementation options for this policy. At a minimum the guidance should instruct that options should include identifying benefits, challenges, and effective organizational structures for implementation. This integrated system will create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance should also include melding the relevant Adaptation and Mitigation Advisory Groups' products with this statewide system to reach a desired outcome of integrated actions in order to address what seems to be increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective statewide system.

POLICY 2:	**SUNSET THE IMMEDIATE ACTION WORKGROUP AND DIRECT THE RELEVANT STATE AGENCIES TO ESTABLISH AN INTERAGENCY COLLABORATIVE WITH EACH OTHER, ALONG WITH RELEVANT FEDERAL AGENCIES AND COMMUNITIES. THIS COLLABORATION REQUIRES REGULARLY SCHEDULED MEETINGS TO COORDINATE INFORMATION, PLANNING, EVALUATION AND DECISIONS ON PUBLIC INFRASTRUCTURE FOR THOSE COMMUNITIES IMPACTED BY CLIMATE CHANGE PHENOMENA.**

The Immediate Action Workgroup believes that the outcomes and results of its ad hoc collaborative efforts over the past year have been exceedingly useful and should be integrated into agencies' operational efforts. This policy recommendation should be viewed as an interim step to implementing Policy 1 above. Once Policy 1 is established as a strategic operational mechanism, then the IAWG should be integrated, reformulated or discontinued, depending on the structure and needs of the statewide system.

Implementation – Initial Steps

IAWG Recommended Action to Subcabinet: Adopt Policy 2 and provide the IAWG with guidance to develop options to accommodate the transition described in Policy 2. At a minimum the guidance should instruct that options include identifying benefits, challenges, and effective organizational structures for implementation. This precursor to an integrated system will set the framework to create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance to the IAWG should also include melding the relevant Adaptation and Mitigation Advisory Groups' products into options for Policy 2. This would be in an effort to reach the desired outcome of taking integrated actions to address the increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective interagency collaborative while a statewide integrated system is being established.

POLICY 3: ASSISTANCE TO COMMUNITIES IN PERIL MUST UTILIZE COMPREHENSIVE INTEGRATED PLANNING AND VIABLE, FUTURE-ORIENTED SOLUTIONS WITH FUNDING THAT ALLOWS FOR SUSTAINABILITY WHETHER THE COMMUNITY REMAINS IN PLACE, USES A MIGRATION STRATEGY OR NEEDS TO RELOCATE.

The Immediate Action Workgroup believes that comprehensive integrated planning must be used to develop and implement solutions for communities in peril. The planning process must integrate the expertise and resources available from many state and federal agencies working with community and regional stakeholders. Flexible funding streams should be sought; and may need to be created, to accommodate the needs associated with preserving the options available for protecting public infrastructure and preventing loss of life. These options range from staying in a community's current location, to a migration strategy, to full relocation. All of these options should integrate the concepts of sustainability into the design, location, and attributes of projects, and if relocating, into future settlements. Existing and new funding mechanisms for responding to climate change hazards should also provide for adaptation and mitigation measures. In seeking funds for adaptation and mitigation, an examination of current federal and State statutes needs to be conducted to identify limitations in addressing these measures. The Stafford Act, for example, limits the ability of the State to deal effectively with communities in peril.

Implementation – Initial Steps

- **IAWG Recommended Action to Subcabinet:** Adopt Policy 3 and include guidance to the IAWG to develop more detailed implementation options in coordination with the appropriate stakeholders

Five major actions are necessary to address and advance assistance to communities in peril. Each of the five includes a description of the action, rationale and implementation steps for each action.

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1) **Comprehensive Integrated Planning must include:**
   a. Suite of Community Emergency Planning Efforts.
      i. Community Evacuation Plans.
      ii. Community Emergency Operation Plans.
      iii. Hazard Mapping, Hazard Analysis, and Mitigation Plans.

iv. Preparedness Activities to include outreach, training, and exercises.

b. Community Wildfire Protection Plans for communities at significant risk of wildfire.

c. Expansion of Comprehensive Community Plans to encompass strategic options to address and mitigate climate change impacts of stay in place, migrate and if necessary, relocation

d. Community-based decision making approach will ensure continued focus to achieve the necessary end result.

e. Local, Regional, Tribal, State, and Federal partnerships.

f. Strategies that address incorporated and unincorporated community eligibility for the National Flood Insurance Program (NFIP), which likely require statutory changes by the State of Alaska.

g. Enhancement and expansion of DCCED/DCRA's partnership with the Alaska Coastal Management Program (ACMP) to enable more effective assistance to the communities in peril and at significant risk.

h. A strategy to consolidate various programmatic and grant reporting requirements into a single format that reinforces comprehensive integrated planning.

i. A strategy to collect and utilize needed data and to develop data where gaps exist, including sustainability principles and strategies. (See Policy 2).

Implementation actions:

- Inclusion of native villages, tribal governments, and other land owners in collaboration with agencies during the planning process provides a wide range of benefits from broad-based community support and commitment to specifics such as land relocation issues. Communities take the lead and receive significant support from state and federal entities.
- Ease the administrative burden on remote communities by establishing a shared web-based system as an initial step toward consolidating program and grant reporting requirements into a single format.
- Identify coordinating and participating agencies and develop necessary Memoranda of Agreement (MOAs).

Rationale:

➢ Comprehensive planning has multiple benefits identified throughout this document. Comprehensive planning increases the ability to address complicated land exchanges involving multiple parties with permitting such as complying with NEPA requirements. NEPA requires the review of the effects of all federal, federally-assisted, and federally-licensed actions at any proposed new village site, including, but not limited to: Estate permits, endangered species, coastal consistency, essential fish habitat, and a host of other regulations and requirements recognizing agencies with funding or potential projects. Increased collaboration should focus on solutions such as a Programmatic EIS that can be developed which addresses many of the general issues involved in a proposed relocation. Once a lead agency is identified for NEPA some of the challenges the lead federal agency may encounter include, and can be most effectively addressed through coordination and cooperation, are:

- Identification of coordinating and participating agencies and development of necessary Memoranda of Agreement (MOAs).
- Identification of funding to undertake a NEPA analysis if such funding is not in the current project budget.

- Waiting for a disaster event that forces relocation will result in unnecessary risks to life/safety and extraordinarily complex response/relocation/recovery.
- Foundational plans (flood plain mapping, orthographic and geologic mapping, hazard mitigation planning, community and regional emergency and evacuation plans) are critical building blocks for comprehensive community relocation planning. Only through integration of these plans can we characterize possible relocation sites, identify hazards, and locate potential construction materials resources
- Adoption of a formal State Hazard Mitigation Program integrated with federal hazard mitigation programs would help protect current investments in communities and preserve the options during the decision making process for possible relocation.
- Preparedness activities provide opportunities for communities to test and modify plans in non-emergency situations.
- A Comprehensive Community Relocation Plan is essential to informed planning for communities in peril and is anticipated to significantly reduce costs compared to disaster-related response costs coupled with non-comprehensive approaches to mitigation and relocation.
- The full costs of not relocating a community in peril, e.g. erosion control at a current site and repair/replacement of essential public facilities should be considered when developing relocation policies and priorities. This analysis should also review projected costs based on different timeframes to relocate. This can provide policy makers as well as taxpayers better information from which to consider cost effective alternative.
- Unincorporated communities are not currently eligible for the National Flood Insurance Program (NFIP) and the State must address this issue. Under existing statutes, the Legislature has responsibility for land-use issues for unincorporated areas of the state. Therefore DCCED and the Department of Public Safety, Division of Fire and Life Safety should develop recommendations and implementation strategies for the Legislature to consider, that addresses incorporated and unincorporated community eligibility in the NFIP.
- Imperiled communities are overwhelmed with the level of paperwork and documentation required by various agencies for grant and regulatory and other compliance. Alaska's small remote villages have the capability but lack the staff to handle this onerous documentation and reporting requirement for each funding stream.. It would greatly help viability and functionality of a remote village if funding agencies could, wherever possible, collaborate and provide integrated report/documentation that could serve the purpose of all funding agencies.
- Obtaining and administering government funds can be a challenge for small communities. Local capacity limitations place many rural communities at a competitive funding disadvantage. Because there is no dedicated funding source for erosion and/or relocation, imminently threatened communities must rely upon existing programs to meet erosion/relocation needs, yet few have the expertise to identify, write, secure and administer grants.

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2) **Flexible Funding Streams must accomplish**:

a. Analysis of projected costs of all viable relocation alternatives, including the costs of remaining in place

b. Emergency, hazardous and evacuation plans for communities in peril to prevent loss of life when a natural disaster occurs

c. A means of prioritizing project funding from many sources for many communities for the most effective results. This includes providing capacity building opportunities in communities by funding local training or consulting efforts, where needs have been identified.

d. State funding to attract federal funds.

e. Sufficient full-time employee positions for state agencies taking a lead or participative role to address expanded agency functions.

Implementation Actions:

- Develop investment guidelines and priorities to address critical infrastructure for communities-in-peril. Guidelines should include an assessment to identify critical needs, similar to the DCCED RUBA program. Guidelines must consider the need to swiftly respond to emerging changes in climate, hazards, and research.
- State appropriations must be synchronized with federal appropriations to better position our coastal erosion needs in the federal process. State appropriations should be distributed through a grant process consistent with the Policy recommendation in paragraph 3. DCCED should be the coordinating agency. Distribution of funds the first year will come with a requirement to identify the Immediate Actions scope, schedule and budget prior to the release of funds for any construction contracts.
- Identify funding to undertake a NEPA analysis if such funding is not in the current project budget. Funding sources, such as through AHFC, encompass new construction but not funds to rehabilitate a damaged structure or one that needs to be moved out of imminent danger, even when the costs of doing so may be substantially less than replacement (e.g., less than $20,000 to save a home). A funding mechanism is needed to stage structures, to stabilize and move infrastructure in imminent danger before the damage is inflicted. Identifying secondary and preventative protections can be accomplished through agency coordination with the community. However, specific assessment tools are lacking as are the entities most appropriate to apply them. These must be identified and applied in a coordinated and site specific effort. The tool(s) should identify at-risk facilities appropriate to move and the means to decide on exact relocation measures – how to move, where to move, whether to elevate or relocate away from threat.
    - Roles and Responsibilities: Each responsible agency must identify barriers to making coordinated decisions on infrastructure investments in threatened and newly designated communities (relocation sites). This process should identify needs to revise existing policies, statutes, and regulations or to create new ones to effectively address communities-in-peril and optimize the current community efforts to keep moving forward in the process.
    - Community in Peril: Newtok finds itself in a Catch-22, or a no-win, situation. Plans to relocate, combined with the imminent threat of flooding and erosion, has rendered Newtok ineligible for capital funding for improvements to existing infrastructure (e.g., water and sewer, bulk fuel tanks, power plant, and clinic) to meet needs at the current village until the relocation is complete or substantially complete. The ability to divert designated resources to the new village site is hampered by policies that create barriers to investment in non-existent communities.
- Any upgraded facilities or new facilities must be protected against imminent environmental threats, such as flooding and erosion, consistent with Administrative Order No. 175.

Rationale:

- Current funding streams neither require nor enable comprehensive analysis of comparative costs, of critical path for construction, or identifying potential conflicts with other projects..
- This long-term problem cannot be addressed with short-term personnel.
- Recent changes to Section 117 of the Consolidated Appropriations Act of 2005, PL 108-447, Division C - Energy and Water Development Appropriations Act, 2005, were intended to streamline the ability of the Secretary of the Army to react to situations in Alaska, but the change only reduced the 15 year cycle to a 2 year cycle. This act states in part as follows:
  "SEC. 117. Notwithstanding any other provision of law, the Secretary of the Army is authorized to carry out, at full Federal expense, structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska, including relocation of affected communities and construction of replacement facilities." However, even with this streamlined authority, without state appropriations federal funds alone will likely not be made at a level to meet immediate needs.
- AO224 potentially presents investment barriers for possible new locations sites. Other standards and requirements also present barriers to investment in new developing communities. For example, ADOT/PF policy suggests that emerging communities have a minimum of twenty-five residents, a post office, and a school before a project will be considered by the Project Evaluation Board. In addition, there is a minimum population requirement of twenty-five children for construction of a new school. Under these guidelines, the deferment of infrastructure investment can be expected to create hardships on relocating communities. Because village relocation is likely to be an incremental process, there will be populations at both locations (the current village and the new village site) and needs must be met concurrently.
- If a disaster affects any community in peril before it is improved or relocated, there is a serious risk to safety of life. Also there will be extraordinarily costs for response and recovery. Further, the state and federal disaster statutes require that all other possibilities be exhausted before relocation is considered.

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3) **Formulate a strategy to implement the Sustainable Community Relocation policy.** The strategy must define the process for addressing the specific needs of a community and the broader needs of a region. Specifically, the strategy must result in a work plan based on principles of sustainability and articulate cooperative working relationships through the specific assignment of roles and responsibilities across agencies, communities, and others along with resources, data and other information needs.

   a. DCCED will serve as the overall coordinating agency to formulate and implement the strategy.
   b. DMVA will serve as the lead agency for the Suite of Community Emergency Planning Efforts.
   c. DNR will serve as the lead agency for Community Wildfire Protection Plans.
   d. DNR will serve as the lead agency for geologic mapping and geologic hazards evaluation.
   e. DCCED will serve as the coordinating agency for the Expansion of Comprehensive Community Plans to encompass Relocation.
   f. DCCED will serve as the coordinating agency to develop and coordinate mechanisms that support community-based decision making.
   g. DCCED will serve as the coordinating agency for coordinating and formalizing Local/Regional, Tribal, State, and Federal partnerships.
   h. DCCED and the Department of Public Safety, Division of Fire and Life Safety will serve as the coordinating agencies to develop recommendations and implementation strategies that address incorporated and unincorporated community eligibility in the National Flood Insurance Program.

Implementation actions:

- Utilize Denali Commission or similar MOU methodology to help address needed collaboration.
- Relocation sustainability community principles shall include:
  - Economic viability including:
    - Renewable / alternative energy technologies, green building design and land use planning
    - Guidelines for ensuring sustainability, including ICLEI Global Sustainability principals and cultural sustainability
    - Guidelines for prioritizing strategies and associated funding streams for erosion and relocation, including mitigation and the alleviation of hazards in proposed location
- Develop a clearing house type function, including planning and technical assistance that will help jump start the process.

Rationale:

- Wherever possible, existing strategies and plans should be used after examination and determined to be effective in the uncertain environment of climate change. Immediately begin a coordinated system to identify potential resources and actions. Through regular meetings of government agencies and stakeholders, we can confidently identify, update deconflict, and integrate projects and funding sources from federal, state and regional/local sources to effectively address the most vulnerable needs. The IAWG recommends using as a model the Denali Commission's MOU process for this process.
- The IAWG believes that DCCED should be the lead coordinating agency for relocation assistance. This is consistent with the current authority of DCCED While there is no formally designated state lead on coordinating relocation assistance, there is considerable authority for a state lead to coordinate ongoing activities and policies on specific hazards such as erosion. This authority has been vested in DCCED through:
  - administrative Order 175,which designates the former Department of Community & Regional Affairs (now DCCED) to be the State's lead on coordinating capital investments where there is a potential for flood and erosion damage.
  - AO231 and AO239 both direct DCCED to be the State's coordinating agency to propose long-term solutions to on-going erosion issues.

  Other authorities identify DCCED as the State's lead coordinating agency:
  - DCCED's Division of Community and Regional Affairs is the State agency, which Article 10, Section 14 of the Alaska Constitution mandates be "...established by law in the executive branch of the state government to advise and assist local governments."
  - DCCED serves as the Governor's appointed state coordinating agency for the National Flood Insurance Program and the Flood Mitigation Assistance Program (Alaska Administrative Order No. 175).
  - DCCED has statutory mandates for Planning Assistance for Development and Maintenance of District Coastal Management Plans (AS 44.33.781. This authority directs DCCED to provide a program of research, training and technical assistance to coastal resource districts within the Alaska Coastal Management Program (ACMP).

- Enhancement and expansion of DCCED/DCRA's partnership with the Alaska Coastal Management Program (ACMP) will enable more effective assistance to those communities in peril and at significant risk due to erosion. Most of the communities currently identified as communities in peril are coastal communities.

➢ It is appropriate to broaden DCCED planning roles to include the process of examining the need for, deciding on, and coordination relocation. As the lead agency, DCCED will assist the community (or community efforts) by providing guidance on where to get assistance, how to access resources, and to bring all the players together – which by working together the agencies and communities will then leverage resources for emergency preparedness, community infrastructure – including housing, education, health, environmental and related needs. Designating a lead coordinating agency does not preclude each agency from using its authorities and expertise and moving its projects forward for which it is responsible.

➢ A Relocation policy will provide non-profit organizations and NGO's such as Engineers Without Borders a better sense of how they can play an effective role and augment resources.

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4) **Develop statutes for Statewide Programs, with dedicated funding assurances, to mitigate hazards to enhance community viability and sustainability.**

a. Statewide Hazards Analysis and Risk Mitigation Program through DMVA
b. Statewide collection of field data on hazards in priority areas lacking information through DNR
c. Statewide Vulnerability Assessment Program through DMVA

Implementation actions:

- DMVA shall develop recommendations for a Statewide Program to proactively address mitigation hazards that is not contingent, directly or indirectly, on the declaration of a federal disaster upon which current funding streams are based.
- Identify local rock and gravel sources for western Alaska communities in peril that will support infrastructure construction at relocation sites.

Rationale:

➢ Well-formulated state statutes will provide clear guidance and support, with associated funding, for ongoing, comprehensive programs. The recent federal funding trend of pre-designating funds for various states has reduced the amount of funds available to states, thus increasing the competitiveness for such funds and decreasing the likelihood of receiving any significant needed mitigation funding.

➢ Identification of local sources for rock and gravel is integral to any relocation planning and will significantly impact viable community alternatives.

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5) **Identify and call for required changes to federal statutes, such as the Stafford Act, that would enhance Alaska's ability to deal effectively with communities in peril and other communities with significant risk.**

Implementation actions:

- Designated state agencies shall develop similar recommendations for changes to existing federal legislation and seek support from appropriate national organizations.

- DMVA shall develop recommendations for changes to the Stafford Act and seek direct support from NEMA (National Emergency Management Association) and its member states.
- The Legislature should support needed changes in federal law through a legislative resolution.
- The Alaska Municipal League should support needed changes in federal law through a supporting AML Resolution.

Rationale:

- Federal competitive mitigation grants rely on a cost-benefit analysis detrimental to the realities of Alaska. Alaskan projects often benefit a small population but at high costs. This results in Alaskan projects being considered of lower national priority. In addition, the cost-benefit analysis does not include the consequence of not mitigating a known hazard. Any investment in hazard mitigation will save many times the investment when the disaster occurs. The Immediate Action Workgroup believes that an effective mitigation and prevention strategy and associated funding, will significantly reduce the risk to public safety and the costs of recovering from any climate or weather disaster. The Stafford Act is written for responding to an actual or imminent disaster. It was not envisioned to be used when the disaster is inevitable as is now the case with changing sea ice, melting permafrost and extreme variations in weather. These inevitable disasters can be identified by DHS&EM and appropriately addressed through the National Emergency Management Association legislative process with companion support from Alaska's congressional delegation. Direct action from the Alaska Legislature and the Alaska Municipal League, through personal companion efforts and through resolutions, would strengthen efforts to seek needed changes.

POLICY 4: THE STATE OFALASKA WILL LEAD A COORDINATING EFFORT TO DEVELOP A COMPREHENSIVE STATEWIDE DATA COLLECTION AND EVALUATION SYSTEM THAT PROVIDES FOUNDATIONAL INFORMATION FOR COMMUNITY AND BUSINESS DECISIONS AND SOLUTIONS LEADINGTO EFFECTIVE RESPONSES AND ADAPTATION STRATEGIES TO ADDRESS CLIMATE CHANGE IMPACTS.

Through the Subcabinet Climate Change Strategy process, various components of a statewide data collection and evaluation system have been identified, yet components need to be coordinated in order to understand and use the information effectively. The phenomena of climate-related impacts are not well understood and the impacts themselves are also uncertain. The State of Alaska, playing the coordinating role, will bring together state agencies, university resources, and federal and local stakeholders to develop an effective data collection and evaluation system. The likely outcomes of this effort will be to identify what data exists in order to build forward from existing data and maps; what format it is in and what technology is needed for the systems to "talk" with each other; what data is needed but missing; and what funding is needed to identify, collect, analyze and disseminate data in order to address impacts from climate change phenomena. Response strategies should be developed through adaptation impact analysis and modeling to identify near-term scenarios for options ranging from protecting what's in place, migration and full relocation.

Implementation – Initial Steps

IAWG Recommended Action to Subcabinet: Adopt Policy 4 and provide the IAWG with guidance to develop implementation options for this policy. At a minimum the guidance should instruct that options

should include identifying benefits, challenges, and effective organizational structures for implementation. This comprehensive data system is another key component to create the knowledge base from which informed decisions can be made to set priorities and allocate resources. The guidance to the IAWG should also include melding the relevant Adaptation and Mitigation Advisory Groups' products with this statewide data collection and evaluation system to reach a desired outcome of integrated actions in order to address what seems to be increasing impacts due to climate change phenomena. The IAWG should work with others throughout the state and federal agencies to develop options, request input, questions and concerns that will need to be addressed in order to create an effective integrated data system. This system must also be a key component of the statewide system identified in Policy 1.

1) **A State led coordinated approach, which results in a comprehensive data collection and evaluation system must ensure data is identified, collected, analyzed, and available to users and policy makers. This coordinating effort is a foundational step to develop a comprehensive system and should:**
    a. Identify suites of data and indicators needed to support policy and strategy decisions for government, communities and businesses.
    b. Catalog currently available data, archived data mapping and/or GIS products (ref DCRA Community Maps) and entities collecting the data that reflect community infrastructure and ownership, site characteristics, known risks and changes in environmental conditions.
    c. Provide data from information outside of existing main databases to gather information such as snow accumulations, wildlife populations, energy usage, permafrost temps, geophysical data on glaciers.
    d. Identify what collaborative MOUs among data custodians and data collectors exists and are needed.
    e. Identify processes for collection of field and local data where lacking and potential costs and timetables.
    f. Ensure data includes cultural and traditional knowledge and recognizes the confidentiality of historical sites and proprietary rights of cultural artifacts.
    g. Identify gaps in data and determine how gaps should be prioritized for funding in order to develop a comprehensive statewide database. An example of a data gap is the current need for reliable flood hazard determination data including high water marks of record, detailed analysis of the flood plain, and base flood elevations.
    h. Identify how to establish a central data access website that links collaborators and data collectors/custodians and enables ready access to current information in both electronic and paper formats.
    i. Identify options to integrate analysis and modeling with data collection efforts and databases to provide the necessary interpretations to inform decision making.

Implementation action:

- Establish a small, yet knowledgeable workgroup to conceptualize and begin detailing the above items, with co-chairs from state and federal agencies. The Immediate Action Workgroup could serve as a functional model for this effort.
- Utilize the work and outcomes on data collection and an evaluation system from the efforts under the auspices of the Subcabinet, bringing together the information identified above into a central distribution node/link
- As data sources are added, augment the existing information with the areas not just identified, but described in 1 above.

- Create recommendations along with rationale, budget projections, and identify cooperative agreements (MOU or MOA) to strengthen the comprehensiveness and applicability of the data products.

Rationale:

- Alaska's communities in peril face complex issues that can only be effectively addressed by understanding factors surrounding the range of options from protecting what's in place, supporting migration and potential for full relocation. These factors and options are also relevant for business decisions and planning for their futures. The viability and sustainability of communities and businesses hinges on the availability of accurate, comprehensive data that potentially relates to their at-risk circumstances.
- Significant knowledge building is required to identify a system that incorporates the items listed in 1 above with data bases and products developed to date (including community, flood plain, fire, and permafrost maps). It is imperative that those who have authorities to collect and those who need to use this data work together, in a collaborative manner, to design a collection, analysis and dissemination/application system if it is to be effective.
- The number of potentially affected communities impacted by climate change phenomena will grow and will require a systems approach if the State of Alaska is to effectively address the increased needs for each community on a prioritized basis.
- A coordinated approach will create more useful information for state, community and business decision makers to use:
    - With a higher degree of confidence to effectively make investment and budgeting decisions for the community at risk, and
    - For expediting permits.

Potential outcomes:

1) A blueprint, clearinghouse or prototype site to establish a web-based system as an integral step toward development of a statewide collection and evaluation system.
2) A State lead coordinating agency or university will be identified along with resources needed to incorporate and disseminate an effective data collection and evaluation system. Recommendations on the following items shall be made to the Subcabinet:
    a. MOUs that are needed with appropriate state and federal agencies and other collaborating entities.
    b. An evaluation system to include comprehensive community planning products and establish a priority system for regions of the state that encompasses communities and businesses in peril from risks either common to or unique within the region (wildfires, glacial retreat and avalanches, ice jams and river floods, and coastal inundation.
    c. Flexibility in funding, including receipt of federal funds and in kind local support for the lead agency and other organizations that actively engage in identification, collection, analysis and dissemination with this management tool to:
        - Support dissemination of the data to available users and policy makers.
        - Prioritize projects that address identified gaps in existing data.
        - Support collection and presentation of new field data to fill identified gaps in priority areas.
        - Align data priorities with priority communities in peril for monitoring trends in risk,
        - Provide sufficient data to identify, on a statewide basis, those communities with significant risk but not in immediate risks. Some of these data needs have been identified by the IAWG,

such as mapping and geologic data needs. Data needs have also been identified by the IAWG by focusing on the changes likely occurring due to climate change: increased wildfires, storm surges, lack of sea ice, flooding, and melting permafrost.

d. Obtain funding for this comprehensive system by considering opportunities within existing grant and additional funding sources to conduct data-related research. Analyze current funding streams for requesting additional supports through a state supplemental /capital budget request, should other sources of funding not prove viable.

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2) **Encourage local communities to take leadership in addressing their unique situations by conducting a climate change assessment and developing locally implementable response strategies through current adaptation impact modeling to identify near-term climate change impacts for both protecting in-place and sustainability relocation scenarios:**

a. Encourage Alaska communities to use the ICLEI model, or other multi-step climate impact planning models, which focuses on a review of scientific data to identify expected climate change impacts and opportunities a community should expect and develop a set of responses/actions to possible changes.

Implementation actions:

- Work with the Alaska Municipal League and Regional For-Profits and Non-Profits who in turn will work with their communities to identify near-term climate change impacts and ensure community's plans accommodate new monitoring and research data. The "milestones community planning model", such as the ICLEI method, has been used to identify emerging impacts and opportunities and develop a set of responses that can be incorporated into local plans.
    - An ICLEI method of community milestone planning should be established in immediate or near-term actions to allow new climate change impacts or opportunities to be factored into the relocation or protect- in- place plan.

Rationale:

➢ The effects of near- term climate changes impacts (as opposed to immediate threats) are not fully identified at this time or adequately documented in existing data products. Further research and data collection into physical and cultural changes will present additional elements to be incorporated into adaptation and relocation plans during various stages of implementation.

APPENDICES

APPENDIX A

THE CASE FOR STRATEGIC INTEGRATION: WHY IAWG RECOMMENDED POLICES ARE NEEDED

IAWG Recommended Polices Are Needed

This section provides background and findings to explain why the set of IAWG recommended policies are needed. The IAWG has created working relationships that can help to advance these recommendations in a meaningful and cost-effective manner.

Background

One of the anticipated outcomes of the IAWG's 2009 efforts was to identify the "next six" communities in need of immediate action, due to impacts from climate change phenomena.

Climate change phenomena have been identified as:

- Lack of sea ice
- Change in extent of sea ice
- Timing of sea ice
- Increased effects of storm surges unbuffered by shorefast ice
- Erosion due to flooding or permafrost melt
- Flooding
- Permafrost melt
- Wild fires

This next six would then be in addition to the first six identified, which of course are:

- Kivalina
- Koyukuk
- Newtok
- Shaktoolik
- Shishmaref
- Unalakleet

In order to identify the "next six" the IAWG brought together information from the various member agencies participating in the IAWG, plus the U.S. Governmental Accountability Office , which to some measure, through Congressional interest, brought attention to Alaska's communities potentially in peril due to impacts resulting from climate change phenomena.

The various agencies were able to identify communities of concern for the IAWG based on each agency's mission specific programs. ***However, not one agency had analyzed their actions, nor responding to community needs based on climate change.***

It's useful to restate that the **IAWG did not define climate change**, but rather identified and based its recommended actions on impacts to communities likely resulting from ***climate change phenomena.***

Findings

By bringing together information from participating agencies, the IAWG found:

- The ability to clearly identify and define impacts as resulting from climate change is difficult because:
  - Data are inadequate to analyze and distinguish between normal weather and climate variability or to determine how the current trends will continue to affect Alaskan communities.
  - No framework exists for the comprehensive identification, analysis, and dissemination of current data or the methodical acquisition of new research to support new policy options.

    - *IAWG Policy 4 specifically identifies next steps to address this.*

- Many state and federal agencies and academia are researching potential projects, programs and research efforts to assist communities that are impacted, or potentially impacted by climate change phenomena. However, each agency is working from differing sets of assumptions, approaches and timelines.
    - The IAWG has compiled a list of more than 150 communities identified by one or more agencies as potentially impacted by climate change phenomena. There is no consistency in criteria, timeline, weighting, data acquisition technique or analysis. (see pages 85 - 89)

- State and federal agencies are severely limited by this lack of integration for data, research, and program or project development. Therefore, this environment of uncertainly increases the risk of many communities of facing extreme risks from the unknown effects of natural disasters. The traditional "stove-piped" approach of creating and managing government programs ensures a narrow, myopic view of community needs and places the individual programs in competition for approval and funding. This segregated approach increases the uncertainty of funding but decreases the potential for meaningful and comprehensive assistance.

- The State of Alaska, just as the federal government, plans for and manages programs primarily through individual departments. The priorities are set usually during budget formulation for the next budget cycle. However, many capital projects need years of planning for engineering study and design and for the identification of federal funding. These funding decisions occur for each individual agency and often are without consideration of other state or federal projects that may be in potential conflict for the same community or region.
    - An integrated, multi-agency and inter-governmental approach is needed to effectively identify and address the needs of communities that are potentially in peril.
    - This integrated approach has significant potential to save money on public infrastructure, avoid costly delays, save funds through economies of scale and combining mobilization, mitigate the effects and costs of disaster relief and recovery.

    - *IAWG Policy 1 specifically identifies next steps to address this.*
    - *IAWG Policy 3 is integral to Policy 1, but is such a key component, that the IAWG created a separate Policy Recommendation for integrated, collaborative planning to align timing of activities, funding and other resources, which likely reduce costs.*

- An integrated, multi-agency and intergovernmental approach using existing government databases, agencies, and programs will take effort to design and implement. However, the State of Alaska can expect immediate improvements in productivity, planning, and public confidence from collaboration.

    - An interim, but not ad hoc, IAWG must be authorized to create a framework for increased continued collaboration among relevant agencies and academia.

    - *IAWG Policy 2 specifically identifies next steps to address this.*

In this appendix, you'll find:

- ***Summary*** of characteristics or criteria each organization used to identify actions for communities based on each agency's programs and missions.
- Compiled list of where agencies are actively providing assistance to communities either due to disasters, potential disasters or preventing disasters.
- Each agency's detailed characteristics or criteria used to identify whether to act or provide assistance to a community. These appear in the following order:
  - U.S. Government Accountability Office (GAO)
  - U.S. Corps of Engineers (USACE)
  - Alaska Dept. of Commerce, Community and Economic Development (DCCED)
  - Dept. of Military and Veterans Affairs – Division of Homeland Security & Emergency Management (EM)
  - Alaska Dept. of Transportation and Public Facilities (DOT)
  - Alaska Dept. of Natural Resources – Division of Forestry (DNR)

SUMMARY OF CRITERIA AGENCIES HAVE USED TO RESPOND OR IDENTIFY COMMUNITY NEEDS

IAWG – 2008 Recommendation Report: 6 communities identified

- Communities were identified in GAO's Previous Report and/or at 11/07 Climate Change/AML meeting
- Life/safety risk during storm/flood events
- Loss of critical infrastructure
- Public health threats
- Loss of 10% or more of residential dwellings

GAO – Current Community Relocation Assessment: 15 communities identified

- Communities Self-Identified
- Or other agencies recommended them to GAO –
- Response to US Senate directive to identify
- and make recommendations for communities facing significant erosion or flooding impacts
- Not based on analysis of impact due to climate change phenomena
- Community wants to relocate in whole or in part to address flooding and erosion issues

USACE – Communities Impacted by Erosion Only (Not Flooding): 21 communities identified

- Critical Infrastructure at Risk (for example, Schools, Utilities, Transportation)
- Cultural Importance
- Subsistence and Shoreline Use
- Environmental Hazard (EX: Landfills, Sewer Lines, Sewage Lagoons, Fuel Tanks)
- Human Health and Safety
- Housing and Population Affected
- Housing in Parallel

DCCED – Potential that a community faces significant impacts due to climate change phenomena in the next 18 – 24 months, based on the following criteria: 32 communities identified

- Life/safety risk during storm/flood events
- Loss of critical infrastructure
- Public health threats
- Loss of 10% or more of residential dwellings

Emergency Management: 119 communities identified

- Number of communities named in stated disaster declarations for flooding, storm surge, and other water events since 1978. The communities are group by river system or coastal area.
- Potential threats to safety or life
- Existing public infrastructure threatened by weather or climate hazards

DOT/PF: 60 communities identified

- Those communities in which DOT/PF believes climate change phenomena has to a high degree necessitated proposed, partial and recently completed projects

DNR- Division of Forestry : 40 communities identified

Actions based on funding for and identification of communities which would benefit from Community Wildlands Prevention Planning (CWPPs).

AGENCY RESPONSES TO A RANGE OF COMMUNITY NEEDS

Agency Actions Are Unrelated to Each Other

INFORMATION REFLECTS WHERE AGENCY ACTIVITIES ARE OCCURRING

	Community	BIA	USACE	DCCED	EM	ADOT	DNR
1	Akiak			X	X		
2	Alatna	X			X		
3	Allakaket	X			X		X
4	Alakanuk			X	X		
5	Anchor Point/Happy Valley/Nikolaevsk						X
6	Anchorage,Rainbow, Indian, Bird Creek, Girdwood, Portage, Eagle River, Chugiak, Ekultna				X		X
7	Angoon				X		
8	Aniak				X		
9	Anvik				X		
10	Atmautluak			X			
11	Barrow		X			X	
12	Bear Creek/Seward/Lowell Point						X
13	Beaver						X
14	Bethel				X		
15	Bettles				X		
16	Bristol Bay Borough				X		
17	Buckland			X	X		
18	Chefornak	X	X	X	X		
19	Chevak		X		X		
20	Chignik				X		
21	Chilkat				X		
22	Chitna						X
23	Circle				X		
24	Clarks Point		X		X		
25	Coldfoot					X	
26	Cooper Landing						X
27	Copper Center				X		
28	Copper River				X		
29	Cordova				X		
30	Craig				X		
31	Crooked Creek				X		
32	Deering		X	X			

	Community	GAO	USACE	DCCED	EM	ADOT	DNR
33	Delta Junction				X		
34	Denali Borough				X		
35	Dillingham		X		X		
36	Diamond Ridge/Fritz Creek/Fox River						X
37	Diomede			X	X		
38	Dry Creek						X
39	Eagle				X		
40	Eagle Village				X		
41	Ekwok				X		
42	Elfin Cove				X		
43	Elim	X			X		
44	Emmonak		X	X	X	X	
45	Endicott Mountains				X		
46	Eyak				X		
47	Evansville/Bettles						X
48	FNSB: Fairbanks, North Pole, College, Fox, Salcha, Ester				X		X
49	Fort Yukon				X		
50	Funny River						X
51	Galena				X	X	X
52	Gambell					X	
53	Glennallen				X		X
54	Golovin	X	X	X	X	X	
55	Goodnews Bay				X		
56	Grayling				X		
57	Haines				X		
58	Halibut Cove & Vicinity						X
59	Holy Cross				X		
60	Homer /Kachemak				X		X
61	Hoonah				X		
62	Hooper Bay			X	X	X	
63	Hope/Sunrise/Summit						X
64	Horseshoe Lake						X
65	Hughes	X			X		
66	Huslia	X	X				
67	Iliamna				X		
68	Juneau				X		

	Community	EAO	USACE	DCCED	EM	ADOT	DNR
69	Kachemak Silo				X		
70	Kake				X		
71	Kaktovik				X		
72	Kalifornsky/Kasilof/Cohoe/Clam Glutch						X
73	Kaltag				X		
74	Karluk				X		
75	Kasaan				X		
76	Kenai				X		X
77	Kenai Borough				X		
78	Kasaan				X		
79	Kongiganak			X	X		
80	Kivalina	X	X	X	X	X	
81	Kipnuk	X			X		
82	Klawock				X		
83	Kobuk				X		
84	Kodiak				X		
85	Koliganek				X		
86	Kotlik		X	X			
87	Kotzebue				X	X	
88	Koyukuk	X		X	X	X	X
89	Kwethluk			X	X		
90	Kwigillingok			X	X		
91	Lake & Pen Borough				X		
92	Little Diomede			X		X	
93	Lime Village		X		X		
94	Mat Su Borough				X		
95	McCarthy, Kennicott,Fireweed Mountain				X		X
96	McGrath		X	X	X		X
97	Mentasta						X
98	Metlakatla				X		
99	Moose Pass, Crown Point, Primrose						X
100	Naknek				X		
101	Nanwalek						X
102	Napakiak			X	X		
103	Napaskiak			X	X		
104	Nelson Lagoon			X			
105	Nenana				X		

	Community	GAO	UNAC	DCCED	EM	ADOT	DNR
106	Newhalen				X		
107	Noatak					X	
108	Nome				X	X	
109	Newtok	X	X	X	X	X	
110	Nightmute			X		X	
111	Nikisiki,Salamatof,Grey Cliffs						X
112	Nilichick,Nilichick Forties						X
113	North Slope Borough				X	X	
114	Northway				X		
115	Nulato	X				X	
116	Nunam Iqua		X	X	X	X	
117	Nunapitchuk			X	X		
118	Pedro Bay				X		
119	Pelican				X		
120	Pilot Station				X		
121	Pitka's Point				X		
122	Platinum				X		
123	Port Graham				X		X
124	Point Hope					X	
125	Port Heiden		X				
126	Quinhagak				X		
127	Red Devil				X		
128	Russian Mission				X		
129	Ruby						X
130	Saint Michael		X		X		
131	Salcha				X		
132	Scammon Bay				X		
133	Seldovia						X
134	Selawik		X			X	
135	Seward			X	X		
136	Shageluk				X	X	
137	Shaktoolik	X	X	X	X	X	
138	Sitka				X		
139	Skagway				X		
140	Soldotna,Ridgeway						X
141	Solomon and Safety Sound					X	
142	Shishmaref	X	X	X	X	X	

	Community	GAU	USACE	DCCED	EM	DOT	UNE
143	Sleetmute				X		
144	Sterling						X
145	Stevens Village						X
146	Strelna						X
147	Tanacross						X
148	Teller			X	X		
149	Tenakee Springs				X		
150	Togiak				X		
151	Tok						X
152	Toksook				X		
153	Tuntutuliak			X	X		
154	Tununak				X		
155	Tyonek/Beluga						X
156	Unalaska				X		
157	Unalakleet	X	X	X		X	
158	Valdez				X		
159	Venetie						X
160	Wainwright				X		
161	Wales			X			
162	Wasilla, Palmer, Butte, Sutton, Chickaloon, Knik, Big Lake, Houston, Willow, Talkeetna, Trapper Creek, Petersville						X
163	Whittier				X		
164	Willow Creek				X		
165	Wiseman				X		
166	Wrangell				X		

INFORMATION ON GAO ENGAGEMENT

Engagement subject: Alaska Native Village Relocation Efforts

Source for the work: GAO is conducting this work in response to a request made by the Senate Subcommittee on Disaster Recovery, Committee on Homeland Security and Governmental Affairs

Objective/key questions: This is an update to GAO's December 2003 study, *Alaska Native Villages: Most are Affected by Flooding and Erosion, Few Qualify for Federal Assistance* (GAO-04-142). Key questions are: (Q1) What flooding and erosion threats do Alaska Native villages currently face? (Q2) What federal and state programs are available to assist villages facing potential disasters? (Q3) What is the status of efforts to assist relocating villages? (Q4) How do federal programs provide and prioritize assistance to threatened villages?

Status: GAO has visited seven villages and spoken with various federal, state, and local government agencies. We have completed the design phase of our work and are currently conducting field work to address our key questions. We expect to have a completed report by mid-May 2009.

Villages visited: Alatna, Allakaket, Kivalina, Koyukuk, Shaktoolik, Shishmaref, and Unalakleet.

Other villages of interest: Chefornak, Elim, Golovin, Hughes, Huslia, Kipnuk, Newtok, and Nulato.

Agencies contacted: Departments of Agriculture; Defense's Army Corp of Engineers; Health and Human Service's Indian Health Service; Homeland Security's Federal Emergency Management Agency; Housing and Urban Development; the Interior's Bureau of Indian Affairs, Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service; and Transportation's Federal Aviation Administration. We have also spoken to officials from the Denali Commission, the Bering Strait Housing Authority, the Maniilaq Association, the Tanana Chiefs Conference, Kawerak, the Northwest Arctic Borough, and the State of Alaska's Department of Environmental Conservation, Department of Commerce, Community, and Economic Development, and Division of Homeland Security and Emergency Management.

GAO contacts:
Jeffery Malcolm, Assistant Director, (202) 512-6536 (phone), (202) 512-8354 (fax), MalcolmJ@gao.gov
Brad Dobbins, Analyst-In-Charge, (415) 904-2278 (phone), (415) 904-2111 (fax), DobbinsB@gao.gov
Allen Chan, Senior Analyst, (415) 904-2263 (phone), (415) 904-2111 (fax), ChanA@gao.gov

USACE Criteria for Assessing Community Needs

Assigning Response Priorities for Erosion and Flooding in Alaskan Communities

Overview

There is a heightened awareness that many Alaskan communities are suffering from erosion and flooding impacts. When looking to identify those in most need, certain criteria can be utilized to differentiate between the issues in each community. Appropriate criteria for differentiating between communities need to focus upon the characteristics that make up a community. Remote Alaska villages typically are largely native, have a significant interest in culture and tradition, rely heavily upon air and water transportation, have economies that are more based in subsistence/trade/barter than upon the exchange of money for goods and services, and typically do not have the ability to internally raising funds to support develop or maintenance of facilities, infrastructure, or measures for protection against natural phenomenon.

Criteria and Factors

Criteria for assigning priority typically will have one or two factors influencing the criteria's magnitude of concern. Single factor criteria are ones that are general descriptors i.e. Does the community have the ability to pay for a project? A two factor criteria is influenced by two measures i.e. How severely is development being damaged and what is the timeline for the damage?

Developing Criteria and Rankings

No single person should believe they can make the determinations of what criteria are to be used, how to scale the criteria, how to weight the criteria, or assigning values for criteria for items being ranked. A typical approach to develop these items is to assemble an "expert panel" of individuals from the area of expertise needed. These experts are typically not policy makers or agency executives. These individuals are those who work most closely to the actual problems and are integrally involved in formulating, describing, and developing solutions.

Alaska Baseline Erosion Risk Criteria Workshop

A workshop was held at Alaska District to develop the risk criteria for which the communities can be assessed.

A focus of discussion at the workshop was the identification of Evaluation Factors for scoring the relative Severity of Expected Erosion Damages across communities. After initial brainstorming and screening, a list of Evaluation Factors was identified for further consideration for ranking communities based upon the level of information available in the ABEA Erosion Information Papers (EIPs). Relative weights were identified for each factor. The identified factors and weights are presented in Table 1.

Table 1 – Workshop Identified Evaluation Factors and Weights	
Evaluation Factor	**Relative Weight**
Infrastructure (School, Utilities, Transportation, Critical)	3
Life Safety	3
Subsistence and Shoreline Use Being Limited	2
Setting/Geographic Location	1
Time Until Damage	3
Population	1
Housing In Parallel	2
Environmental Hazard	3
Cultural Importance	1
Percent Of Affected (Numbers of Structure/People)	2
Commercial/Public/Store/Church/Community Infrastructure	2
Source: Meeting Minutes provided to Tetra Tech by Melanie Harrop, 1/23/08.	

Further consideration of the identified factors following the meeting resulted in the following recommendations:

1) "Population" and "Percent of Affected" be combined into one category: "Housing and Population Affected" – these categories seem to be similar and may have the effect of doubling the weight for the impact on housing.

2) "Time until Damage" be removed as a Severity of Damage Evaluation Factor and instead by rated and multiplied by the Severity of Damage Score for each community as a more appropriate way of scoring the relative Erosion Risk at each community. (See Section 3).

3) Several of the headings have suggested editorial changes

Table 2 presents the suggested changes to the identified Evaluation Criteria.

Table 2 – Suggested Revisions to Identified Evaluation Factors

Evaluation Factor	Relative Weight
Critical Infrastructure (for example, School, Utilities, Transportation)	3
Human Health and Safety	3
Subsistence and Shoreline Use	2
Community Setting/Community Geographic Location	1
~~Time Until Damage~~	~~3~~
Housing and Population Affected	1
Housing in Parallel	2
Environmental Hazard (for example, Landfills, Sewer Lines, Sewage Lagoons, Fuel Tanks)	3
Cultural Importance	1
~~Percent Of Affected (Numbers of Structure/People)~~	~~2~~
Commercial/Public/Store/Church/Community Infrastructure	2

Incorporation of Risk Consideration into Methodology

There are various definitions of risk. The Corps of Engineer's report Beyond Expected Value: Making Decisions under Risk and Uncertainty (USACE, IWR Report 02-R-4 (Dick Males); September 2002) provides the following simplistic definition of risk and uncertainty:

> *"Risk is the chance of something bad happening. Uncertainty is a characteristic of a situation in which a number of possibilities exist but we do not know which of them will occur. Uncertainty exists because of natural variability and knowledge gaps."*

The entire BEA study is a risk analysis (examination of erosion risk) across communities throughout the state. Due to the number of communities with potential problems, Alaska District is proceeding with the study in an iterative manner to systematically assess the relative risk across communities and prioritize follow-on detailed study activity on those communities at the highest perceived risk first.

Risk analysis as applied to the Corps Civil Works problems can be viewed as having three components:

- Risk assessment;
- Risk communication; and
- Risk management.

In Risk Analysis and Risk Informed Decision Making: An Overview (USACE; Planning Ahead, Volume 10, Issue 10 (Brian Harper/David Moser) November, 2007), these three components are described as follows:

- Risk assessment is a systematic process for quantifying and describing the nature, likelihood, and magnitude of risk associated with a situation, action, or event. The assessment includes consideration of relevant uncertainties.

- Risk management is the process used to identify, evaluate, select, implement, monitor and modify actions taken to alter levels of risk. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce risks while taking into account economic, environmental, social, cultural, ethical, political and legal considerations.

- Risk communication is the open, two-way exchange of information and opinion about hazards and risks leading to a better understanding of the risks and better risk management decisions.

The prioritization exercise which is the topic of this memo is a form of risk assessment where the *Severity of Damage* ratings estimate the relative nature and magnitude of erosion risk in each community and the *Time Until Damage* ratings estimate the likelihood/timing of the expected event. Together, these two factors can provide the basis for prioritizing communities for further evaluation. The following relationship is recommended:

Erosion Risk Ranking = Severity of Damage Score * Time until Damage Score

Risk assessment should also explicitly consider the uncertainties that are inherent to our estimates of the *Severity of Damage* and *Time until Damage*. Based on the preliminary level of data (in many cases anecdotal, subjective descriptions) available for the EIP's, the largest source of uncertainty for both scale ratings is likely information gaps (for example; no data available, overly general information available, or uncertainty in reliability of available data).

During the rating of "Time until Damage" for each community, a rating of the relative confidence in the score also be recorded. This allows explicit consideration of the uncertainty in the ratings by providing another layer of information (For example, "We think Community X has a rating of 20 however because of uncertainty in our estimate of Time until Damage, its rating could range from a 15 to a 25. This information is useful for informing the prioritization decision making process and allows for flexibility in selecting communities for further study.

Severity of Damage Evaluation Factor Rating Criteria:
Through research by the PDT, input from the workshop, and recommendations by Tetra Tech, a consultant to the Corps assisting on the Baseline Erosion Assessment, the following criteria have been developed. Tetra Tech compiled these thoughts and with their additional insight, submitted the following criteria. These are now the proposed that will be utilized is assessing the risk for each community. Table 3 documents these criteria.

USACE Table 3 – Draft Rating Criteria for Severity of Damage Evaluation Factors			
Evaluation Factor	**Weight**	**Scoring Criteria**	
Critical Infrastructure (for example, School, Utilities, Transportation)	3	Low Impact (1)	• One item of critical community infrastructure at risk • Loss of infrastructure would not result in loss of community sustainability • Damage could be repaired or alternative service restored in less than 1 month
		Medium Impact (2)	• More than one item of critical community infrastructure at risk • Loss would not result in loss of community sustainability • Damage could be repaired or alternative service restored between 1 and 6 months
		High Impact (3)	• More than one item of critical community infrastructure at risk • Loss would impact community sustainability • Repaired or establishment of alternative service would take more than 6 months
Human Health and Safety	3	Low Impact (1)	• Situations that would cause life safety concerns or negatively affect ability to provide emergency services are not likely • Ingress/egress to/from community not at risk • Community has ability to mitigate or avoid life safety concerns
		Medium Impact (2)	• Only rare events would threaten life safety • Access to or from community by land or airport threatened • Quick and easy access to emergency services is available

Human Health and Safety (continued)		High Impact (3)	• Erosion damage is expected to result in human health and safety concerns • Critical health/safety services facility at risk • Portions or all of the population cut-off from emergency services • Air &/or road access at great risk or impassable to all or a portion of community
Subsistence and Shoreline Use	2	Low Impact (1)	• Minor and temporary interruptions that are a nuisance but made up in same year • Damage could be repaired locally, for example regarding boat launch access each spring • Access is altered but not of substantial consequence or inconvenience
		Medium Impact (2)	• Frequent loss or disruption of access to subsistence or damage to important shoreline uses • Structural mitigation of risk practicable solution but may disrupt high value traditional use and access areas • Critical habitat &/or use areas mild to moderately threatened; traditional practices inconvenienced but not disrupted
		High Impact (3)	• Interruptions sever enough to impact supply on a continual basis • Critical habitat &/or use areas severely threatened; traditional practices limited to focus on survival • Structural mitigation of risk possible but may eliminate or harm vital subsistence/shoreline use area

Community Setting/Community Geographic Location	1	Low Impact (1)	• Land is readily available in erosion free zones for new development or relocations • Soils, hydrology/hydraulic conditions not conducive to erosion; aggregate resources available locally if erosion protective measures needed • Land use controls in place and/or safe land area between shoreline and development exists
		Medium Impact (2)	• Lands in erosion free zones are limited, precluding new development or relocations into safe areas • Soils and hydrologic/hydraulic conditions conducive to erosion • Limited distance between shoreline and development but safe zones available and some local resources to assist with mitigating problem
		High Impact (3)	• High erosion rates and flooding • Poor soils conducive to erosion, permafrost melt possible added impact • No or limited safe land areas to move structures; community on barrier islands or spit • Community is hub of goods/services supporting other communities in region/sub-region
Housing and Population Affected	1	Low Impact (1)	• Less than 10 % of population/housing affected • Alternative housing available
		Medium Impact (2)	• 10 to 25% of population/housing affected • Alternative housing available but limited
		High Impact (3)	• Over 25% of population/housing • Limited to no alternative housing available

Housing in Parallel	2	Low Impact (1)	• Only a few waterfront structures and limited associated infrastructure at risk (one time loss)
		Medium Impact (2)	• Multiple Rows of structures parallel to waterfront and limited associated infrastructure improvements are at risk (expected future recurrence of damages)
		High Impact (3)	• Multiple Rows of structures parallel to waterfront and extensive associated infrastructure improvements are at risk (higher level of expected future recurrence of damages)
Environmental Hazard (for example, Landfills, Sewer Lines, Sewage Lagoons, Fuel Tanks)	3	Low Impact (1)	• Minor issue that can be easily addressed at the time of damage • Impact can be addressed locally
		Medium Impact (2)	• Moderate environmental effect that will require limited intervention by an external agency for a limited period of time
		High Impact (3)	• Large issue that will require extensive intervention by one or more external agencies for an extended period of time • Damage or loss will impact the entire population or high % of population, such as contaminated water supply • If erosion causes environmental impact that has long term impacts &/or impacts to other communities or region may suffer (such as hazardous substances, fuel facilities or landfills eroding into an anadromous stream)
Cultural Importance	1	Low Impact (1)	• Minor or temporary disruption in cultural/traditional activities with no lingering negative impacts • Minimal expected damage to known cultural and historic resources

Cultural Importance (continued)		Medium Impact (2)	• Intervention required for community to continue with cultural/traditional activities • Some cultural resources are lost, but rarely occurs without appropriate records being taken to catalog what resources have been lost.
		gh Impact (3)	• Cultural resource being lost at a high rate with little or no ability to catalog and record what is being lost. • Traditional practices are being abandoned to focus solely on life-safety and survival.
Commercial/Non-Residential	2	Low Impact (1)	• Impacts have no or little affect on overall community cash flow • Little and only temporary impact to a community's ability to operate their commercial facilities with minor interruptions • Little or no exterior financial support is necessary to re-establish full capacity
		Medium Impact (2)	• Impacts have moderate impact on overall community cash flow • Impacts to a community's commercial infrastructure will require significant external assistance to come back to full capacity • Loss of commercial infrastructure can be handled at an alternative site or location (such as a 2nd local store, or other commercial/public dock facilities)
		High Impact (3)	• Impacts have severe, dramatic affect on cash flow of a community • The ability to operate the commercial sector for the community is severely impacted • Loss of commercial infrastructure will impact entire community (such as loss of a single store, with no replacement facilities); or ability to gather materials or have goods and services brought in is no longer possible (i.e. a commercial dock is destroyed with no replacement or alternate facilities)

Revised Strawman Matrix

Following the workshop, Tetra Tech prepared a prioritization ranking framework that incorporates the risk assessment factors described in the recommendations in this memorandum. The framework is presented in Table 4 and provided as an electronic file (Excel spreadsheet) under separate cover.

The spreadsheet file would allow the District to enter accepted scoring values for each Evaluation Factor in Table 3 from drop down lists, apply user defined weights (currently set to those in Table 3), select accepted scoring values for Time until Damage, and select accepted values for Confidence in Time until Damage estimates. The spreadsheet calculates a Damage Score based upon the Evaluation Factors and their respective weights, and calculates Community Ranking Scores with uncertainty based upon user selected confidence in the Time until Damage rating. (Note that the scores shown in Table 4 are for example only and do not reflect scores developed for any specific communities.)

.TABLE 4 - DRAFT COMMUNITY RANKING METHODOLOGY												
SCORES FOR COMMUNITY RANKING CRITERIA BASED UPON INFOMRATION IN EIPS		**Community 1**	**Community 2**	**Community 3**	**Community 4**	**Community 5**	**Community 6**	**Community 7**	**Community 8**	**Community 9**	**Community 10**	**Community 11**	**Community 12**
SEVERITY OF DAMAGE:													
Critical Infrastructure (for example, School, Utilities, Transportation)	***(1) LOW IMPACT:*** • *One item of critical community infrastructure at risk* • *Loss of infrastructure would not result in loss of community sustainability* • *Damage could be repaired or alternative service restored in less than 1 month*	0	1	1	1	1	1	2	2	2	3	3	3
	(2) MEDIUM IMPACT: • *More than one item of critical community infrastructure at risk* • *Loss would not result in loss of community sustainability* • *Damage could be repaired or alternative service restored between 1 and 6 months*												
	(3) HIGH IMPACT: • *More than one item of critical community infrastructure at risk* • *Loss would impact community sustainability* • *Repaired or establishment of alternative service would take more than 6 months*												

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Human Health and Safety	***(1) LOW IMPACT:*** *• Situations that would cause life safety concerns or negatively affect ability to provide emergency services are not likely • Ingress/egress to/from community not at risk • Community has ability to mitigate or avoid life safety concerns*	0	1	1	1	1	1	2	2	2	3	3	3
	(2) MEDIUM IMPACT: *• Only rare events would threaten life safety • Access to or from community by land or airport threatened • Quick and easy access to emergency services is available*												
	(3) HIGH IMPACT: *• Erosion damage is expected to result in human health and safety concerns • Critical health/safety services facility at risk • Portions or all of the population cut-off from emergency services • Air &/or road access at great risk or impassable to all or a portion of community*												

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Subsistence and Shoreline Use	*(1) LOW IMPACT:* *• Minor and temporary interruptions that are a nuisance but made up in same year* *• Damage could be repaired locally, for example regarding boat launch access each spring* *• Access is altered but not of substantial consequence or inconvenience*	0	1	1	1	1	1	2	2	2	3	3	3
	(2) MEDIUM IMPACT: *• Frequent loss or disruption of access to subsistence or damage to important shoreline uses* *• Structural mitigation of risk practicable solution but may disrupt high value traditional use and access areas* *• Critical habitat &/or use areas mild to moderately threatened; traditional practices inconvenienced but not disrupted*												
	(3) HIGH IMPACT: *• Interruptions sever enough to impact supply on a continual basis* *• Critical habitat &/or use areas severely threatened; traditional practices limited Structural mitigation of risk possible but may eliminate or harm vital subsistence/shoreline use area*												

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Community Setting/Community Geographic Location	***(1) LOW IMPACT:*** *• Land is readily available in erosion free zones for new development or relocations • Soils, hydrology/hydraulic conditions not conducive to erosion; aggregate resources available locally if erosion protective measures needed • Land use controls in place and/or safe land area between shoreline and development exists*	0	1	1	1	1	1	2	2	2	3	3	3
	(2) MEDIUM IMPACT: *• Lands in erosion free zones are limited, precluding new development or relocations into safe areas • Soils and hydrologic/hydraulic conditions conducive to erosion • Limited distance between shoreline and development but safe zones available and some local resources to assist with mitigating problem*												
	(3) HIGH IMPACT: *• High erosion rates and flooding • Poor soils conducive to erosion, permafrost melt possible added impact • No or limited safe land areas to move structures; community on barrier islands or spit • Community is hub of goods/services supporting other communities in region/sub-region*												
Housing and Population Affected	***(1) LOW IMPACT:*** *• Less than 10 % of population/housing affected • Alternative housing available*	0	1	1	1	1	1	2	2	2	3	3	3

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	(2) MEDIUM IMPACT: *• 10 to 25% of population/housing affected* *• Alternative housing available but limited*												
	(3) HIGH IMPACT: *• Over 25% of population/housing* *• Limited to no alternative housing available*												
Housing in Parallel	***(1) LOW IMPACT:*** *• Only a few waterfront structures and limited associated infrastructure at risk (one time loss)*	0	1	1	1	1	1	2	2	2	3	3	3
	(2) MEDIUM IMPACT: *• Multiple Rows of structures parallel to waterfront and limited associated infrastructure improvements are at risk (expected future recurrence of damages)*												
	(3) HIGH IMPACT: *• Multiple Rows of structures parallel to waterfront and extensive associated infrastructure improvements are at risk (higher level of expected future recurrence of damages)*												
Environmental Hazard	***(1) LOW IMPACT:*** *• Minor issue that can be easily addressed at the time of damage* *• Impact can be addressed locally*	0	1	1	1	1	1	2	2	2	3	3	3

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	(2) MEDIUM IMPACT: *• Moderate environmental effect that will require limited intervention by an external agency for a limited period of time* ***(3) HIGH IMPACT:*** *• Large issue that will require extensive intervention by one or more external agencies for an extended period of time* *• Damage or loss will impact the entire population or high % of population, such as contaminated water supply* *• If erosion causes environmental impact that has long term impacts &/or impacts to other communities or region may suffer (such as hazardous substances, fuel facilities or landfills eroding into an anadromous stream)*												
Cultural Importance	***(1) LOW IMPACT:*** *• Minor or temporary disruption in cultural/traditional activities with no lingering negative impacts* *• Minimal expected damage to known cultural and historic resources*	0	1	1	1	1	1	2	2	2	3	3	3

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	(2) MEDIUM IMPACT: *• Intervention required for community to continue with cultural/traditional activities* *• Some cultural resources are lost, but rarely occurs without appropriate records being taken to catalog what resources have been lost.*												
	(3) HIGH IMPACT: *• Cultural resource being lost at a high rate with little or no ability to catalog and record what is being lost.* *• Traditional practices are being abandoned to focus solely on life-safety and survival.*												
Commercial/ Non-Residential	***(1) LOW IMPACT:*** *• Impacts have no or little affect on overall community cash flow* *• Little and only temporary impact to a community's ability to operate their commercial facilities with minor interruptions* *• Little or no exterior financial support is necessary to re-establish full capacity*	0	1	1	1	1	1	2	2	2	3	3	3
	(2) MEDIUM IMPACT: *• Impacts have moderate impact on overall community cash flow* *• Impacts to a community's commercial infrastructure will require significant external assistance to come back to full capacity* *• Loss of commercial infrastructure can be handled at an alternative site or location*												

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	(such as a 2nd local store, or other commercial/public dock facilities)												
	(3) HIGH IMPACT: *• Impacts have severe, dramatic affect on cash flow of a community* *• The ability to operate the commercial sector for the community is severely impacted* *• Loss of commercial infrastructure will impact entire community (such as loss of a single store, with no replacement facilities); or ability to gather materials or have goods and services brought in is no longer possible (i.e. a commercial dock is destroyed with no replacement or alternate facilities)*												
DAMAGE SCORE:		**0**	**18**	**18**	**18**	**18**	**18**	**36**	**36**	**36**	**54**	**54**	**54**

TIME UNTIL DAMAGE:													
TIME UNTIL DAMAGE RATING	***Enter One of Following Values or Select from Drop Down List:*** ***3 for Short Term (1 to 10 Years)*** ***2 for Mid Term (10 to 20 years)*** ***1 for Long Term (20 years and beyond)***	**1**	**2**	**2**	**2**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**

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CONFIDENCE IN TIME UNTIL DAMAGE RATING	***Enter Closest of following Values or Select from Drop Down List:*** *25% Confidence Rating (Hunch)* *50% Confidence Rating (Educated Guess)* *75% Confidence Rating (Think so)* *100% Confidence Rating (Sure)*	**25%**	**25%**	**50%**	**75%**	**100%**	**25%**	**25%**	**75%**	**100%**	**25%**	**75%**	**100%**
COMMUNITY RANKING SCORES:													
COMMUNITY RANKING SCORE:		**0**	**36**	**36**	**36**	**36**	**54**	**36**	**72**	**108**	**54**	**108**	**162**
CONFIDENCE RANGE LOW:		**0.0**	**22.5**	**27.0**	**31.5**	**36.0**	**40.5**	**36.0**	**63.0**	**108.0**	**54.0**	**94.5**	**162.0**
CONFIDENCE RANGE HIGH:		**0.0**	**49.5**	**45.0**	**40.5**	**36.0**	**54.0**	**63.0**	**81.0**	**108.0**	**94.5**	**121.5**	**162.0**

DCCED/DCRA Criteria

DCCED/DCRA sent the following email to Field Personnel requesting assistance to identify communities they believed met the IAWG's criteria for communities potentially impacted from climate change phenomena.

From: Boothby, Taunnie L (CED)
Sent: Friday, December 05, 2008 4:27 PM
To: Mello, Christopher P (AIDEA); Magee, Gregory L (DEC); Ruby, Scott (CED)
Cc: Jollie, Tara L (CED); Black, Michael L (CED); Cox, Sally A (CED); McKay, Peter J (CED); St Amour, Ruth R (CED)
Subject: Requesting your assistance on behalf of Deputy Commissioner Mike Black and DCRA Tara Jollie

Good Afternoon,

On behalf of Deputy Commissioner Mike Black and DCRA Director Tara Jollie, we are asking for your recommendations of communities that may need immediate action to prevent loss of life, health or great property damage. This list will be compiled for dialogue during the Immediate Action Workgroup of the Governor's Climate Change Subcabinet.

We are requesting this input because you are the subject matter expert in your fields and your vast knowledge of the communities across the State. This experience is vital to the discussion and we appreciate your time.

Below is a brief summary of what has happened and what the criteria to consider when recommending communities.

On April 17, 2008, the Immediate Action Workgroup (IAWG) released their final report and recommendations to the Governor's Subcabinet on Climate Change for the initial six communities experiencing climate change related affects, namely Kivalina, Koyukuk, Newtok, Shaktoolik, Shishmaref, and Unalakleet.

Currently the IAWG are collecting a list of additional communities for discussion purposes on a potential second round of communities.

DCRA has determined our mission statement for this task to be the following:

Identify the next set of communities facing the most significant impacts due to climate change in the next 18 – 24 months, based on the following criteria:

(1) Life/safety risk during storm/flood events
(2) Loss of critical infrastructure
(3) Public health threats
(4) Loss of 10% or more of residential dwellings

Communities recommended to date:

Akiak
Alakanuk
Atmautluak
Chefornak
Diomede
Golovin
Kotlik
Kwethluk
Kwigillingok
Little Diomede
Napakiak
Nelson Lagoon

This list is not an inclusive list of communities affected by Climate Change.

We are asking for your recommendations of communities based on the DCRA mission statement for this task. Please provide your input via e-mail to taunnie.boothby@alaska.gov and tara.jollie@alaska.gov by close of business Dec 12, 2008.

Thank you,
Taunnie L. Boothby, CFM
State NFIP Coordinator/Floodplain Management Programs
DCCED/Division of Community and Regional Affairs
Phone: 907-269-4583; E-mail: taunnie.boothby@alaska.gov

Alaska Division of Homeland Security & Emergency Management
Compiled in November 2008
Summary of Alaskan Flood Disasters
1978-2008
Sorted by Region, Community and Year

This summary includes only the communities and flooding events resulting in a state disaster declaration. The same event often affects several communities, sometimes widely separated. Flooding events result from:

- Rainfall
- Ice jam
- Storm surge
- Wind driven waves
- Snow melt
- Rising ground water

Region	Communities	Flooding Events
Yukon	13	17
Koyukuk	6	7
Kuskokwim	11	32
Bristol Bay	5	7
Aleutians & Peninsula	4	7
West Coast	22	43
Northwest	10	20
North Slope	4	4
Interior	6	15
Southcentral	14	33
Kenai PB	6	11
Kodiak	2	7
Southeast	16	25
Total	**119**	**228**

Year	Flooding Events
1978	4
1979	15
1980	5
1981	1
1982	2
1983	3
1984	7
1985	15
1986	4
1987	3
1988	5
1989	8
1990	10
1991	14
1992	5
1993	1
1994	10
1995	14
1996	0
1997	4
1998	4
1999	0
2000	16
2001	2
2002	19
2003	6
2004	7
2005	23
2006	16
2007	0
2008	5
Total	**228**

Yukon River	
Anvik	1985 1991
Circle	1989
Eagle	1992
Eagle Village	1992
Fort Yukon	1982 1989
Galena	1991 1992 1994
Grayling	1991
Holy Cross	1991
Kaltag	1988
Pilot Station	1985
Pitka's Point	1985
Russian Mission	1982
Shageluk (Innoko)	1991

Yukon River	
1982	Fort Yukon Russian Mission
1985	Anvik Pilot Station Pitka's Point
1988	Kaltag
1989	Circle Fort Yukon
1991	Anvik Grayling Holy Cross Shageluk Galena
1992	Eagle Village Eagle Galena
1994	Galena

Koyukuk River	
Alatna	1994
Allakaket	1994
Bettles	1994
Hughes	1994
Koyukok	2001 2006
Wiseman	1994

Koyukuk River	
1994	Alatna Allakaket Bettles Hughes Wiseman
2001	Koyukok
2006	Koyukok

Kuskokwim River	
Akiak	1995
Aniak	1983 1987 1991 1995 2002
Bethel	1985 1990 1995 2006
Crooked Creek	1985 1988 2002
Lime Village (Stony R)	2002
McGrath	1985 1990 1991 1993 2002 2005
Napakiak	1986 1988 1990 2005
Nunapitchuk	1990
Red Devil	1985 1991 2002
Sleetmute	1985 1987 2002
Tuntutuliak	1990

Kuskokwim	
1983	Aniak
1985	Bethel Crooked Creek McGrath Red Devil Sleetmute
1986	Napakiak
1987	Sleetmute Aniak
1988	Crooked Creek Napakiak
1990	Bethel Mcgrath Napakiak Nunapitchuk Tuntutuliak
1991	Aniak McGrath Red Devil
1993	McGrath
1995	Akiak Aniak Bethel
2002	Aniak Crooked Crook Lime Village (Stony R) McGrath Red Devil Sleetmute
2005	McGrath Napakiak
2006	Bethel

Bristol Bay	
Bristol Bay Borough	2005
Clark's Point	2005
Dillingham	1980 2000 2005
Ekwok	2002
Koliganek	1991

Bristol Bay	
1980	Dillingham
1991	Koliganek
2000	Dillingham
2002	Ekwok
2005	Bristol Bay Borough Clark's Point Dillingham

Aleutians & Peninsula	
Chignik	2000 2002
Lake & Pen Borough	2000 2003 2005
Naknek	2003
Unalaska	1985

Aleutians & Peninsula	
1985	Unalaska
2000	Chignik Lake & Peninsula
2002	Chignik
2003	Lake & Peninsula Naknek
2005	Lake & Peninsula

West Coast	
Alakanuk	1984 1991 1995 2002 2005 2006
Chefornak	1979
Chevak	2004
Emmonak	1984 1985 1991 1995 2002 2005 2006
Goodnews Bay	1979 2004
Hooper Bay	1979 2004
Kipnuk	1979 1983
Kongiganak	1979 2006
Kwethluk	1995 2002 2006
Kwigillingok	1979 1990
Napaskiak	1995
Newtok	1979 2005
Nunam Iqua	1979
Platinum	1979
Quinhagak	1979 2005
Scammon Bay	1979
Shaktoolik	2005
St. Michael	2005
Togiak	1979
Toksook Bay	1979
Tununak	1979
Unalakleet	2003 2005

West Coast	
1979	Chefornak Goodnews Bay Hooper Bay Kipnuk Kongiganak Kwigillingok Newtok Nunam Iqua Platinum Quinhagak Scammon Bay Togiak Toksook Bay Tununak
1983	Kipnuk
1984	Alakanuk Emmonak
1985	Emmonak
1990	Kwigillingok
1991	Alakanuk Emmonak
1995	Alakanuk Emmonak Kwethluk Napaskiak
2002	Alakanuk Emmonak Kwethluk
2003	Unalakleet
2004	Chevak Goodnews Bay Hooper Bay
2005	Alakanuk Emmonak Newtok Quinhagak St. Michael Shaktoolik Unalakleet
2006	Alakanut Emmonak Kongiganak Kwethluk

Northwest	
Buckland	1985 1987
Diomede	1990 2004
Elim	2004 2005
Golovin	2004 2005
Kivalina	2006
Kobuk	1985 1990
Kotzebue	1990
Nome	2003 2005
Shishmaref	1988 1997 2001 2002 2005
Teller	1990

Northwest	
1985	Buckland Kobuk
1987	Buckland
1988	Shishmaref
1990	Diomede Kobuk Kotzebue Teller
1997	Shishmaref
2001	Shishmaref
2002	Shishmaref
2003	Nome
2004	Diomede Elim Golovin
2005	Elim Golovin Nome Shishmaref
2006	Kivalina

North Slope	
Endicott Mountains	1998
Kaktovik	2008
North Slope Borough	1989
Wainwright	2008

North Slope	
1989	North Slope Borough
1998	Endicott Mountains
2008	Kaktovik Wainwright

Interior	
Delta Junction	1994 2000 2006
Denali Borough	2006
Fairbanks NSB	1989 1991 1992 1997 2000 2002 2008
Nenana	2008
Northway	1997
Salcha	2002 2008

Interior	
1989	North Star Borough
1991	North Star Borough
1992	North Star Borough
1994	Delta Junction
1997	North Star Borough Northway
2000	Delta Junction North Star Borough
2002	Salcha North Star Borough
2006	Delta Junction Denali Borough
2008	North Star Borough Nenana Salcha

Southcentral	
Anchorage	1978 1980 1989 1995 2000
Copper Center	1980
Copper River	1985 1997 2006
Cordova	1983 1985 1986 1995 2000 2006
Eyak	2006
Glennallen	1989
Iliamna	2000
Mat Su Borough	1980 1986 1991 1994 1995 2000 2006
McCarthy	2006
Newhalen	2000
Pedro Bay	2003
Seward	1989
Whittier	1995 2000
Valdez	2000 2006

Southcentral	
1978	Anchorage
1980	Anchorage Copper Center Mat Su Borough
1983	Cordova
1985	Copper River Cordova
1986	Cordova Mat Su Borough
1989	Anchorage Glennallen Seward
1991	Mat Su Borough
1994	Mat Su Borough
1995	Anchorage Cordova Mat Su Borough Whittier
1997	Copper River
2000	Anchorage Cordova Iliamna Mat Su Borough Newhalen Valdez Whittier
2003	Pedro Bay
2006	Copper River Cordova Mat Su Borough Eyak McCarthy Valdez

Kenai Peninsula	
Homer	2000 2002
Kachemak Silo	2002
Kenai	1995 2000
Kenai Borough	1981 1986 2002 2006
Port Graham	2002
Willow Creek	1979

Kodiak	
Karluk	1978
Kodiak	1980 1991 1992 2000 2002 2003

Southeast	
Angoon	1984
Chilkat	1998
Craig	1978
Elfin Cove	1995
Haines	1985 1988 1998 2005
Hoonah	2005
Juneau	1984 1998 2005
Kake	1984 2000
Kasaan	2004
Klawock	1989
Metlakatla	1994
Pelican	1995 2005
Sitka	1984 2005
Skagway	1994 2005
Tenakee Springs	1984
Wrangell	1978

Kenai Peninsula	
1979	Willow Creek
1981	Kenai Borough
1986	Kenai Borough
1995	Kenai
2000	Homer Kenai
2002	Homer Kachemak Silo Kenai Borough Port Graham
2006	Kenai Borough

Kodiak	
1978	Karluk
1980	Kodiak
1991	Kodiak
1992	Kodiak
2000	Kodiak
2002	Kodiak
2003	Kodiak

Southeast	
1978	Craig Wrangell
1984	Angoon Juneau Kake Sitka Tenakee Springs
1985	Haines
1988	Haines
1989	Klawock
1994	Metlakatla Skagway
1995	Elfin Cove Pelican
1998	Chilkat Haines Juneau
2000	Kake
2004	Kasaan
2005	Haines Hoonah Juneau Pelican Sitka Skagway

Alaska DOT&PF - Erosion Control Projects: 1998 – 20099

Used to Identify Communities Potentially Impacted by Climate Change
Updated 12/3/2008

In addition to the projects listed below, ADOT & PF addresses permafrost warming/melting on every road in the interior. Major routes include the Alaska Highway, Glenn Highway, Tok Cutoff, Richardson Highway, Parks Highway, Elliott Highway, Dalton Highway, Denali Highway, and the Edgerton Highway. Northern Region Maintenance and Operations spends approximately $10M per year on combating warming/melting permafrost. This is the funding level provided and does not reflect ADOT&PF's estimate of need.

Proposed or Current Design Projects	Funding Source	Project #	Description
Barrow Arctic Research Center Road	FHWA	76970	Relocate access road to Research Center due to erosion of Stevenson Street.
Chignik Bay Airport	CIAP		Airport Access Culvert Replacement
Chignik Lagoon Runway Repairs	GF/CIAP		Proposed project
Coldfoot Airport Erosion Control	FAA	60851	Protect the Coldfoot airport and access road from imminent erosion by the Koyukuk River.
Emmonak Airport Rehabilitation - Stage II	FAA	62641	Included in the scope of the Airport Project is to Relocate the existing powerline to the Airport due to River Erosion
mmonak Flood Permanent Repairs Airport/Clinic Road	FHWA	62754	Repair damage to airport access road caused by recent flooding.
Galena Campion Road Erosion Protection	FHWA	61653	Relocate a portion of Campion Road to avoid erosion of approximately 2 miles of the existing alignment that is threatened by the Yukon River.
Gambell Evacuation Road	FHWA	62973	Repair and extend road used for evacuation of village during annual coastal floods from large westerly storms.
Glenn Highway Erosion MP 62.4	GF		Proposed
Glenn Hwy Realignment MP 78	GF		Proposed
Hughes Airport Improvements	FAA	60245	Address the current flood threat to the facility by raising the grade of the airport and relocating the apron, and possible relocation.
Kivalina Airport Permanent Repairs	FEMA	76926	Repair eroded side slopes and safety area at the airport eroded during 2005 Bering Sea Storm. Protect the most severely damaged portion of the side slopes with a stone revetment.
Kotzebue Roads - Shore Avenue	FHWA	60788	Reconstruct Shore Avenue to provide erosion protection from storms and long-shore currents.

Proposed or Current Design Projects	Funding Source	Project #	Description
Little Diomede Helipad Improvements	FAA	61470	Repair ice scour damage to helipad embankment, repair lighting damage from Storm Events.
Nanwalek Airport	AIP		
Newtok/Mertarvik	GF		
Noatak Airport Relocation	FAA	61478	Airport Relocation due to erosion by the Noatak River
Nome Council Permanent Repairs	FHWA		This project is currently in Construction to repair damages to the Nome Council Road due to the 2005 Bering Sea Storm. A hardened rock structure is being constructed in selected areas to aid in future protection of the road.
North Slope Borough Road Improvements	FHWA	76972	Relocate access road connection to Cake Eater Road due to erosion of Stevenson Street.
Nulato Airport Road	None		Project includes armoring embankment and raising grade to stop flooding and erosion by the Yukon River.
Nunam Iqua Airport Rehabilitation	FAA		Part of the scope of this project is to Construct a road to the airport to eliminate the Boardwalk Access. Currently, the boardwalks are damaged from flooding from both fall storms, and spring ice jam events, and have to be repaired. This project will Construct a road above flood levels to the airport.
Parks Highway Erosion Protection MP 72	CIAP		Willow Creek – Proposed
Point Hope Evacuation Road Extension	FHWA	76968	Construct an evacuation road extension to an elevation above flood levels.
Point Hope Evacuation Road Rehabilitation	FHWA	76966	Rehabilitate and raise grade of road used for evacuation of village from storm surge and flooding.
Portage Glacier Highway	CIAP		Erosion Protection – Proposed
Quigillingok Airport	GF		Currently addressing land acquisition issues
Seward Highway Culvert Replacement	CIAP		Proposed
Shageluk Airport Access Road Improvements	FHWA	62171	Raise roadbed or realign to minimize impact of flooding by Innoko River.
Shishmaref Airport Masterplan	FAA		Masterplan activities evaluating airport relocation options related to Community relocation.
Shishmaref Relocation Road	FHWA	76776	Reconnaissance study to construct road to access Ear Mountain Material source for material to relocate Shishmaref village due to severe erosion from storms.
Sterling Highway Realignment MP 153.2	FHWA		Proposed

Active Projects Needing Additional Funding	Funding Source	Project #	Description
Gambell Evacuation Road		62973	Current Cost estimates indicate there is not enough funding to complete road to far side of the island. The community has requested additional funding for the project, and DOT&PF is considering the request.
Kivalina Airport Permanent Repairs		76926	The engineer's estimate for the rip rap revetment along the taxiway of the airport is considerably higher than initial FEMA estimates. DOT&PF currently has a request to FEMA for the additional funding, but we are unsure if FEMA will approve the request.
Kotzebue Roads - Shore Avenue		60788	This project is currently designed with an additive alternate to provide a hardened rock structure along the first 1000' of the project, North of Lake Street. Depending on how the bids come in this additive may or may not be awarded. The city has also identified an area of erosion concerns North of the Shore Avenue project limits along the beach.
Point Hope Evacuation Road Extension		76968	Current Cost estimates indicate there is not enough funding to construct the evacuation road to the length requested by the community.
Shishmaref Relocation Road/Airport sterplan		76776	Currently DOT&PF is funded to prepare a Reconnaissance Study and perform masterplan studies. No funding for construction has been identified.
me Council Road			FHWA ER funded project will not permanently protect the airport from erosion damage. Additional needs include grade raises/slope protection.

Projects Completed	Funding Source	Project #	Description
Chignik Airport Access Road	FHWA		Shore Protection
False Pass Airport	AIP		Replaced 1/3 of Runway (10 years ago)
Girdwood Airport Erosion Protection	AIP Surface Maintenance		Surface maintenance effort
Homer – Burbank Culvert	GF		Constructed by Maintenance
Homer Spit Fishing Lagoon	FHWA		Dynamically stable beach/beach nourishment project
Homer Spit Road and Trail shore protection	FHWA		Construction Complete
Hooper Bay Airport	AIP/GF		15 years ago – major project; smaller projects within last 5 years
Hyder	GF/FHWA		Completed several erosion projects
Kivalina Airport	FEMA		Shore Protection
Kodiak – Pasagshak Road	FHWA		Shore protection – constructed
Kodiak Ferry Terminal	FHWA		Shore Protection
Koyukuk Airport Improvements			Completed Airport Improvements to increase airport elevation above 100 year flood levels.
Ninilchik Access Road	GF		Shore Protection – Maintenance
Platinum Airport	AIP		Erosion issues – FY 09 Construction
Sand Point Runway Armor Stone	GF		
Shaktoolik Airport Permanent Repairs			Completed Airport Repairs to the Safety Area and Nav Aids due to the 2005 Bering Sea Storm flooding.
Skagway	FHWA		Completed Tiaya River Erosion Control Project
Solomon and Safety Sound Waysides Permanent Repairs			Both waysides were damaged during the 2005 Bering Sea Storm event. The Boardwalks were repaired and replaced where needed, and roads and parking areas were repaired.
Unalakleet Beach Road Permanent Repairs			Constructed repairs and a new hardened rock structure along the Beach Road that was damaged in the 2005 Bering Sea Storm.
Unalakleet Airport Access Road	FHWA		Dynamically stable beach/berm breakwater project – constructed
Unalaska Airport	GF		Constructed
Unalaska Airport	GF		Corrected a big erosion issue in last 5 years
Unalaska East Point and Ballyhoo Road	FHWA		Shore protection – completed

Department of Natural Resources – Division of Forestry – Community Wildlands Protection Plans					
Number	Lead Agency(s)	CWPP Name	CWPP Status	Estimated Cost	Communities included in CWPP
1	FNSB, DOF	Fairbanks North Star Borough	Complete	$40,000	Fairbanks, North Pole, College, Fox, Salcha, Ester
2	MSB,DOF, Local	Horseshoe Lake	Complete	Unknown	Horseshoe Lake
3	MSB	Matanuska- Susitna Borough	Complete	Unknown	Wasilla,Palmer,Butte,Sutton,Chickaloon,Knik,Big Lake,Houston,Willow,Talkeetna,Trapper Creek, Petersville
4	Muni of Anchorage	Municipality of Anchorage	Complete	Unknown	Anchorage,Rainbow, Indian, Bird Creek, Girdwood, Portage, Eagle River, Chugiak, Ekultna
5	DOF, Local	Chitna	Complete	Unknown	Chitna
6	KPB, DOF,Local	Anchor Point/Happy Valley/Nikolaevsk	Complete	$20,000	Anchor Point,Happy Valley,Nikolaevsk
7	KPB, DOF,Local	Cooper Landing	Complete	$20,000	Cooper Landing
8	KPB, DOF	Diamond Ridge/Fritz Creek/Fox River	Complete	$20,000	Diamond Ridge,Fritz Creek,Fox River
9	KPB, DOF	Funny River	In Progress	$20,000	Funny River
10	KPB, DOF	Halibut Cove & Vicinity	Complete	$20,000	Halibut Cove & Vicinity
11	KPB, DOF	Homer /Kachemak	Complete	$20,000	Homer,Kachemak
12	KPB, DOF	Hope/Sunrise/Summit	Complete	$20,000	Hope,Sunrise,Summit
13	KPB, DOF	Kalifornsky/Kasilof/Cohoe/Clam Glutch	Complete	$20,000	Kalifornsky,Kasilof,Cohoe,Clam Glutch
14	KPB, DOF	Kenai	Complete	$20,000	Kenai
15	KPB, DOF	Moose Pass/Crown Point/Primrose	Complete	$20,000	Moose Pass,Crown Point,Primrose
16	KPB, DOF	Nawalek	Complete	$20,000	Nawalek
17	KPB, DOF	Nilichick/Nilichick Forties	Complete	$20,000	Nilichick,Nilichick Forties
18	KPB, DOF	Nikisiki/Salamatof/Grey Cliffs	Complete	$20,000	Nikisiki,Salamatof,Grey Cliffs
19	KPB, DOF	Port Graham	Complete	$20,000	Port Graham
20	KPB, DOF	Soldotna/Ridgeway	In Progress	$20,000	Soldotna,Ridgeway
21	KPB, DOF	Seldovia	Complete	$20,000	Seldovia

Department of Natural Resources – Division of Forestry – Community Wildlands Protection Plans					
Number	Lead Agency(s)	CWPP Name	CWPP Status	Estimated Cost	Communities included in CWPP
22	KPB, DOF	Bear Creek/Seward/Lowell Point	In Progress	$20,000	Bear Creek,Seward,Lowell Point
23	KPB, DOF	Sterling	In Progress	$20,000	Sterling
24	KPB, DOF	Tyonek/Beluga	In Progress	$20,000	Tyonek/Beluga
25	USFWS	Allakaket	Complete	Unknown	Allakaket
26	USFWS	Ruby	Complete	Unknown	Ruby
27	USFWS	Beaver	Complete	Unknown	Beaver
28	USFWS	Venetie	In progress	Unknown	Venetie
29	USFWS	Galena	Complete	Unknown	Galena
30	USFWS	Stevens Village	Complete	Unknown	Stevens Village
31	USFWS	Evansville/Betties	Complete	Unknown	Evansville,Bettles
32	DOF, Local	Mentasta	Planned	$20,000	Mentasta
33	DOF, Local	Dry Creek	Planned	$20,000	Dry Creek
34	DOF, Local	Glennallen	Complete	$20,000	Glennallen
35	DOF, Local	Strelna	Complete	$20,000	Strelna
36	DOF, Local	Tanacross	Planned	$20,00	Tanacross
37	DOF, Local	Tok	Complete	Unknown	Tok
38	DOF, Local	Koyukuk	Planned	$25,000	Koyukuk
39	DOF,BLM,Local	McGrath	In Progress	Unknown	McGrath
40	DOF,local	McCarthy	In Progress	$20,000	McCarthy, Kennicott,Fireweed Mountain

APPENDIX B
FORMAL SUBMISSIONS FROM AND TO THE IAWG

STATE OF ALASKA
DEPARTMENT OF
COMMERCE
COMMUNITY AND
ECONOMIC DEVELOPMENT
Office of the Commissioner

Sarah Palin, Governor
Emil Notti, Commissioner

December 11, 2008

Mr. John H. Dunnigan
Assistant Administrator for Ocean Services & Coastal Management
NOAA
1305 East-West Highway
Silver Spring, MD 20910

Dear Mr. Dunnigan:

The State of Alaska has embarked on an ambitious and timely process of examining the issues, approaches and solutions to the impacts of a warming arctic environment. As part of that effort, the Governor has appointed members of her cabinet to serve as her Climate Change Sub-cabinet advisory body. The chair of the Sub-cabinet is Commissioner Larry Hartig of the Department of Environmental Conservation. Subsequently, Commissioner Hartig established an Immediate Action Work Group to identify actions and policy development the work group feels is necessary in the immediate future. I serve as State co-chair while Patricia Opheen of the Corps of Engineers serves as the federal co-chair of the work group. Although we have a very limited membership, we are extremely pleased that Amy Holman of your organization has consented to serve on our work group.

On behalf of the State of Alaska and the Immediate Action Work Group of the Governor's Sub-cabinet for Climate Change, I commend NOAA for participating in our efforts. I also am excited that NOAA is seeking additional data on the weather, sea level heights and tidal ranges of Alaska's oceans. Lack of data on tides and weather patterns on the Alaskan coastlines is a substantial barrier to understanding what changes may be occurring in relation to climate change phenomena.

It is our understanding that NOAA plans to establish new tidal gauges and meteorological monitoring sites along Alaska's coast. The Immediate Action Work Group called for additional tide and water level stations in our April 2008 recommendations report to the Governor. Our top ten priority areas for placement of these stations (including meteorological instrument packages) are:

1. Bering Straits- Wales or Little Diomede;2. Norton Sound – Unalakleet ; 3. Kuskokwim Bay – Platinum; 4. Arctic Ocean – Barrow; 5. Bristol Bay – Dillingham; 6. St Lawrence Island – Savoonga or Gambell; 7. Bering Sea – Hooper Bay or Scammon Bay; 8. Alaska Peninsula – Nelson Lagoon; 9. Cape Lisburne; 10. Nelson Island – Metarvik.

550 W. 7th Avenue, Suite 1770, Anchorage, Alaska 99501-3510
Telephone: (907) 269-8100 Fax: (907) 269-8125 Text Telephone: (907) 465-5437
Website: http://www.commerce.state.ak.us/

STATE OF ALASKA
DEPARTMENT OF
COMMERCE
COMMUNITY AND
ECONOMIC DEVELOPMENT

Office of the Commissioner

Sarah Palin, Governor
Emil Notti, Commissioner

Thank you for considering our opinion on this very important data-gathering effort. If we can be of further service, please contact me at the number listed below or by email at Michael.Black@alaska.gov.

Sincerely,

Michael L. Black
Deputy Commissioner

Cc: Michael W Szabados
Director, NOS Center for Operational Oceanographic Products and Services

CAPT Steven R. Barnum
Director, Office of Coastal Survey
NOAA Commerce and Transportation Goal Team Lead

550 W. 7th Avenue, Suite 1770, Anchorage, Alaska 99501-3510
Telephone: (907) 269-8100 Fax: (907) 269-8125 Text Telephone: (907) 465-5437
Website: http://www.commerce.state.ak.us/

2

TO: Tessa Rinner, Director of Programs, Denali Commission

Date: January 9, 2009

RE: **Immediate Action Workgroup (IAWG) Comments to FY 2009 Commission Work Plan**

Comments prepared by: Jamilia George, State Co-Chair Representative to the Denali Commission

The Immediate Action Workgroup is a jointly chaired state-federal working group formed to make recommendations on projects, policies and goals that can be initiated or accomplished in a 12 – 18 month period (January 2009 – July 2010), for communities facing imminent threats of loss of life, loss of infrastructure, loss of public and private property or health epidemics due in–part to a changing climate.

IAWG members include DCCED, NOAA, USACE, DEC, DOT, DHS&EM, Denali Commission, ANTHC and others. All meetings are public and many rural community leaders participate in person and by teleconference. Deputy Commissioner Mike Black (DCCED) and Trish Opheen (USACE) are co-chairs.

Members identified 3 reports as highly relevant in reaching consensus on policy, project and budget recommendations for rural infrastructure: USACE – Baseline Erosion Assessment; Military & Veterans Affairs 30 Year Review of Disasters in Alaska; and the GAO Revised Report on Relocating Alaska Rural Communities. Central to the decision making process is the ability of rural communities to effectively identify known risks and hazards. In this regard, hazard mitigation planning on a regional level s critical. Funding for such planning is limited at both the state and federal level under current administrative and congressional regulations.

The Denali Commission FY 2009 Work Plan and revised policies and procedures recognize the importance of regional planning, support and strategy to sustainable infrastructure and community vitality. The IAWG believes that the Work Plan as drafted should include the opportunity for rural communities to apply for funding of Regional Hazard Mitigation Plans. The IAWG members understand the Commission's support of regional planning to be a necessary component to the decision-making process for funding infrastructure investment at the Commission. The IAWG therefore requests that the Work Plan be amended to include a modest but reasonable pool of funds **for purposes of establishing Regional Hazard Mitigation planning. It is the recommendation of the IAWG that $1,000,000. for Fiscal Year 2009 be included in the Work Plan for this purpose.**

For further information supporting the above comments and request, please contact Deputy Commissioner Mike Black (DCCED), Trish Opheen (USACE) or John Madden (DHS & EM).

December 3, 2008

To: Governor's Sub-Cabinet on Climate Change
From: The Interagency Hydrology Committee for Alaska
Subject: Hydrology Needs for Alaska

The Interagency Hydrology Committee for Alaska (IHCA) is an organization of technical specialists working for Federal, State, borough, and local governments and Federally recognized tribes, who coordinate the collection and interpretation of data related to water resources and climate throughout the State of Alaska.

As you are well aware, climate change, particularly current warming trends in the high latitudes, is leading to changes in Alaska's freshwater, estuarine, and marine environments. One of the best measures of the rate and magnitude of change, and perhaps the most impacted natural resource in terms of both timing and quantity changes, is in fact water volume and associated characteristics. For example, rivers and lakes freeze over later in the year and become ice-free earlier in the year, permafrost is thawing, and precipitation patterns are changing. Agencies and communities in Alaska have become increasingly aware of the emerging and potential effects of climate change. However, the authorities charged with protecting the public safety and managing natural resources in the best public interest require appropriate information and tools to take specific actions in response to and preparation for changing environments.

IHCA has developed the following list of topics that are especially important to detecting, quantifying, and adapting to climate-driven change and recommend that research and monitoring in support of state and local needs be encouraged and supported with the highest priority:

- Extent of permafrost and the effects of changing permafrost on subsurface hydrology, aquifer yield, and lake draining or formation;
- Baseline flow and water volume conditions of rivers and lakes versus changing spatial and temporal hydrologic patterns, such as changes in seasonality, flood magnitude, and drought severity;
- The spatial and seasonal distribution, timing, intensity, and state of precipitation;
- Freeze-up, break-up, ice thickness, and ice jams on lakes and rivers;
- Extent of glacier mass changes, the contribution of glacier melt to streamflow, and frequency of outburst floods;
- Geologic and geotechnical trends related to active layer detachments, mass wasting, and sloughing;
- Avalanche timing, prevalence, and trends;
- Socio-economic cost to address changing conditions of water availability and quality;
- Erosion and sediment transport effects resulting from changes in runoff patterns;
- Short and long term planning for water supply, demand, and support infrastructure to mitigate emerging and anticipated environmental change.

IHCA will be happy to provide additional details, including specific agency projects and outstanding needs that will benefit from the hydroclimatic research listed here. We are also happy to provide technical support to your group upon request.

Sincerely,

Steven A. Frenzel
Chair, Interagency Hydrology Committee for Alaska

DEFINITIONS FOR IAWG

MITIGATION AND ADAPTATION

As stated in the Arctic Climate Impact Assessment, "The science suggests that responding to this challenge will require two sets of actions; one, *mitigation*, to slow the speed and amount of future climate change by reducing greenhouse gas emissions; and the other, *adaptation,* to attempt to limit adverse impacts by becoming more resilient to the climate changes that will occur while society pursues the first sect of actions," (ACIA, 2004). It is important to note that mitigation in the context of the Alaska Department of Military & Veterans' Affairs and FEMA, is consistent with adaptation in improving infrastructure to minimize damage from natural disaster events. (Final Commission Report, Alaska Climate Impact Assessment Commission, March 17, 2008).

SUSTAINABILITY

World Commission on Environment and Development

Sustainability is "meeting the needs of the present without compromising the ability of future generations to meet their own needs." (Bruntland Report, WECD, 1987- broad, most commonly accepted definition, as set out by the World Commission on Environment and Development (WCED)

EPA Sustainable Infrastructure Initiative

Looking forward, EPA wants to promote practices that encourage utilities and their customers to address existing needs so that future generations will not be left to address the approaching wave of infrastructure needs that will result from aging infrastructure.

SEA ICE

Defined by World Meteorological Organization in numerous terms:
http://www.aari.nw.ru/gdsidb/XML/sea_ice_nomenclature.html

For purpose of our work, refer to landfast sea ice: http://mms.gina.alaska.edu/supp/Definition.pdf

Excerpt: Numerous definitions of landfast ice exist in the literature, which consider to different extents all the processes that occur in the nearshore zone in the presence of sea ice. According to Weaver (1951) "fast ice or landfast ice is the young coastal ice which, in stationary sheets, builds seaward from the shore of landmasses … by being more or less attached to the shore, or by being otherwise confined". The World Meteoroligical Organization (1970) defines fast ice as "Sea ice which remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, or over shoals, or between grounded icebergs". Stringer *et al.* (1978) define the fast ice zone as "the area generally shoreward of the 20m isobath with quite stable ice much of the year" and only include ice contiguous with the shore. Barry *et al.* (1979) list three criteria that can distinguish landfast ice from other forms of sea ice: "(i) the ice remains relatively immobile near the shore for a specified time interval; (ii) the ice extends from the coast as a continuous sheet; (iii) the ice is grounded or forms a continuous sheet which is bounded at the seaward edge by an intermittent or nearly continuous zone of grounded ridges".

Furthermore, according to the WMO, sea ice can be classified as either landfast ice or pack ice, while Weaver describes drift ice as a third category, which is "transitionary between the fast ice and the polar pack ice". Similarly, Stringer *et al.* define a category for ice in the shear zone between the landfast ice and pack. (AK-03-06, MMS-71707), Mahoney, et.al.

ARCTIC

The **Arctic** is the area around the earth's North Pole. The Arctic includes parts of Russia, Alaska, Canada, Greenland, Lapland and Svalbard as well as the Arctic Ocean. The 10°C (50°F) July isotherm is commonly used to define the border of the Arctic region.
From: http://www.knowledgerush.com/kr/encyclopedia/Arctic/

RIVERINE

FLOOD - A flow beyond the carrying capacity of a channel.

EROSION - The wearing away of land by the action of natural forces. On a river the carrying away of material by wave action or flow of water.

COASTAL

FLOOD - A water level above the highest estimated tide.

EROSION - The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, and littoral currents.

Erosion/Deposition is an ongoing natural process, not a unique event, often times increased during flooding.

Flooding is a unique natural event, the boundaries of which can be influenced by the extent of erosion.

Planning/Program/Project Integration

Immediate Action Workgroup
Policy 1 Recommendation

Step 1: Data

- Identify all data on public and critical infrastructure
  - State agencies
  - Federal agencies
  - Denali Commission
  - Local and tribal entities
  - Non-governmental organizations
  - Private sector
  - Academia
- Consolidate/link together the data
- Enable queries for agencies and communities
- Improve quality of data and databases

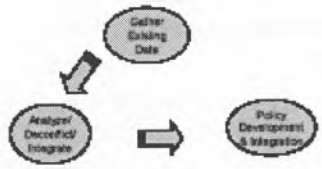
Step 2: Analysis

- Identify and fill gaps in data
- Determine status and capability of current infrastructure
- Determine useful life and future plans for repair, renovate, retrofit, replacement, or relocation
- Determine vulnerabilities to climate/weather and other environmental/economic factors
- Identify all funding and budget streams
- Identify conflicts between agency plans

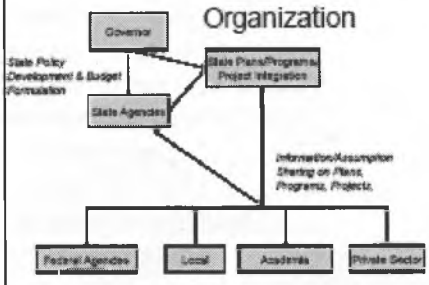
Step 3: Policy Integration

- Improve policy coordination between agencies – timing, impacts, integration
- Determine effects of proposed policies
- Test assumptions of climate, economic trends and strategic directions
- Determine effects of non-state policies and budgets
- Update analyses for new data information
  - Weather patterns/flood plains/mapping
  - Economic assumptions
  - Changes in demographics
- Document out-year O&M costs
- Calculate life cycle costs
- Contribute data to budget formulation

Implementation Steps For Integrating Plans, Programs, and Projects



Organization



IAWG Sustainability Considerations

The common idea for sustainability uses the Brundtland Commission definition of sustainable development to view a community's present needs:

> *"without compromising the ability of future generations [in a rural community] to meet their own needs".*

Alaska's Small Communities Could be Sustainable – viable in the near term - to the extent they are resilient to interrelated vulnerabilities presented by climatic/ecological changes.

Larger communities face a very different scale of sustainability issues.

National or international economic forces impacting financial conditions increase sensitivity within a community. These forces originate outside of the immediate locale such as energy and resource extraction operations.

A Sustainable Community is Able to Respond to Climate Impacts and to Become Resilient.

Local government can be organized in many ways to achieve this: as a conventional city/local government, tribal entity or it may rely on a traditional town hall or congregational meeting structure.

Minimum Level of Population.

What is likely needed is for the community to have a minimum level of population to continue basic functions of:

- education,
- economic structure
- public safety,
- community water / sewer,
- management of the waste stream, and
- cohesive culture and social presence.

Additionally, an intrinsic part of sustainability requires directly linking a community's viability to the costs of energy and transportation, which frequently are based on factors not directly associated with a minimum population level. A viable community, whether it remains in its location, or if migration or relocation occurs requires:

- viable connections to transportation systems, and
- affordable and appropriate energy.

Protect in Place.

Critical to a community's sustainability is its population. If people relocate to larger urban centers, sometimes called out migration, the remaining community may be reduced to a level that cannot maintain needed services and infrastructure. To insure that this out migration does not lead to the original community's loss of culture and social presence, it is important that the community prepare and plan to "protect in place" and evaluate possible contingencies including a relocation plan.

Weighted Sustainability Index.

The question being asked in some arenas is whether and at what point a community should be considered for climate impact responses. A weighted sustainability index should be used to determine when climactic influences impacting a small community are strong enough to warrant a response. Small communities could be very sustainable while others may be critically impacted.

This index could include:

- economic measurements,
- current energy usage and viable energy alternatives,
- access to subsistence resources,
- population change, along with
- available municipal, private, state and federal programs.

The local weighting factors for a community's relocation would depend on:

- estimating present and future time tables, programs and costs (all to be determined),
- ecological/climatic change modeling of impacts and opportunities
- consideration of all stakeholders' interests.

IAWG Recommendation to Review Funding Structure for Public Infrastructure O&M And Protect Public Infrastructure Investment and Prevent Loss of Life

The Immediate Action Workgroup identified, as we believe the Subcabinet and the PI - TWIG have also recognized, that maintenance of the State's infrastructure is a critical immediate action to prevent loss of life and infrastructure due to impacts from climate change phenomena.

The IAWG also recognized that the policy issues to address budgeting for maintenance is beyond the scope of its work, but identified it as a significant item warranting the immediate action to encourage and support your efforts to advance changes in policy.

The ***guiding principles*** supporting the IAWG's recommendation to the Subcabinet and PI-TWIG are:

- Protecting Alaska's infrastructure investment that is already in place is an immediate need.
- Authorization and funding of an Infrastructure Maintenance Capital Fund, if well-structured would be an effective tool:
    - Use revenue sharing model
    - Use prioritization mechanism to identify projects
        - Coordinate plans for capital projects in a given community for cost-effectiveness
        - Utilized by both State and Local entities
            - When local is the lead, supported with engineering and professional assistance by State (ADOT) or Federal (USACE)

The IAWG's rationale and ideas for policy changes on maintaining infrastructure investment follow.

Effective and sustainable shore-protection structures must be an integral part of the state's climate change adaptation strategy and must be supported by a long-term maintenance funding program.

- The State of Alaska has vital national and state interest in the stability and behavior of coastal structures around its coastline, to ensure public safety – for both life and infrastructure investments and for the economic health of many coastal communities.
- The dominant coastal structure between Alaskan ports, harbors, navigation channels and the sea are rubble mounds. These include breakwaters, revetments, jetties, and groins. Other types of structures are common and include seawalls, piers, and bluff protection.
    - They are used for protecting harbors, wave reduction within harbors, retaining sediment, protecting navigation waterways, shoreline protection, and bluff protection.
- The purpose of maintenance is to ensure the long-term viability of public infrastructure investment, public safety and economic health by:
    - Protecting harbors and inlets that are important commercial and military navigation links
    - Protecting shore-based infrastructure
    - Providing beach and shoreline stability control
    - Stabilizing navigation channels
    - Protecting navigation, coastal communities, roadways, bridges, etc.
    - Providing flood protection
    - Providing recreational activities

While most navigation structures are federally owned and maintained, most shore-protection structures are locally owned and maintained, yet funded by the State.

The cost of replacing existing coastal protection infrastructure investment is high, and the cost of responding to a disaster is exorbitant. The State of Alaska needs to improve the means and methods for reducing these costs. If can do this by:

- Regular preventative maintenance efforts can substantially reduce risks, save lives and property, and reduce full replacement costs and can extend the life of investment for 50 or more years.
- Reducing the design and construction costs of coastal structures by employing risk, life-cycle, and reliability analysis techniques in both planning and design studies in order to develop more efficient designs.

Alaska has aging infrastructure requiring maintenance:

- Most of these structures were originally built in the early 1900's and have been extended and rehabilitated many times.
- Maintenance of existing inlets becomes more important each year as ship traffic and ship drafts increase.
- As the inlet-protecting jetties erode, dredging costs can increase at an alarming rate. In addition, maintenance of existing revetments and other shoreline structures is becoming more important with increasing coastal population.
- As a result, inspection, repair, and rehabilitation of existing structures represents a large part of coastal rubble-mound work within the state while new construction of this class of structure represents a diminishing fraction of the projects.

Challenges and suggestions for changes to an Infrastructure Maintenance Policy:

- State builds, and then a community is responsible for maintenance.
    - How does a community get funding to maintain?
    - How is infrastructure inspected?
        - ADOT isn't sure of what the infrastructure inventory is
            - ADOT needs an inventory of what is out there. DCRA-Rapids Database has been identified as the preferred inventory database
        - ADOT isn't sure of the condition of infrastructure and doesn't have funding for inspections
            - Problems are discovered when there is an emergency or almost emergency situation and a community alerts DOT about a problem
- Create an Infrastructure Maintenance Capital Fund for ADOT and local governments to draw on to:
    - Conduct inspections for infrastructure and facilities, and allow ADOT or others to maintain in a timely manner

      Examples: Beach nourishment—5 years is a standard maintenance timeframe.
    - Funds could be used for design work, upgrade riprap structures and rock revetments to replace the rock decreasing the amount of decay.
        - Develop a mechanism to prioritize projects; some ideas are:
            - Eligible for funds if a community had a certain type of structure—or possibly expand (revetment or beach nourishment)
            - Local—would need guidance from USACE or ADOT—to ensure appropriate work being conducted – to maintain life of structure.
            - When local government is responsible for—maybe factor into a revenue sharing formula, or perhaps based on Legislative districts, capital matching grants. (ex: —$1500 per mile for road maintenance; will need p/ft rock revetment formula to fund local projects)

APPENDIX C
DOCUMENT PRESENTATIONS AND SUBMISSIONS

Document Presentations and Submissions

This section includes only some of the handouts and presentation materials presented at the IAWG meetings. All materials can be found at the **IAWG Website:**
http://www.climatechange.alaska.gov/IAWG.htm

- **For Each IAWG Meeting Listed in Appendix D:**
  - Agendas
  - Meeting Summaries
  - Working Drafts Which Became Sections of this IAWG Recommendations Report
  - Public Meeting Notices

- **Presentations by Alaska Dept. of Transportation and Public Facilities:**
  - Infrastructure and Erosion Control, Beach Nourishments Efforts
  - Shore Protection, Nourish or Armor?

- **Presentation by Dept. of Commerce, Community & Economic Development**
  - Community Databases Managed by Division of Community & Regional Affairs:
    - 10 Databases – see page 1XX of this report for descriptions

- **Presentation by Dept. of Natural Resources – Division of Coastal and Ocean Management**
  - Coastal Impact Assessment Program (CIAP)
    - Additional materials complementing those in this report, starting on page 1XX

- **August 28, 2008 Status and Progress Presentations by IAWG Member Agencies**
  - Six Communities in Peril, Division of Homeland Security & Emergency
  - Management Status of Project Actions for IAW Alaskan Communities, US Army Corps of Engineers
  - Community Projects, Dept. of Transportation and Public Facilities
  - Alaska Climate Change Impact Mitigation Program, Dept. of Commerce
  - Update on Denali Commission projects in threatened communities

- **Website Link - Presentation by ArcticNet a Network of the Canadian Centres Of Excellence**

  A joint program of the Natural Sciences and Engineering Research Council of Canada, the Social Sciences and Humanities Research Council of Canada, the Canadian Institutes of Health Research and Industry Canada. The Centres mission is to mobilize research and commercialization to build a healthier, more advanced, more competitive and more prosperous Canada.

- **Documents:**
  - Baseline Erosion Assessment by U.S. Army Corps of Engineers
    (will be posted in early April 2009)
  - Shaktoolik Route (Evacuation Road) Reconnaissance Study
  - Golovin - Multi-Hazard Mitigation Plan

From: Bobby Schaeffer [mailto:bschaeffer@nwabor.org]
Sent: Tuesday, December 23, 2008 4:14 PM
To: MARGARET KING
Subject: RE: IAWG 12/22 Agenda and 12/5 Meeting Notes

Marge,
I did listen in on most of todays tele. I just wanted to inform you and the IAWG that the village of Deering has been dealing with their erosion problem for quite some time. In fact, I recently received their Capitol Projects request and first on their list of priorities is Phase 3 of their beach erosion protection project. I worry about them as when you go there in the summer, frequent strong storms has eroded the beach line very close to the homes. In fact, one more large storm and some of these homes will fall into the sea. The village has been quite passive about the issue as they have worked directly with the legislators who represent this election district for funding for erosion control. Since the State is taking the lead in identifying villages facing serious erosion problems, and will ultimately find the resources to mitigate the problem, I do think they do need to get on the State list.

DATA RESOURCE GUIDE

Division of Community and Regional Affairs
www.commerce.state.ak.us/dcra/

Alaska Community Database – contains community profiles for more than 390 places in Alaska, the majority of which are communities. An interactive database provides a wide range of community-based information and data for planning, policy-making and technical assistance decisions.

Alaska Community Directory – current information on community officials and contacts. The online system is updated throughout the year,

Community Maps – online versions of the community profiles maps. These maps include information on these maps includes, but is not limited to: land status; platted boundaries; land use (for example, public, commercial and residential improvements, boat haul-out areas, etc.); topography; latitude and longitude points (for emergency response purposes); sensitive and natural hazard areas; as-built information.

Municipal Finances – The information in this database is derived from certified financial statements and financial audits that are submitted annually by municipalities. DCRA staff review the audits and certified financial statements and enter the information into the database to allow further analysis. DCRA has compiled this information since 1985. Only the latest information is shown on the Community Profiles page. However, if you want Municipal Finance data for earlier years you can contact Research and Analysis staff with you request.

Capital Projects Database – information on capital projects administered by over 20 State and federal agencies. Information includes project descriptions, funding levels and project status for over 20,000 capital projects past and present.

Economic Development Resource Guide (EDRG) – is designed to bring together in one place an inventory of programs and services that can provide economic development assistance to Alaska communities and businesses.

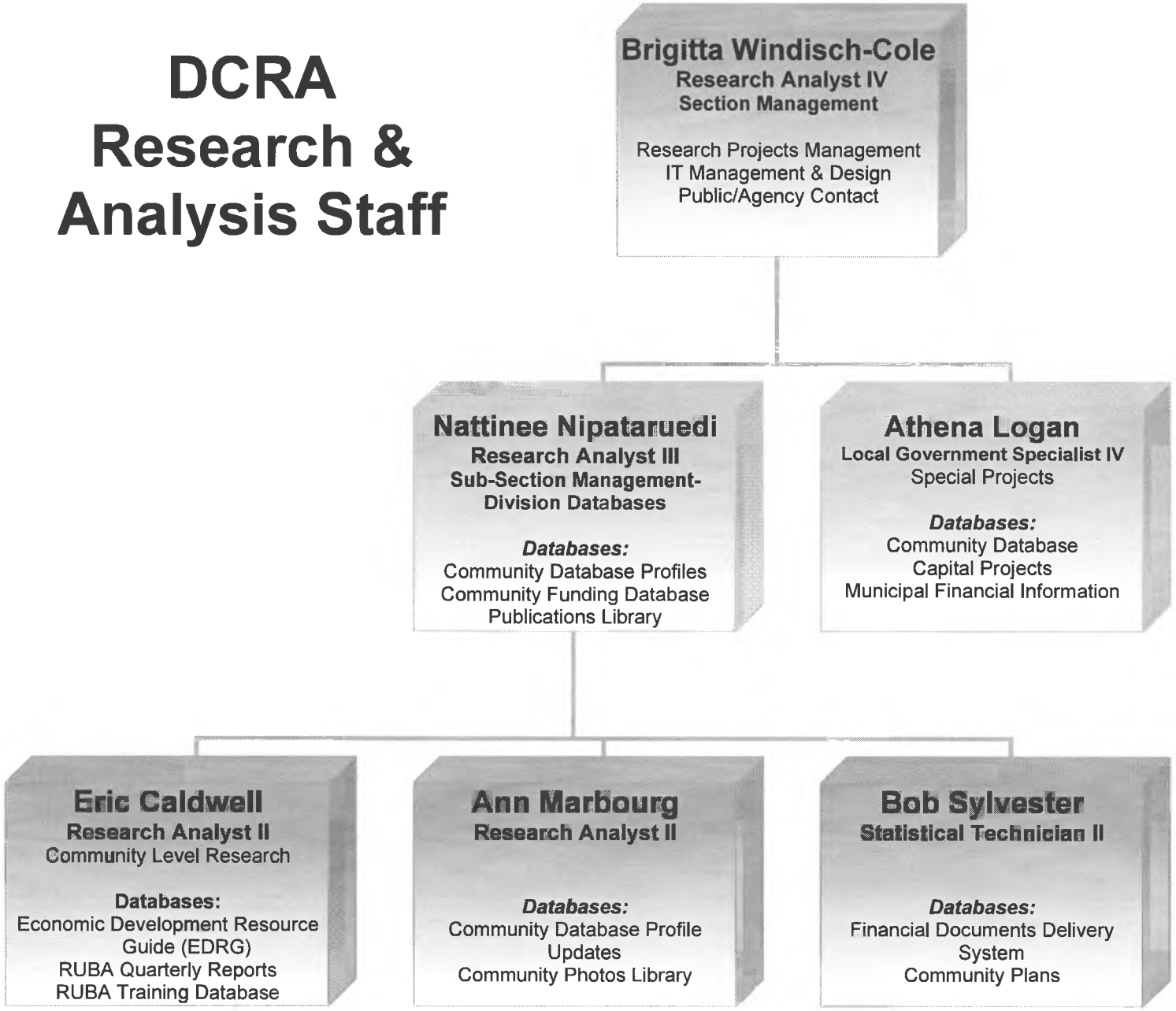
Community Funding Database – contains information on past and current funding to communities administered by the Division of Community and Regional Affairs, such as Mini-Grants, CDBG, Legislative Grant, etc. ***(Note: this does not include any projects that were funded through another Department or Division)***

Financial Documents Delivery System – Online copies of municipal budgets and financial statements submitted to the Division. Municipal budgets date back to FY2000. The year-end financial statements date back to FY1998 and consist of either an audit or city-prepared financial statement certified as true and complete by the local governing body.

Community Plans Library – houses an assortment of plans for communities. Documents include, community plans, comprehensive plans, and more.

Community Photo Library – contains community photos submitted by staff and the public

DCRA Research & Analysis Staff



Coastal Impact Assistance Program

The Energy Policy Act of 2005 (Public Law 109-58) was signed into law by President Bush on August 8, 2005. Section 384 of the Act establishes the Coastal Impact Assistance Program (CIAP) which authorizes funds to be distributed to Outer Continental Shelf (OCS) oil and gas producing states to mitigate the impacts of OCS oil and gas activities.

Under the CIAP, the Secretary of the Interior is authorized to distribute to producing

- States, and
- Coastal political subdivisions (CPS's)

$250 million for each of the Federal fiscal years (FY) 2007 through 2010. This money will be shared among Alabama, Alaska, California, Louisiana, Mississippi, and Texas and will be allocated to each producing state based upon allocation formulas prescribed by the Act. Further, the CIAP allocates money to the eligible CPS's of the states identified above.

Pursuant to the Act, a producing state or CPS shall use all amounts received under this section for one or more of the following five authorized uses:

Authorized Uses:

1. Projects and activities for the conservation, protection, or restoration of coastal areas, including wetland.
2. Mitigation of damage to fish, wildlife, or natural resources.
3. Planning assistance and the administrative costs of complying with CIAP.
4. Implementation of a federally-approved marine, coastal or comprehensive conservation management plan.
5. Mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs.

CIAP Contacts

Ms. Sylvia Kreel
Alaska Dept. of Natural Resources
Division of Coastal and Ocean Management
302 Gold Street, Suite 202
PO Box 111030
Juneau, AK 99811-1030
MS 1030/JNU
(907) 465-3177/ (907) 465-3075 (fax)
sylvia.kreel@alaska.gov

Mr. David Johnston
MMS Regional CIAP Representative
Minerals Management Service
Alaska OCS Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503
(907) 334-5273
David.Johnston@mms.gov

IAWG Comments on CIAP

Only Authorized Uses 3 and 5 above apply to the Immediate Action Workgroup's efforts.

Of this,

- Authorized Use 3: Planning assistance and the administrative costs of complying with CIAP - has been funded annually, while
- Authorized Use 5: Mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs has never been funded.

Yet, Authorized Use 5 could be valuable in developing projects that address immediate needs, including evacuation roads at Point Hope, Kivalina, etc. Shaktoolik and Shishmaref could be included but is only allowed funding under the State, while other authorizations are allowed for Coastal Political Subdivisions.

COASTAL IMPACT ASSISTANCE PROGRAM

Section 384 of the Energy Policy Act of 2005 established the Coastal Impact Assistance Program (CIAP). The Act authorizes the U.S. Department of Interior, Minerals Management Service to distributed $250 million annually for the years 2007 through 2010 to Outer Continental Shelf (OCS) oil and gas producing states and coastal political subdivisions (CPSs) to mitigate the impacts of OCS oil and gas activities.

Per a formula prescribed by the Act, Alaska's eight eligible CPSs will receive a combined total of 35 percent of Alaska's allocation. The remaining 65 percent is allocated directly to the state.

In 2007 and 2008 Alaska was allocated 1 % of the national CIAP funds. Due to the recent Chukchi Lease Sale, MMS has projected that Alaska's allocation will increase to be between 12% and 17 % of the national CIAP allocation in 2009 and 2010. MMS will announce final allocation in April 2009.

The tables below show the annual and total projected CIAP allocations to the state and the CPSs for both the high and low estimates.

Allocation Directly to State (65% of total to state)

	Total	2007	2008	2009	2010
Low end (12% of total federal funds for 2009 and 2010)	**30,982,500.00**	1,576,250.00	1,576,250.00	18,915,000.00	18,915,000.00
High end (17% of total federal funds for 2009 and 2010)	**56,745,000.00**	1,576,250.00	1,576,250.00	26,796,250.00	26,796,250.00

Allocation Directly to CPSs - Low end (35 % of total to state)

	Total	2007	2008	2009	2010
Municipality of Anchorage	**3,581,566.76**	137,767.88	137,767.88	1,653,025.50	1,653,025.50
Bristol Bay Borough	**17,627.72**	665.86	665.86	8,148.00	8,148.00
Kenai Peninsula Borough	**1,544,770.72**	59,435.36	59,435.36	712,950.00	712,950.00
Kodiak Island Borough	**1,902,235.04**	73,170.52	73,170.52	877,947.00	877,947.00
Lake & Peninsula Borough	**898,096.08**	34,518.54	34,518.54	414,529.50	414,529.50
Matanuska-Susitna Borough	**816,488.30**	31,399.15	31,399.15	376,845.00	376,845.00
North Slope Borough	**7,187,406.52**	276,448.76	276,448.76	3,317,254.50	3,317,254.50
Northwest Arctic Borough	**6,119,288.86**	235,343.93	235,343.93	2,824,300.50	2,824,300.50
Total	**22,067,500.00**	**848,750.00**	**848,750.00**	**10,185,000.00**	**10,185,000.00**

Allocation Directly to CPSs - High end (35 % of total to state)

	Total	2007	2008	2009	2010
Municipality of Anchorage	**4,959,109.00**	137,767.88	137,767.88	2,341,786.12	2,341,786.12
Bristol Bay Borough	**24,417.72**	665.86	665.86	11,543.00	11,543.00
Kenai Peninsula Borough	**2,138,895.72**	59,435.36	59,435.36	1,010,012.50	1,010,012.50
Kodiak Island Borough	**2,633,857.54**	73,170.52	73,170.52	1,243,758.25	1,243,758.25
Lake & Peninsula Borough	**1,243,537.32**	34,518.54	34,518.54	587,250.12	587,250.12
Matanuska-Susitna Borough	**1,130,525.80**	31,399.15	31,399.15	533,863.75	533,863.75
North Slope Borough	**9,951,785.28**	276,448.76	276,448.76	4,699,443.88	4,699,443.88
Northwest Arctic Borough	**8,472,872.62**	235,343.93	235,343.93	4,001,092.38	4,001,092.38
Total	**30,555,000.00**	**848,750.00**	**848,750.00**	**14,428,750.00**	**14,428,750.00**

DNR/Division of Coastal and Ocean Management
July 2008

TO: IAWG Members
FROM: Steve Weaver, ANTHC
DATE: 10/29 – 11/3/08 (Series of emails to M. King)

I've tried to capture my thinking about climate change data and effectively using that data by creating 3 tools: (1) Community Planning Strategy - on page 2; (2) Key Data Points – on page 3, and (3) Community Vulnerability Assessment Tool – described below.

Together these tools summarize a conceptual climate change adaptation strategy of (1) local empowerment and (2) providing understandable and actionable data that can be integrated into on-going community planning.

Link to Funding: I think this kind of framework is essential to an **incremental** relocation strategy where we are trying to *fund most of adaptation infrastructure expenses thru the existing traditional funding framework*. Virtually all current public works projects started as a local constituent legislative request or funding agency application.

To effectively use existing capital project processes will require communities to anticipate the impact of climate change and identify climate change infrastructure projects as high priority.

I originally put these concept papers together to show ANTHC staff how our climate change project might fit in to the big picture.

ANTHC is beginning work on a Community Vulnerability Assessment (CVA) tool (Tool 3).

The vulnerability tool would be a platform to list key data points and use that as a basis for establishing relative vulnerability. The outcome of the assessment would be a reference point integrated into overall community planning and a basis for application for climate change impact project funding.

This is why we hope to partner with the IAWG/Climate Change Effort so a consensus on what the "key indicators" are can be built and a broader acceptance of the tool facilitated.

I think the CVA tool could potentially include a conceptual community planning strategy as an appendix. How it can be utilized to facilitate better community planning and document and support an application for climate change adaptation project funding would make it a more useful tool.

We have the project funded, and are now looking for working partners.
Our plan is to:

- Write a draft community vulnerability assessment tool (CVA)*, then
- Test it in at least one rural Alaska Native community, preferably where ANTHC has a funded sanitation project – likely an ANTHC in-house vs. contractor implemented project
- Our intent is that the outcome product will be structured to be better aligned and suited to a broad application base.
- Develop a detailed work plan or schedule of completion in place – with a '09 outcome.

We believe this is "ground floor" opportunity.

If anyone, the IAWG, or individual agencies, are interested in working with us, please let me know.

Date: October 14, 2008
From: Steven M. Weaver, P.E. - ANTHC
Subject: An Adaptation Strategy to Prepare for Climate change in Alaska (version2)

My recommendation for the primary theme for a statewide adaptation strategy is: local empowerment. By that I mean give local leaders the information, the tools and the opportunity to incorporate climate change adaptation in to their current community plans. The goal is to inspire and inform residents to maximize the opportunity for orderly transition.

Climate change adaptation can be most effective not as a separate report or initiative, but as an integral component of all community planning and improvement. To accomplish that goal it seems to me that five basic deliverables are needed:

(1) A central systematic source of current environmental data from which local authorities and design professionals know "what is" and how "what is" has been changing. I am thinking an internet portal and custodial agency to index and link existing sites, identify the data gaps and organize the requests to fill those gaps. This site could include a new "Environmental Atlas" to replace the one published by the University of Alaska in 1984.

(2) A statewide set of climate zone profiles summarizing the environmental changes expected based on the best science. The definition of the "best science" needs to be established and consistently used/systematically updated on a statewide basis.

(3) Local vulnerability assessment tool
   a. Town site vulnerability & monitoring requirements
   b. Infrastructure component vulnerability
   c. Economic impacts
   d. Natural environment impacts (e.g. permafrost changes, and animal & plant migration, etc)

(4) Local adaptation information and prioritization tool
   a. Relocation and incremental relocation strategies
   b. Life cycle infrastructure replacement/relocation/strengthening strategies
   c. Community land use/expansion strategies
   d. Economic change/opportunity
   e. Example community/personal behaviors and activities that can make a difference

(5) A statewide information framework to register vulnerability assessments, share successful adaptation projects/outcomes, classify threat levels, organize coordinated responses, and resource prioritization & allocation methodologies.

DATE PUB.10/14/08, VERSION 3 -ANTHC

Climate Zone Profile

	PROJECTION YEARS		
	10	50	100
Sea level rise & potential for event intensity change			
Land temperature change			
Water temperature change			
Air temperature change			
Precipitation change & event intensity change			
Changes in months of the year with ice cover			

NOTES: (1) This is a survey of climate change expectations based on the best science currently available. It is developed based on empirical data collection, modeling and scientific analysis. The purpose of this information is to assist Alaska's community leaders with community planning to better adapt to our changing environment. This data is periodically updated see www.climatechange._____ for most current information.

(2) This data could also be displayed in a series of maps - the goal is to identify key data needed to do effective aligned community planning and then display it in a way that is useable and actionable by local leaders and industry professionals.

APPENDIX D

COMMUNITY PARTICIPANTS AND IAWG MEETING SCHEDULE AND AGENDA ITEMS

IAWG Members and Community Participants

IAWG Members

Mike Black, Co-Chair (DCCED)
Trish Opheen, Co-Chair (USACE)
Amy Holman (NOAA)
Luke Hopkins (AML)
Bob Pawlowski (Legislative Budget & Audit Committee Representative)
John Madden (DMVA/DHS&EM)
Chris Maisch (ADNR - Forestry)
Mike Coffey (ADOT/PF – Maintenance & Operations)
George Cannelos (Denali Commission)
Larry Hartig (Chair Climate Change Subcabinet and ADEC Commissioner)

Community Participants

Stanley Tom, Tribal Administrator Newtok Traditional Council
David Albert, Newtok IGAP Coordinator
Margaret Nicholson

Steve Oomittuk, Mayor - Point Hope
Christine Amaktoolik, Elim

Enoch Adams, Kivalina – Northwest Arctic Borough
Janet Mitchell, City of Kivalina
Colleen Swan, Tribal Village of Kivalina
Alice Adams
Bobby Schaefer, Northwest Arctic Borough

Frank Myomick, St Michaels–Kawerak Transportation Planner
Robert Iyatunguk
Ester Iyatunguk
Howard Weyiouanna, Sr.- Member of SERC, member of the City of Shishmaref and the Native Village of Shishmaref
Brice Eningowuk, Shishmaref Kawerak Transportation Planner
Curtis Nayokpuk
Karla Nayokpuk
Fred Eningowuk
Stanley Taktoo

Cindy Pilot, Tribal Administrator Koyukuk

John Alvis, Kawerak Transportation Engineer
Jeanette Pomrenke, Kawerak
Sterling Gologergen, Kawerak
Steve Ivanoff, Unalakleet - Kawerak Transportation Planner

Roberta Chavez (Alaska Village Council of Presidents)
Erin Harman, Tanana Chiefs Conference

Michael Sookiayak, Shaktoolik

Toby Anungazuk, Jr., Golovin
Jack Fagerstrom, Golovin

Public and Agency Participants

Karen Rehfield (Alaska OMB/Denali Commission)
Rhonda McBride (State of Alaska)

Tara Jollie (DCCED/DCRA Director)
Sally Russell Cox (DCCED/DCRA)
Erik O'Brien (DCCED/DCRA)
Athena Logan (DCCED/DCRA)
Taunnie Boothby (DCCED/DCRA)

Carl Borash (USACE)
Bruce Sexauer (USACE)
Melanie Harrop (USACE)
Guy McConnell (USACE)

David Kang (DHS&EM)
Andy Jones (DHS&EM)

Krag Johnsen (Denali Commission)
Jamilia George (Executive Branch Representative to Denali Commission)

Kolena Momberger (ADEC)
Greg Magee (ADEC)
Jackie Poston (ADEC)
Susan McNeil (ADEC)

Carven Scott (NOAA/NWS)
Joel Scheraga (US EPA, Director Global Change Research)
Dan White (UAF)

Clint Adler (ADOT/PF)
Ryan Anderson (ADOT/PF)
Mike Lushkin (ADOT/PF)
Ruth Carter (ADOT/PF)
Cindie Little (ADOT/PF)

Dave Johnston (MMS)
Denny Lassuy (North Slope Science Initiative)
Judy Jacobs (USF&WS)

Rod Combellick (DNR- DGGS)
Deanna Stevens (DNR -DGGS)
Sylvia Kreel (DNR-DCOM)

Jeff Malcolm (US GAO)
Brad Dobbins (US GAO)
Allen Chan (US GAO)
Steve Weaver (ANTHC)

Interested Citizens

Darcy Dugan (Yale/Girdwood)
Stefan Milkowski (Fairbanks- Independent Reporter)
Jordon Marshall (Rasmuson Foundation)
David Rogers (Juneau)
Allison Butler (UAF-PhD Student)
Elizabeth Marino (UAS-PhD Student)
Robin Bronen (UAF-PhD Student)

Nate Oberlee (Oasis Environmental)
Cory Black (Oasis Environmental)
Karl Ohls
John Woodward

Climate Change Consultiants

Vivian Melde, Ecology & Environment
Margit Hentschel, Walsh Environmental
Barbara Sheinberg (Sheinberg & Associates)
Indra Arriaga (Info-Insights)
Randy Freed (ICF)

Facilitator

Margaret (Meg) King (MJ King & Associates)

IAWG Meeting Schedule and Topics: 2008-09	
August 27, 2008	Review IAWG Mission
	Agency Updates including Flood Protection and Planning
	Potential Budget Needs
	National Commission on Energy
October 28, 2008	Framing the IAWG's 2008-09 efforts
	Strategy, timeline and topics
	Policy, funding and other suggestions to effectively meet IAWG's mission
	Detailed discussion notes
November 10, 2008	GAO Draft Report Overview
	EM – 30 Year Hazards Report Overview
	Advance IAWG Policy #2 Data Needs and ANTHC input for RNWG Guidance
	Identify: Budget/OMB Submission Dates /Subcabinet Meeting Dates/Approval on IAWG Policy Recommendations
	Revisit IAWG Membership
	Budget Placeholder Templates for State CIP and Ops Budgets and process/responsibility for getting placeholder in
	Determine how to prioritize other communities for IAWG's efforts: e.g. are others involved, e.g. Regional-health, Native/Village Corps; How vulnerable is a community? (take away homework)
November 24, 2008	Revise and Update Community Projects and Goals for Initial 6 Communities
	Complete Prioritization/Criteria for other communities (11/10 homework)
	Identify Projects and Goals for New Communities
	Mini-Grants – Identify system that transitions mini-grant projects into Program
	Identify New Funding and/or coordination of funding
December 5, 2008	Identify means to advance Policies 1 & 2 from 4/17/08 Report
	Augment Policies 1 & 2 and determine if additional policy recommendations are needed/what can be agreed upon.
	NOAA Opportunities – How to integrates State's needs into NOAA projects
	Review/Refine Projects and Goals for 6 initial and new communities and identify who can provide budget/cost projections
	Create Table of Contents for Draft Report

December 22, 2008	Homework – Identify Community Projects in next 12 – 18 months
	Homework - Identify new priority Communities in peril (beyond the 6)
	CIAP Presentation (S. Kreel – DNR/D. Johnston - MMS)
	Follow – up: Policies 1&2 from 2008 and new potential policies
	NOAA request for additional IAWG input (Lidar)
	First Draft of Recommendations Report – Continue to refine items from previous meetings
January 6, 2009	New Policy on Strategy for addressing/preventing emergencies/IA
	Detailing 2008 Policies 1&2 and identify other potential new policies
	Other states have an Emergency Preparedness Fund – discussion if IAWG wants to make a recommendation
	Characterizing (new) communities and projects not already identified in 4/17/08 – actions in next 12 – 18 months
	CIAP Proposals – Next Steps
	Discussion on Recommendations Report
January 27, 2009	Report Discussion– Recommended projects, budgets, coordination and policies to Subcabinet
	Discussion – Alaska Forum on the Environment – Coordinating IAWG Presentations
	ADOT – Coastal Erosion Efforts and Techniques
	Depicting Strategy Recommendations
	O&M Policy Recommendations
	IAWG Presentation at Subcabinet
February 23, 2009	Review Final Draft IAWG Recommendation Report

Research Needs Work Group

Recommendations on Research Needs Necessary to Implement an Alaska Climate Change Strategy

Submitted to the Alaska Climate Change Sub-Cabinet

June 2009

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1 Executive Summary

The Challenge

Native and long-time Alaskan residents describe dramatic changes in Alaska's climate and the chronic and catastrophic effects these changes are having on their lifestyles and cultures. Knowledgeable scientists, engineers, leaders, and decision-makers acknowledge that climatic changes are occurring in Alaska and have great potential, in consort with other factors, to adversely impact the natural, social, economic, and infrastructure systems that Alaskans rely upon for their way of life. Nearly everyone, however, unanimously laments the paucity of data, analyses, information infrastructure, and decision-support and sharing tools necessary for effective assessment and response to such changes.

While many of the impacts are potentially negative, others may be beneficial. For example, reduced Arctic sea ice may open new shipping opportunities. A warming climate may increase growing seasons, thereby increasing agricultural opportunities. New fishing opportunities may become available in the Arctic. Each of these will require assessment and monitoring.

There is no single agency, organization, or collaborative association within Alaska that is tasked with systematically coordinating the identification, collection, compilation, analysis, and publishing of climate change data and research. This important task is required to ensure the quality necessary to effectively support decision-making and evaluate and manage multifaceted risks and threats such as those associated with climate change in Alaska. However, there are many scientific agencies and organizations collecting and interpreting natural and economic data in Alaska that can be used in an overall climate change response strategy. The challenge is to coordinate the many different data sets, identify the information and data gaps for climate related policy and mitigation/adaptation efforts, and make sure sufficient funding is available and distributed to do the work.

One Process

Through Administrative Order 238 Governor Sarah Palin established, a Sub-cabinet on Climate Change to advise her on the preparation and implementation of an Alaska climate change strategy. The Sub-cabinet established four advisory groups. The four groups included the:

- Immediate Action Working Group (IAWG) focusing on near term actions needed in Alaska;
- Mitigation Advisory Group (MAG) to identify and propose measures to mitigate Alaska's greenhouse gas emissions;
- Adaptation Advisory Group (AAG) to identify and propose methods to adapt to the impacts of climate change on Alaska; and
- Research Needs Work Group (RNWG) to recommend research strategies for mitigating greenhouse gases and adapting to the impacts of climate change.

The RNWG was established to assist the Sub-cabinet in identifying needed research to implement mitigation and adaptation strategies identified by the Advisory Groups, and ultimately, the Sub-cabinet. Research needs were broadly defined and included measures to implement or encourage:

- data collection and management;
- monitoring;
- addressing workforce needs;
- scientific research;
- the development of engineering standards, practices and other support tools;
- infrastructure needs and improvements;
- technology development;
- the assembly of traditional knowledge; and,
- modeling.

To develop its recommendations, the RNWG worked with the Technical Working Groups (TWG) of the MAG and AAG to identify research needs that dovetail with the policy recommendations being offered for the climate change strategy. Input was compiled from the policy recommendations from the MAG TWG:

- Cross Cutting (7)
- Energy Supply and Demand (9 recommendations)
- Forestry, Agriculture and Waste Management (3 recommendations)
- Oil and Gas (8 recommendations)
- Transportation and Land Use (10 recommendations)

and from the AAG TWG:

- Economic Activities (5 recommendations)
- Health and Culture (5 recommendations)
- Natural Systems (7 recommendations)

- Public Infrastructure (3 recommendations)

Additional policy recommendations made by the RNWG are also presented in the respective sections.

The Vision

The Research Needs Work Group (RNWG) envisions an integrated research and knowledge management infrastructure supporting multi-disciplinary systematic analyses and decision-making as an integral part of the climate change strategy that will allow Alaska to effectively, economically, and sustainably adapt to and mitigate the consequences of climate change.

The Strategy

The RNWG members recognized that addressing the impacts to Alaska from climate change and the value of efforts to mitigate greenhouse gases will be most effective through a systematic approach. The State of Alaska should pursue this systematic approach by:

- Developing a comprehensive inventory of ecosystems, communities, resources and infrastructure vulnerable to climate change;
- Developing and implementing a robust monitoring system of key climate change indicators;
- Increasing the current acceptance of risk by managing uncertainty with strengthened science-based research and probabilistic scenario analyses;
- Embracing a systematic outcome-focused approach to decision-making that addresses sustainability, economic impact, climate change adaptation needs, and long-range planning;
- Promoting innovation and continuous quality improvement by increasing applied research capacity and incentives for new methods for adapting to impacts and managing mitigation measures; and
- Establishing mechanisms to ensure communication and coordination among State agencies and with federal agencies and with stakeholders to provide research-derived information to address multi-jurisdictional needs in mitigating greenhouse gas emissions and adapting to climate change.

The RNWG encourages the leaders of the Executive Branch, the Legislature, and the University to assume a more proactive and collaborative role in planning, developing, and clarifying a strategic vision, goals, and performance measures for State government in promoting sustainable communities and addressing climate change in Alaska. The strength and effectiveness of this integrated strategic planning will be a function of the specificity of the state's roles, focus on long-term sustainability, and extent of collaboration with stakeholders. The RNWG believes that this strategic planning is necessary for, and will be the most effective way to prioritize the research needs identified herein.

Identified Research Needs

This report identifies both overarching and specific research needs that are necessary to implement policy recommendations being offered by the MAG and AAG TWGs. Included is an evaluation of the completeness of the TWG policy recommendations and the identified research needs necessary to implement the identified recommendations. An assessment of the research required to fully complete the goals of specific suggested policies is included. For each identified needs, a description of the need is provided. In total, 52 overarching and 95 specific research needs are identified.

The Urgency

Impacts to Alaska from climate change have been increasingly recognized over the past decade, with the breadth of impacts well documented since 2004 (ACIA, 2004). Research strategies have been evolving to address the challenges being faced in Alaska. These include advanced models, various climate change scenarios, and research programs aimed at understanding the rate of change and potential risks to state resources. There is a general consensus that a systematic approach within a multi-disciplinary research strategy will provide the best science-based decision making tools for proactive solutions. It takes time, however, to transform research data to useful information. Identifying research today, with particular attention to the cross cutting needs, will support better decisions in a shorter time frame and ensure that Alaska leads the nation in successfully adapting to the impacts of climate change, while mitigating the greenhouse gas emissions as part of our national role.

2 Introduction

The Arctic is a unique and dynamic ecosystem. Many natural and anthropogenic factors influence this system. Of these, a changing climate has become a dominant driver of change in the Arctic. Native and long-time Alaskan residents describe dramatic changes in Alaska's climate and the chronic and catastrophic effects these changes are having on their lifestyles and cultures. Knowledgeable scientists, engineers, leaders, and decision-makers acknowledge that climatic changes are occurring in Alaska and have great potential, in consort with other factors, to adversely impact the natural, social, economic, and infrastructure systems that Alaskans rely upon for their way of life. While many of the impacts are potentially negative, others are potentially beneficial. For example, reduced Arctic sea ice may open new shipping opportunities. A warming climate may increase growing seasons, thereby increasing agricultural opportunities. New fishing opportunities may become available in the Arctic.

Nearly everyone unanimously laments the paucity of data, analyses, information infrastructure, and decision-support and sharing tools. This leads to significant uncertainty in our ability to predict the effects of climate change and to develop responses to such changes. Despite this, there is an urgent need to develop proactive mitigation and adaptation strategies to climate change.

There is no single agency, organization, or collaborative association within Alaska that is tasked with systematically coordinating the identification, collection, compilation, analysis, and publishing of climate change data and research. This important task is required to ensure the quality necessary to effectively support decision-making and evaluate and manage multifaceted risks and threats such as those associated with climate change in Alaska. However, there are many scientific agencies and organizations collecting and interpreting natural and economic data in Alaska that can be used in an overall climate change response strategy. The challenge is to coordinate the many different data sets, identify the information and data gaps for climate related policy and mitigation/adaptation efforts, and make sure sufficient funding is available and distributed to do the work.

There is a general consensus that a systematic approach within a multi-disciplinary research strategy will provide the best science-based decision making tools for proactive solutions. It takes time, however, to transform research data to useful information. Identifying research today, with particular attention to the cross cutting needs, will support better decisions in a shorter time frame and ensure that Alaska leads the nation in successfully adapting to the

impacts of climate change, while mitigating the greenhouse gas emissions as part of our national role.

It is in this frame that Governor Sarah Palin issued Administrative Order 238. This order established a Sub-cabinet on Climate Change to advise her on the preparation and implementation of an Alaska climate change strategy. The Sub-cabinet established four advisory groups. The four groups included the:

- Immediate Action Working Group (IAWG) focusing on near term actions needed in Alaska;
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The RNWG was established to assist the Sub-cabinet in identifying needed research to implement mitigation and adaptation strategies identified by the Advisory Groups, and ultimately, the Sub-cabinet. Research needs were broadly defined and included measures to implement or encourage data collection and management; monitoring; addressing workforce needs; scientific research; the development of engineering standards, practices and other support tools; infrastructure needs and improvements; technology development; the assembly of traditional knowledge; and, modeling.

To develop its recommendations, the RNWG worked with the Technical Working Groups (TWG) of the MAG and AAG to identify research needs that dovetail with the policy recommendations being offered for the climate change strategy. Input was compiled from the policy recommendations from the MAG TWG:

- Cross Cutting (7)
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and from the AAG TWG:

- Economic Activities (5 recommendations)
- Health and Culture (5 recommendations)
- Natural Systems (7 recommendations)
- Public Infrastructure (3 recommendations)

Additional policy recommendations made by the RNWG are also presented in the respective sections.

3 Overarching Needs Summary

The overarching needs identified by the RNWG are:

- **Improved downscaled (local) climate models:** The ability to effectively implement policy recommendations is largely dependent upon being able to act at local levels. This necessitates being able to predict the impacts of a changing climate locally. Programs like Scenario Network for Alaska Planning need to be expanded to include more variables and greater specificity, as well as the variety of Alaska ecosystems (ocean, coastal, terrestrial) and the needs of natural system services (e.g. wildlife, fisheries, subsistence, economic, etc.).
- **Need for baseline environmental research and monitoring:** The success and accuracy of downscaled models is largely dependent upon the quantity and quality of data available. There is an urgent need to collect baseline environmental research and monitoring data. This includes developing a robust baseline monitoring program of a variety of physical, chemical, biological and socio-economic variables that take into account seasonal, annual, and decade-long variability. It also includes implementing a well-developed research program that includes process studies and applications.
- **Improved research infrastructure:** Our ability to collect data is largely dependent upon our ability to improve our research infrastructure (e.g. computers, radars, ships, satellites, personnel, etc). This includes research as well as baseline data collection and monitoring.
- **Improved data integration and sharing:** To assure there is not duplication of efforts it is imperative to coordinate data integration and sharing between agencies. This will ensure the success of various inter-disciplinary efforts that will be needed to address climate change issues. Other key elements include data management, interoperability, access and archiving.
- **Multiple level decision-making tools:** Many of the identified policy recommendations will need to be implemented at the local level. There is an urgent need for expanding the availability of appropriate decision-making tools for local and state officials.
- **Adaptable legal and policy frameworks:** Many laws, regulations and policies on the federal, state, and local levels were developed for a static environment where climate change was not recognized. The challenge for government leaders and businesses will be to adapt to a future made less certain due to a more rapidly changing climate. This will necessitate an evaluation of existing laws, regulations and policies and possible changes to institutional, legal and policy frameworks in an adaptive manner
- **Improved baseline mapping:** The ability to predict landscape level changes due to climate change is dependent upon being able to define the status quo. Unfortunately,

few baseline maps of key environmental variables are available for Alaska. Improved baseline mapping and associated data collection is a critical need.

- **Education and Outreach:** Our ability to implement policy changes is largely affected by public perception and understanding. There is a critical need to develop and implement an education and outreach program aimed at improving public understanding of climate change and its affects, as well as the need to address them.

4 Recommendations: Mitigation

Mitigation Technical Workgroups

The Mitigation Advisory Group (MAG) was tasked with identifying policy recommendations that could be implemented to reduce Alaska GHG emissions and carbon footprint. Five technical workgroups (TWGs) were formed as a part of the MAG:

- Cross Cutting
- Energy Supply and Demand
- Forestry, Agriculture and Waste Management
- Oil and Gas
- Transportation and Land Use

4.1 Cross Cutting (CC) TWG

TWG Recommendations

CC-1. Establish an Alaska Greenhouse Gas Emission Reporting Program

CC-2. Establish Goals for Statewide GHG Emission Reduction

CC-3. Identify and Implement State Government Mitigation Actions

CC-4. Integrate Alaska's Climate Change Mitigation Strategy with the Alaska Energy Plan

CC-5. Explore Various Market-Based Systems to Manage GHG Emissions

CC-6. Create an Alaska Climate Change Program that Coordinates State Efforts for Addressing Climate Change

RNWG Recommendations

CC-7. Assess the long-term economic impact of GHG emissions reporting and reduction programs on the Alaskan economy at statewide and local levels.

Specific Research Needs

The RNWG did not identify specific research needs for this TWG. It is the opinion of the RNWG that research needs identified for other TWGs, in combination, will be sufficient to implement the identified policy recommendations.

4.2 Energy Supply and Demand (ESD) TWG

The Energy Supply and Demand (ESD) TWG was charged with evaluating climate change mitigation policy options related to energy. The ESD TWG prepared a suite of draft policy options, some of which contained elements of research and development, and one of which was specifically about research and development (see TWG Recommendations). As such, three of the policy options, ESD 7, 8 and 9 were lumped into one and it was from there forward referred to as the R&D policy option. A subgroup of TWG members generated the R&D Policy Option. In addition, a second subgroup was assembled to discuss the specifics about energy research that related to minimizing or managing carbon. These were then detailed and are included as research needs under unique identifiers.

The TWG did two things. First, it created a policy option for research (ES&D 7, 8 and 9). Only one "Policy Option" was drawn up for ESD 7, 8 and 9 and it is hereafter referred to as a single, group option. Second, a subcommittee generated a list of specific research needs on behalf of the TWG. The list of specific research needs was generated to address needs for the ESD policy options 1-6.

The R&D Policy Option (ESD 7,8,9) was directed to establishing programmatic incentives for participation and support of public and private investment in fundamental research, demonstration, and deployment of carbon-emission reduction and energy production technologies that hold promise for implementation throughout Alaska.

- Advanced technologies in electric power generation, both small-scale and large-scale, in fossil generation, nuclear generation, and renewables will provide greater efficiency in power supply for utility and industrial purposes.
- A statewide emphasis on enhanced utilization of new and emerging technologies that provide the end-use benefits of electric energy with greater efficiency will provide economic and environmental benefits throughout Alaska.
- The policy will provide incentives and reduce barriers to implementation of advanced generation technologies using the variety of energy sources available to Alaska.
- While emphasis may be provided on cold-climate applicability (e.g., combined heat and power) or other regional characteristics (e.g., geothermal availability) the emphasis will be on cost-effective supply and net environmental impacts.
- In addition to R&D on reducing CO_2 production, policy should encourage R&D on carbon capture and management. Such examples could include food production in greenhouses or other novel value-added carbon capture as well sequestration.

TWG Recommendations

ESD-1. Transmission System Optimization and Expansion

ESD-2. Energy Efficiency for Residential and Commercial Customers

ESD-3. Implementation of Renewable Energy

ESD-4. Building Standards/Incentives

ESD-5. Efficiency Improvements for Generators

ESD-6. Energy Efficiency for Industrial Installations
ESD-7. Implementation of Small-Scale Nuclear Power
ESD-8. Research and Development for Cold-Climate Renewable Technologies
ESD-9. Implementation of Advanced Supply-Side Technologies

RNWG Recommendations

No additional recommendations.

Specific Research Needs

The list of specific research needs centered around two themes: managing carbon, and minimizing carbon. Both of these themes were limited to the aspects related to energy supply and demand.

4.2.1 Carbon Capture, Sequestration and Management

4.2.1.1 Carbon sequestration research is needed to better understand the state's options for storing carbon in geologic formations. This research involves field investigation of likely sites. (Responds to Policy Option ES&D 7-9)

Alaska has a major coal resource. New coal power plants or coal to liquids processes will likely either require carbon sequestration or be negatively impacted by carbon caps or taxes. To prepare the state for both managing the carbon dioxide it produces currently and for permitting of new carbon dioxide producing facilities, sequestration options must be available. ***Action Type: Modeling, Data Management, Monitoring. Cross-Cutting Topics:*** Oil and Gas

4.2.1.2 Research is needed on value added carbon capture technologies such as carbon capture and use in greenhouses for food and energy production, carbon incorporation into high-tech products, such as carbon fiber or H_2 storage, enhanced oil recovery, and carbon addition to H_2 for fuels production. Many other options may also be available. Research is needed to determine which opportunities hold the greatest promise for Alaska. (Responds to Policy Option ES&D 7-9)

To comply with future carbon caps, trading, taxation, and carbon dioxide reduction for mitigation purposes, the state needs to identify options for carbon dioxide management. Beneficial use makes the most sense if reasonable options are available. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Oil and Gas***

4.2.1.3 Research is needed to improve generation efficiency from improved control and operation practices of existing generation capacity (e.g., diesel). This includes the management of hybrid systems which typically are very complicated from a management and control standpoint. (Responds to Policy Option ES&D 5,6)

Carbon emissions can be reduced by increasing the efficiency of carbon producing processes such as diesel power generation and hybrid power systems. The goal is not to improve the efficiency of the diesel engine itself, but to introduce control strategies that would reduce the net carbon emissions from the diesel power plant without a reduction in supply. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.1.4 Research is need on the best application and best management of a coal-to-liquids technology as well as carbon capture and beneficial use. (Responds to Policy Option ES&D 7-9)

Research on the use of coal in Alaska is needed to most effectively develop an abundant energy rich resource while achieving goals for mitigating climate change. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.2 Geothermal Research

4.2.2.1 A site-specific geothermal resource assessment is needed. In addition, research and testing of low temperature power generation designs for power and heat, mineral recovery from geothermal brines, and ground source heat pumps is needed. Additionally, research into uses for power at or close to geothermal prospects should be conducted. Such uses could include value added mineral refining, timber processing, or greenhouse food/energy production. (Responds to Policy Option ES&D 3, 7-9. This potentially could be coupled with the Natural Systems, Policy Option 2B.)

A general understanding of the state's geothermal potential is available. However, little site-specific information is available to assess feasibility of implementation. Without this information there is little chance that developers will be willing to invest in a geothermal prospect. Exploration often accounts for ¼ to ½ of the cost of a geothermal power development project. ***Action Type: Modeling, Products, Monitoring. Cross-Cutting Topics: NA***

4.2.3 Hydropower and Hydrokinetic Research

4.2.3.1 To make hydropower an effective and efficient power alternative, research is needed into technologies for fuel switching (e.g., from gas to electric heat), pumped storage and integration, reducing adverse intake icing conditions, and integration schemes for incorporating small-scale

hydro power in village settings where other generating technologies are being used. (Responds to Policy Option ES&D 3, 7-9)

Hydropower has many different forms and has many issues that determine its ultimate effectiveness as a source of power. In this need hydropower is limited to water retention and passage through power generating turbines. In-river, tidal, and wave power is discussed in a subsequent need referred to as hydrokinetic power.

Research is needed on propeller and crossflow turbine runners to reduce manufacturing costs and advanced materials such as composite blades and other blade types not requiring extensive metal casting, and use of heat recovery for heat load dumps used to regulate hydropower frequency fluctuation. Testing is needed on intake screens for cold weather hydro applications, and water conservation schemes for preservation of reservoir storage during frequency regulation. To reduce the cost of hydropower programs, standardized plans for small hydro applications are needed with details on intakes, powerhouse, induction plants, tailraces, etc., Alaska needs friendly fish passage designs for in and out of a lake/reservoir, as well as research into how best to provide for flushing flows and sediments to replenish spawning gravels in fish streams, optimal winter instream flow releases for traditional hydropower projects, and improved methods to predict snow-melt and runoff for modeling reservoir operations. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.3.2 There is a need for hydrokinetic resource assessment, including a baseline inventory of possible development sites. Research is needed on the impacts of hydro on fish populations, hydrokinetic device testing, and optimization of hydrokinetic devices for the Alaskan environment (issues such as deployment, anchoring, ice effects, tidal energy capture, etc). Another area of research needed is the application of high pressure water in non-electrical generating applications such as mechanical grinding and processing. (Responds to Policy Option ES&D 3, 7-9)

Many of Alaska communities are on rivers or along coastlines where hydrokinetic devices could augment power provided by diesel or another source. Unfortunately without some research into the likelihood of success and environmental impact of hydrokinetic devices, very little funding will be dedicated to such prospects. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.4 Wind Energy Research

4.2.4.1 There remain significant issues with wind field modeling, grid integration, power storage, foundations, and de/anti-icing options for wind turbine

blades in Alaska that require additional research. (Responds to Policy Option ES&D 3, 7-9)

Wind systems are being installed around Alaska. While they are producing power, many are not reducing the use of diesel as much as they could. This is largely a controls, grid integration, and power storage issue. The issue of foundations and de-icing are practical problems that increase the cost of wind projects. These issues could be resolved with some applied research and development. Other issues relate to wind field modeling. Wind field models can provide information about variability in power production and are needed before a windfarm can be adequately sited. ***Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: NA***

4.2.5 Biomass Technologies

4.2.5.1 Research is needed to find suitable biomass technologies for generating power in the smaller communities that could simultaneously provide space heating. (Responds to Policy Option ES&D 3, 7-9. This option could also overlap with options in the Forestry and Agricultural Waste Management technical working group.)

Biomass produced heat could be coupled with greenhouse production of food and energy crops. Algae, for example, could be grown in concentrated masses in greenhouses and converted to biofuels. Heat, light and CO2 from biomass burning could fuel the greenhouse operation. Little has been done in this area to prove the economics or other benefits of such an operation thereby limiting investment. A field-scale demonstration site would encourage the development of biomass generated heat and power (incl. food and energy) in Alaska.

There is also a need to optimize biomass development opportunities for rural heat and power as well as investigating the opportunities to cultivate biomass. For example, if willows can be cultivated and harvested for use in heat and power generation, the land area required for biomass production would be significantly reduced compared to harvesting of native biomass stands. ***Action Type: Products, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.6 Nuclear Technologies

4.2.6.1 There are currently no commercial nuclear power plants operating in Alaska. As part of a diversified energy portfolio, nuclear power should be investigated. (Responds to Policy Option ES&D 7-9)

There is a need to better understand the technologies and opportunities for nuclear power in Alaska. Potential matches between technologies and potential sites needs to be identified and studied. ***Action Type: Products, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.7 Transmission Technologies

4.2.7.1 The Denali Commission has just finished a study into transmission potential for the state of Alaska. In particular, the potential for hub and spoke solutions to rural transmission were evaluated further. Research is needed into the vulnerabilities and efficiencies of small rural grids. In particular, as many rural communities invest in renewable technologies, small grids could be looking at very high renewable penetration rates. The stability and efficiency of these grids in not known. Applied research and monitoring for high renewable penetration grids could develop new control strategies that would make these grids more stable and able to meet customer needs. **(Responds to Policy Option ES&D 1)** ***Action Type: Products, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.2.7.2 Assess Advanced Coal Technologies and their applicability in Alaska. (Responds to Policy Option ES&D 7-9)

Alaska has a major coal resource. New coal power plants or coal to liquids processes advances into clean coal processing or technologies such as in situ or on-site gasification. Much is unknown about clean coal technologies with respect to Alaskan Coal. In most cases, pilot studies for new technologies should be conducted. A testbed for clean coal technologies would help ensure success when technologies are finally implemented. *Action Type: Modeling, Data Management, Monitoring.*

4.3 Forestry, Agriculture and Waste Management (FAW) TWG

The Forestry, Agriculture and Waste Management (FAW) TWG reviewed and evaluated a number of policy options and narrowed the focus to three recommendations. The group did consider several ideas for agricultural projects, but the scope and scale of agriculture is fairly small in the state and thus the impact from a CO2 mitigation standpoint was low. The group focused their attention on the Forestry and Waste Management opportunities.

TWG Recommendations

The TWG forwarded the following mitigation policy options for further consideration by the Mitigation Advisory Group (MAG) and the Climate Change Sub-Cabinet:

FAW-1. Forest Management Strategies for Carbon Sequestration

FAW-2. Expanded Use of Biomass Feedstocks for Energy Production

FAW-3. Advanced Waste Reduction and Recycling

RNWG Recommendations

No additional recommendations.

4.3.1 Overarching Research Needs

4.3.1.1 Develop a protocol for determining carbon baselines, carbon sequestration rates, additionality permanence and leakage of carbon for silvicultural treatments in boreal and coastal forests.

Carbon trading under a cap and trade system requires verification of carbon additionality above a baseline reference. This "additional" carbon can be sold as part of a mitigation strategy for a carbon producer that needs to exceed their cap. Silvicultural treatments need rigorous third party review to ensure they meet the needs of the market. ***Action Type: Modeling, Data Management, Monitoring. Cross-Cutting Topics: Overarching, Natural Systems***.

4.3.1.2 Refine global climate models for better understanding of regional variations within Alaska. Provide means to disseminate these data.

Improved monitoring and modeling data will allow for development and dissemination of environmental information and design criteria for use in adapting to climate change. ***Action Type: Modeling, Products. Cross-Cutting Topics: Overarching.***

4.3.1.3 Study expected carbon losses during permafrost melt and addition of emissions to the Alaska GHG Inventory and Forecast (I&F).

Better understanding of the GHG impacts of melting permafrost and appropriate representation in Alaska's GHG Inventory and Firecast There is a potential for large impact to the Inventory and Forecast report if these areas are considered to be anthropogenic. ***Action Type: Modeling. Cross-Cutting Topics: Overarching***

4.3.1.4 Review IPCC materials on the definition of managed or unmanaged forests. Confer with in-state forestry experts to assess the proper classification of the Boreal Forest based on past and future management.

There is a potential for a large impact on the overall GHG emissions of the state if the Boreal Forest is considered a managed forest, and hence, an anthropogenic source of emissions. Determination of coverage of carbon fluxes in the boreal forest as part of the Alaska GHG Inventory and Forecast. ***Action Type: Education/Outreach. Cross-Cutting Topics: Overarching.***

Specific Research Needs

Specific research needs are discussed in more detail in the appendix.

4.3.2 EPA Compliance/Public Health

4.3.2.1 In an arctic climate wood burning appliances need testing for particulate matter (PM), nitrogen oxides (NOx) and carbon monoxide (CO) to ensure

public health is not negatively impacted. Demonstrate that in arctic weather conditions, modern wood combustion appliances, such as wood pellet stoves, boilers and larger scale wood chip or co-fire facilities meet Environmental Protection Agency (EPA) particulate matter (PM-2.5) and other pollutant standards. This is very important for the communities of Fairbanks and Juneau which have been in violation of the new PM-2.5 standard and may have wood burning closures to help deal with the issue.

Like other combustion systems wood boilers emit a variety of pollutants, including particulate matter, nitrogen oxides, carbon monoxide, volatile organic compounds (VOC), sulfur dioxide (SO2), carbon dioxide (CO2) and other pollutants. Wood boilers emit PM, NOx, and CO in much greater quantities than the other pollutants. For this reason, these are the three pollutants to track and carefully monitor to determine potential impacts. Wood systems also emit greater quantities of CO2, however unlike fossil fuels; woody biomass is considered carbon neutral. ***Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Natural Systems***.

4.3.3 Carbon Cycle

4.3.3.1 Develop a protocol that assigns a carbon life to different types of wood products, including durable wood products.

In most models that portray carbon flux between sinks and sources there is currently no allocation made for carbon storage as a tree moves from a log to a forest product. When the tree is harvested from the forest, it is treated as an emission. This is a simplification that is not accurate in the real world use of wood. Products substitution (using wood instead of steel, concrete or other building products) can have much higher carbon footprint then wood. Life cycle assessment studies have conclusively shown marked differences in energy requirements associated with different building materials and structures made from them, yet current carbon trading protocols don't make allowances for this type of sequestration or reduction of GHG emissions. ***Action Type: Modeling, Data Management. Cross-Cutting Topics: Natural Systems***.

4.3.3.2 Determine if woody biomass used in energy production is a carbon-neutral fuel source. Scientifically demonstrate that woody biomass used as a fuel for energy is a carbon-neutral fuel.

Currently woody biomass is considered a carbon neutral fuel when compared to fossil fuels, such as coal, oil or natural gas. The combustion of all fuels produces CO2, but trees that are harvested for this purpose are replaced by new trees that sequester carbon from the atmosphere. Over time, the CO2 released by the combustion process will be captured again by the new tree crop. This concept is important because in the carbon trading market place, an offset credit can be

generated by using a biomass fuel for a fossil fuel. It is a straight forward calculation to determine how much C is in a gallon of fuel oil or ton of coal and when you "offset" this fuel type with biomass you generate a credit that can be sold. ***Action Type: Modeling, Data Management. Cross-Cutting Topics: NA***.

4.4 Oil and Gas (OG) TWG

The Oil and Gas Technical Work Group was tasked with developing recommendations for policies and actions to reduce GHG emissions related to the oil and gas industry in Alaska. Of the 52 MMT gross CO_2/yr emissions in Alaska, the oil and gas industry produces 15 MMT, 12 MMT of which are from the North Slope, the majority from Prudhoe Bay. Recognizing that although most of the recommendations focus on the North Slope and Prudhoe Bay, many of the principles can also be applied to the Cook Inlet and other oil and gas operations. Additionally, this TWG was tasked to address Carbon Capture and Sequestration (CCS) research needs both within and outside oil and gas facilities.

TWG Recommendations

The TWG's principal working mitigation options being worked at this time are:

OG-1. Evaluate reductions in GHG that can be related to overall conservation activities, i.e. reducing liquid fuel consumption, minimal venting, and other best practices.

OG-2. Reduce fugitive methane emissions (emissions due to leaks.)

OG-3. Electrification of Oil and Gas Operations, with Centralized Power Production and Distribution

OG-4. Improved Efficiency Upgrades for Oil and Gas Fuel burning Equipment

OG-5. Use of Renewable Energy Sources in Oil and Gas Operations

OG-6. Carbon capture and sequestration from high CO2 fuel gas. Use of CO2 for enhanced oil recovery.

OG-7. Carbon capture and sequestration from exhaust gas at Prudhoe Bay. Use of CO2 for enhanced oil recovery.

OG-8. Carbon capture and sequestration from exhaust gases away from existing oil and gas fields.

RNWG Recommendations

To these policy options the following additions are recommended:

Identify critical infrastructure risks associated with:

OG-9. Changes in permafrost

OG-10. Changes in surface and subsurface hydrology

OG-11. Sea level changes

OG-12. Changes in habitat and wetlands

OG-13. Changes in length of operational season

OG-14. Coastal erosion from reduced sea ice during storm season

OG-15. Changes in shipping scenarios

OG-16. Data sets, maps, and digital information needed for long term monitoring and forecasting of environmental change

OG-17. Engineering change needed in operations, i.e., platform design

Economic

OG-18. Short and long term value of carbon

OG-19. Short and long term value of natural gas

OG-20. Impact of various incentives to major capital improvement investment

OG-21. Potential impact of carbon mitigation efforts on royalty revenue stream coming to the State of Alaska from oil and gas production

General infrastructure and baseline data needs

OG-22. Bathymetry and detailed Digital Elevation Model (DEM) information

OG-23. Regionally appropriate baseline physical mapping and imagery including bathymetry

OG-24. Regionally appropriate baseline mapping and monitoring of surface and subsurface (groundwater) hydrology

Research Needs

There are some significant research topics that should be pursued, and they are segregated between the reactionary and proactive realms. On the reactionary front, there must be analysis of how various policies will affect the ultimate recovery of the state's resource given some economic threshold. Secondly, analysis must be done on a "bang for the buck" scale that at least addresses an economic prioritization of research topics. Ultimately, it is critical that much of the available time and capital be spent pursuing 'low hanging fruit', and only minimal effort be expended on those projects that will produce minimal reductions.

On the proactive front, there should be vigorous research on new energy technologies and efficiencies, and incorporating long-term renewable energies into the huge energy sink of producing oil. This only makes sense from the standpoint of maximizing the sale of the transportable energy by exploiting local renewables that cannot be easily exported.

Finally, small advances in technology can have the greatest affect on aged developments, especially if those assets have experienced minimal modernization and upgrade during their history. Focusing a reasonable portion of research on new innovations to old equipment and methods has the capability of reaping the strongest benefit.

4.4.1 Overarching Research Needs

Overarching research needs for the Oil and Gas TWG activities include:

4.4.1.1 Economic: Investigate impact of various incentives to major capital improvement investments.

This is an issue because incentives will drive a significant amount of private sector investment to reduce overall emissions and improve energy efficiency. ***Action Type: Modeling. Cross-Cutting Topics: Energy supply and demand***

4.4.1.2 Economic: Assess short and long term value of carbon and determine whether the state may benefit from proactive carbon policies.

Understanding the value of carbon will be critical in developing reasonable and effective policy for all CO2 mitigation activity. These values will also be used to assess the economic impact of CO2 mitigation on the state's economic future. Many states are now developing local policy in the forefront of federal regulation. Alaska should evaluate this option carefully and determine whether some level of control can be attained by proactive policy measures. ***Action Type: Modeling. Cross-Cutting Topics: Overarching***

4.4.1.3 Economic: Determine potential impact of carbon mitigation efforts on royalty revenue stream coming to the State of Alaska from oil and gas production.

Carbon mitigation costs will have a detrimental effect on the ultimate recovery of oil and gas in the state because of the impact on production costs and reduction of economically recoverable oil and gas. This impact is potentially quite large for some of the depleted fields. ***Action Type: Modeling. Cross-Cutting Topics: Overarching***

4.4.1.4 Technical: Develop regionally appropriate baseline mapping and monitoring of surface and subsurface (groundwater) hydrology.

Most areas of the state do not have adequate data on hydrology and what the affects development might have on requirements and impacts of surface and subsurface water resources. ***Action Type: Modeling, Education/Outreach, Monitoring. Cross-Cutting Topics: Overarching***

4.4.1.5 Technical: Develop regionally appropriate baseline physical mapping and imagery including bathymetry.

Nearly all modern research efforts must be based on a solid foundation of baseline topographic and attribute mapping in order to achieve the level of resolution needed. It is difficult to perform modern analyses without up-to-date DEMs, orthoimagry, and detailed geologic mapping. Unfortunately, Alaska is woefully lacking in much of this most basic information, and when compared to all other states, and most other countries, Alaska is literally in the "dark ages" when it comes to baseline data. ***Action Type: Products, Data Management, Monitoring. Cross-Cutting Topics: NA***

4.4.1.6 CO2 storage: Evaluate capacity of geologic and biologic sequestration in different regions of the State of Alaska.

Depending on what type of reductions mandates are adopted, understanding the capacity and location of viable storage sites is critical. It is equally important that regulations and legal liabilities are developed and identified prior to the planning and implementation of long-term storage activities. ***Action Type: Modeling, Education/Outreach. Cross-Cutting Topics: Overarching, Energy supply and demand***.

Specific Research Needs

Specific research needs are discussed in more detail in the appendix.

4.4.2 Economic

4.4.2.1 Assess short and long term value of natural gas. Understanding the value of natural gas will allow a comparison of other forms of power generation at operations and will drive investment decisions on energy source.

Action Type: Modeling. Cross-Cutting Topics: Energy supply and demand

4.4.3 CO2 Storage

4.4.3.1 Evaluate enhanced hydrocarbon recovery options using CO2 flooding and pressure support.

Enhanced Hydrocarbon recovery is one of the only CCS methods that derives economic benefit from the activity and increases ultimate recovery of a resource for the State. ***Action Type: Modeling. Cross-Cutting Topics:*** NA

4.4.3.2 Evaluate the feasibility of saline reservoir sequestration in non-marine basins prevalent throughout Alaska.

CO2 storage in saline reservoirs may become an issue in Alaska after conventional reservoirs are saturated or in areas where no convention reservoirs exist (e.g., interior Alaska). ***Action Type: Modeling, Monitoring. Cross-Cutting Topics: NA***

4.4.4 Technical

4.4.4.1 Evaluate the feasibility of various entrained and exhaust CO2 capture technologies for North Slope and Cook Inlet.

Capturing CO2 from various exhaust systems will be a challenging effort and will need many new technologies. ***Action Type: Products. Cross-Cutting Topics: Energy supply and demand***.

4.4.4.2 Study where renewable energy sources co-exist with oil and gas operations.

Renewables may be able to play a significant role in the portfolio of supplying energy for operations. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: Energy supply and demand***.

4.5 Transportation and Land Use (TLU) TWG

The Transportation and Land Use TWG assessed to potential areas in transportation and land use where GHG emissions can be reduced. Actions by the state are identified that include education, planning, and regulations.

TWG Recommendations

The TWG forwarded the following adaptation policy options for consideration by the Climate Change Sub-Cabinet:

TLU-1. Transit, Ridesharing, and Commuter Choice Programs
TLU-2. Vehicle Idling Regulations and/or Alternatives
TLU-3. Transportation System Management
TLU-4. Promote Efficient Development Patterns (Smart Growth)
TLU-5. Promotion of Alternative Fuel Vehicles
TLU-6. Vehicle Mile Travelled and Greenhouse Gas Reduction Goals in Planning
TLU-7. On-Road Diesel Engine Efficiency Improvement
TLU-8. Marine Vessel Efficiency Improvements
TLU-9. Aviation Emissions Reductions
TLU-10. Alternative Fuel Research and Development

RNWG Recommendations

To these policy options the following addition is recommended:

TLU-11. Systematically identify and address economic barriers to implementing climate change planning efforts.

Research Needs

4.5.1 Overarching Research Needs

Overarching research needs for Transportation and Land Use TWG activities include:

4.5.1.1 Develop statewide tools for planning.

Need statewide planning tools to systematically evaluate GHG emissions on future scenarios. Priority: High. Urgency: Planning tools can provide the most benefit if

they are immediately available. Activity type: Modeling, Products. Cross-Cutting Topics: NA

Specific Research Needs

4.5.2 Fuels

4.5.2.1 **An essential research need is to understand carbon cycle from cradle to grave to see if reducing tail pipe emissions is worthwhile.**

The carbon-cost of creating fuel needs to be included in the evaluation. Decision makers need complete information to make valid data driven decisions. If only part of the carbon cycle is considered, the economics of decisions may not be realistic. ***Activity type: Modeling, Products. Cross-Cutting Topics: NA***

4.5.2.2 There is a need to analyze the life-cycle GHG impacts of various alternative fuels in the Alaska context. The life-cycle GHG impacts of alternative fuels depend heavily on emissions from fuel production and transport. Nearly all research to date has focused on the lower 48. GHG impacts in Alaska could be quite different. Need to understand which alternative fuels have GHG benefits in AK. ***Activity type: Modeling. Cross-Cutting Topics: NA***

4.5.3 Transportation Planning

4.5.3.1 Develop methods or tools to accurately estimate GHG impacts of transportation plans in Alaska.

Transportation agencies will soon be required to quantify GHG impacts of transportation plans. Tools and methods are being developed for lower 48. But arctic climate in AK might affect the GHG emissions from motor vehicles and necessitate tools or methods that are adapted to AK. ***Activity type: Modeling, Products. Cross-Cutting Topics: NA***

4.5.3.2 Investigate potential to reduce fuel use and GHG emissions by coordinating transportation networks and commercial fishery openings.

Excess fuel use and GHG emissions occur because of poor coordination of fishery openings. Priority: ***Activity type: Modeling, Monitoring. Cross-Cutting Topics: NA***

4.5.4 Marine Vessels

4.5.4.1 Determine GHG impacts of replacing older marine vessel engines with newer engines.

Newer marine engine have lower particulate matter emissions due to federal standards. But their effect on GHGs is uncertain. ***Activity type: Modeling. Cross-Cutting Topics: NA***

4.5.5 Aviation

4.5.5.1 Evaluate the actual reduction of GHG from a pilot study of continuous descent approaches to Ted Stevens International Airport.

Aviation in Alaska has a disproportionate impact on GHG emissions compared to other forms of transportation. Focusing on aviation reductions may be an area where large reductions can be realized. ***Activity type: Modeling, Monitoring. Cross-Cutting Topics: NA***

4.5.6 Public Transportation

4.5.6.1 Conduct analysis to determine what is required to increase citizen use of public transportation and increase conservation efforts.

Need to understand what actions by the government result in greater use of public transportation and greater conservation efforts. ***Activity type: Education/Outreach. Cross-Cutting Topics: NA***

5 Recommendations: Adaptation

Adaptation Technical Workgroups

The Adaptation Advisory Groups (AAG) was tasked with identifying policy recommendations that could be implemented to help Alaska adapt to a changing environment resulting from climate change impacts. Four technical workgroups (TWGs) were formed as part of the AAG:

- Economic Activities
- Health and Culture
- Natural Systems
- Public Infrastructure

5.1 Economic Activities (EA) TWG

The Economic Activities TWG evaluated the effects of climate change on a wide range of economic activities across Alaska. They focused on oil and gas, renewable energy, mining, ocean transportation, rural non-road transportation, transportation and recreation, boundaries and ownership, energy demand, evolving jobs and economy, information collection and dissemination, and other economic sectors.

TWG Recommendations

The TWG forwarded the following adaptation policy options for consideration by the Climate Change Sub-Cabinet:

EA-1. Evaluate potential needs for expanded ocean oversight and regulatory activities
EA-2. Explore economic activity opportunities offered by climate change
EA-3. Develop scenarios for the Alaska economy affected by climate change
EA-4. Establish a center for knowledge sharing on Arctic issues
EA-5. Improve availability of mapping, surveying, charting, and imagery data

RWNG Recommendations

To these policy options the following addition is recommended:

EA-6. Systematically identify and address economic barriers to implementing climate change planning efforts

EA-7. Evaluate full-cycle economic impact of mitigation and adaptation proposals in relation to ultimate cost of energy, state revenue income stream, required state and federal subsidies, and local economic impact to businesses reliant on existing infrastructure.

Research Needs

5.1.1 Overarching Research Needs

Successful implementation of these policy options will require baseline data collection, scenario modeling, monitoring and assessment. Many of these research needs overlap those identified by other TWG, in that economic factors form a common thread. Overarching research needs for economic activities include:

5.1.1.1 Develop higher resolution climate modeling and monitoring data and improve its accessibility and utility.

This need is common among nearly all the TWG. To assess and plan for changing economic conditions as a result of a changing climate will require higher resolution climate modeling and monitoring information at more local levels. Additionally, there is a need to increase the accessibility and utility of these data to government officials and businesses. Finally, there is a need to tailor these data to the needs of government officials and businesses. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: All**

5.1.1.2 Assess statutory, regulatory, and policy frameworks and barriers to implementing climate change policy recommendations.

Many laws, regulations and policies on the federal, state, and local levels were developed before the signs of more rapid climate change were recognized. For example, resource managers in Alaska may need to revise Alaska policies relative to wildland fire management in light of the effects of climate change. Another example is the need to modify water quality standards that call for maintenance of water temperatures in cold water systems in light of warming temperature. The challenge for government leaders and businesses will be to adapt to a future made less certain due to a more rapidly changing climate. This will necessitate an evaluation of existing laws, regulations and policies and possible changes to institutional, legal and policy frameworks in an adaptive manner. **Action Type: Products, Education/Outreach. Cross-Cutting Topics: All**

5.1.1.3 Assess economic impacts of market-based approaches (e.g., cap and trade) to manage greenhouse gas (GHG) emissions and their impacts on the Alaskan economy.

Market-based approaches to manage GHG emissions can have a significant impact on many aspects of the Alaskan economy. It will be imperative to track these approaches as they develop and to proactively formulate strategies to adopt state approaches and, if necessary, adapt to adopted approaches. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: All**

5.1.1.4 Systematically identify and address economic barriers to implementing climate change planning efforts.

Uncertainty associated with climate change may result in barriers to implement identified climate change strategies/options and planning efforts. It is important to identify these barriers and strategies for addressing them. The uncertainty and risk of the current predictions should be well understood and incorporated in the decision process. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: All**

5.1.1.5 Assess data and information (economic indicators) needed to develop or adapt short and long term planning tools to assess impacts of climate change on economic activities.

There is a lack of baseline economic information and data needed to develop or adapt both short and long term planning tools to implement identified climate change strategies and options. It is critical to identify and collect the needed economic indicators. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: All**

5.1.1.6 Implement adaptive (scenario-based) planning tools that integrate economic indicators to improve climate change mitigation and adaptation decision-making and implementation.

Successful implementation of climate change strategies/options will require development and implementation of adaptive planning tools. These tools need to be probabilistic and scenario-based and integrate economic indicators. **Action Type: Products, Education/Outreach, Monitoring. Cross-Cutting Topics: All**

5.1.1.7 Catalog and assess new or expanded economic opportunities that may become available with climate change.

While some existing economic activities may be deleteriously affected by a changing climate, others may be benefited while still others may become established. For example, a warming climate may open new economic opportunities in the Arctic basin, including commercial fishing and transpolar shipping. A necessary first step towards developing these opportunities is to catalog and assess them. **Action Type: Products, Education/Outreach. Cross-Cutting Topics: All**

Specific Research Needs

Specific research needs by economic activity research area are presented below by sector. They are discussed in more detail in the appendix.

5.1.2 Oil and Gas

5.1.2.1 Develop economic analysis of potential rise or decline of oil and gas development on state revenues.

Oil and gas production provides significant revenues to Alaska. As such, any changes to oil and gas production can be expected to have significant impacts to the Alaskan economy. Climate change and resultant efforts to mitigate for it, or adapt to it, is expected to have impacts to oil and gas production. For example, development of cap and trade programs could have significant impacts on oil and gas production. Given the likelihood of such impacts it is imperative to develop economic analysis of potential rise or decline of oil and gas development on state revenues. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Oil and Gas**

5.1.2.2 Consider how potential rise or decline of oil and gas operation and maintenance may affect state revenues.

Climate change is expected to have impacts on oil and gas operations and maintenance. Under current tax structures, operation and maintenance costs can influence the amount of revenue the state receives from production. For this reason, it is important to determine how potential rise or decline of oil and gas operation and maintenance may affect state revenues. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Oil and Gas**

5.1.2.3 Model coastal vulnerability to establish criteria for pipeline coastal transition set-backs and burial depths.

Climate change is expected to impact coastal zones through erosion and coastal inundation. This will require an assessment of the current permitting and oversight of pipelines and other operations in the coastal zone. This assessment will require a modeling of coastal vulnerability to establish criteria for pipeline coastal transition set-backs and burial depths. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Public Infrastructure and Oil and Gas**

5.1.2.4 Expand research on ice road and pad construction techniques and in-season monitoring to maximize seasonal use and minimize impacts.

Climate change is impacting the length of time ice roads and pads can be used on the North Slope of Alaska. Expanded research on ice road and pad construction techniques and in-season monitoring is needed to maximize seasonal use and minimize impacts. **Action Type: Modeling, Products, Education/Outreach, Data**

Management, Monitoring. Cross-Cutting Topics: Public Infrastructure and Oil and Gas

5.1.2.5 Expand research on climate change impacts on permafrost engineering design.

Permafrost is being impacted by climate change. These impacts are affecting existing and planned structures. Design standards are inadequate to address these impacts. Expanded research on climate change impacts on permafrost engineering design is needed. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Public Infrastructure and Oil and Gas**

5.1.2.6 Develop new techniques to clean up oil spills in icy waters.

There is an interest in developing offshore oil and gas in Arctic areas. This increases the potential for oil spills in offshore areas that are being impacted by changing ice conditions associated with climate change. There is a need to develop new techniques to plan for and clean up oil spills in icy waters. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Oil and Gas**

5.1.3 Renewable Energy

5.1.3.1 Assess economic potential for developing carbon-neutral energy sources.

Federal legislation may likely call for a larger proportion of energy production to come from carbon-neutral sources (definition, e.g. including forest materials). In Alaska, little is known about the economic potential for developing carbon-neutral energy sources. Given this, it is imperative to assess the potential for developing carbon-neutral energy sources. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Energy Supply and Demand**

5.1.3.2 Identify potential economies of scale and return on investments in developing renewable energy sources.

Little is known about the long-term economics associated with renewable energies. As there is an increased call for shifting energy production to renewable energy sources it is important to identify potential economies of scale and return on investments in developing renewable energy sources. This will allow better decision tools to be developed to inform the economic impacts of renewable energy sources. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Energy Supply and Demand**

5.1.4 Mining

5.1.4.1 Research cost-effective techniques for construction, operation, and reclamation that will be responsive and useful in changed environmental conditions.

Energy conservation and renewable energy alternatives require metals and metal alloys. As renewable energies increase, this will increase the demand for metals. Since Alaska has world class metal resources, it can be expected that there may be increased interest in mining. It will be important to research cost-effective techniques for construction, operation, and reclamation that will be responsive and useful in changed environmental conditions. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Public Infrastructure, Natural Systems, Energy Supply and Demand.**

5.1.4.2 Assess engineering standards for tailings storage in Arctic/Subarctic climates.

Energy conservation and renewable energy alternatives require metals and metal alloys. As renewable energies increase, this will increase the demand for metals. Since Alaska has world class metal resources, it can be expected that they will be increased interest in mining. As new mines are developed it will be important to assess engineering standards for tailings storage in Arctic/Subarctic climates. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Public Infrastructure, Natural Systems, Energy Supply and Demand**

5.1.4.3 Develop economic analyses of potential rise or decline of mining and impact on state revenues.

Energy conservation and renewable energy alternatives require metals and metal alloys. As renewable energies increase, this will increase the demand for metals. Since Alaska has world class metal resources, it can be expected that they will be increased interest in mining. As this demand increases it will be important to develop economic analyses of potential rise or decline of mining and impact on state revenues. **Action Type: Modeling, Education/Outreach, Monitoring. Cross-Cutting Topics: Public Infrastructure, Natural Systems, Energy Supply and Demand**

5.1.5 Ocean Transportation

5.1.5.1 Model sea ice and its effect on ocean transportation.

Climate change is reducing sea ice in the Arctic at varying rates. It is important to model sea ice and its effect on ocean transportation. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Natural Systems, Public Infrastructure**

5.1.5.2 Develop economic analysis of potential rise or decline of shipping and impact on state revenues.

Climate change is reducing sea ice in the Arctic, creating economic opportunities and localized costs. It is important to assess the impacts of increased shipping to Alaska and its economy. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Natural Systems, Public Infrastructure**

5.1.5.3 Identify trends that may influence impacts of shipping on the environment, hunting, fishing and communities.

Climate change is reducing sea ice in the Arctic and allowing for increased shipping. This will potentially influence the environment, hunting, fishing and coastal communities. As such it is necessary to identify trends that may influence impacts of shipping on the environment, hunting, fishing and communities. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Natural Systems, Public Infrastructure**

5.1.5.4 Increase ice-breaking capabilities in the Arctic.

Climate change is impacting the formation and breakup of sea ice in the Arctic. To increase the duration of shipping and provide for assistance in sea ice conditions, ice-breaking will be required. For these reasons it is imperative to Increase ice-breaking capabilities in the Arctic. **Action Type: Modeling, Products, Monitoring. Cross-Cutting Topics: Public Infrastructure**

5.1.5.5 Research innovative approaches and building techniques for supporting arctic shipping and developing sustainable ports.

Climate change is changing sea ice formation and breakup in the Arctic, which will change how ports are developed and shipping routes maintained. This will require research into innovative approaches and building techniques for supporting arctic shipping and developing sustainable ports. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Public Infrastructure**

5.1.6 Rural Non-Road Transportation

5.1.6.1 Assess the impact of climate change on existing rural transportation networks.

Much of Alaska's rural transportation network is non-road based, depending on frozen tundra and unfrozen river and lake routes for surface transportation. As a result, climate change can potentially significantly affect these networks. For these reasons, it is imperative to assess the impact of climate change on existing rural transportation networks. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Public Infrastructure and Health and Culture**

5.1.6.2 Develop economic analysis of potential costs associated with expected impacts to rural transportation networks.

Much of Alaska's rural transportation network is non-road based. As a result, climate change can potentially significantly affect these networks. With increases to costs of transportation, it is important to develop economic analysis of potential costs associated with expected impacts to rural transportation networks. **Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Public Infrastructure and Health and Culture**

5.1.7 Other Economic Sectors

5.1.7.1 Develop economic analysis of potential rise or decline of recreational, subsistence and commercial fishing.

Climate change will impact fish and their habitats to varying degrees. Some fisheries will benefit while others will be negatively impacted. Research into fisheries should support economic analysis of the potential rise or decline of recreational, subsistence and commercial fishing. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Natural Systems, Health and Culture**

5.1.7.2 Assess and model increased insurance costs.

Climate change is recognized as causing increased risks to private and government infrastructure. Insurance premiums are based on environmental conditions and projected risks. It will be important to assess and model insurance costs associated with risks perceived from climate change influences. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Public Infrastructure and Health and Culture**

5.1.8 Transportation and Recreation

5.1.8.1 Develop economic analysis of potential rise or decline of tourism and impact on state revenues.

Tourism is an increasing contributor to the Alaskan economy. It is unknown how a changing climate may impact tourism. It is important to develop economic analysis of potential rise or decline of tourism and impact on state revenues related to climate change. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Natural resources, Public Infrastructure, Health and Culture**

5.1.8.2 Develop economic (scenario) analysis of potential national and international changes in patterns of people and freight movements.

Climate change is impacting natural systems throughout the Arctic, both in the terrestrial and ocean areas. The impact to these natural systems will likely change the patterns of movement of people and freight. It is important to develop

economic (scenario) analysis of potential national and international changes in patterns of people and freight movements. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Natural resources, Public Infrastructure, Health and Culture**

5.1.8.3 Assess opportunities for development/enhancement of recreation due to climate change.

Climate change is impacting natural systems throughout the Arctic with changes to seasonal recreation. It is imperative to assess opportunities for development/enhancement of recreation due to climate change. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Natural resources, Public Infrastructure, Health and Culture**

5.1.9 Boundaries and Ownership

5.1.9.1 Improve mapping and surveying to accurately and efficiently establish boundaries, address boundary disputes as needed and aid charting for safe navigation.

As climate changes, boundaries that are dependent upon physical features may be impacted. It is necessary to improve surveying and mapping to accurately display the land and land/water interface. This will support establishing boundaries and provide data to address boundary disputes. Improved charting for safe navigation and mapping for overland travel will be an ancillary product. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Natural resources, Public Infrastructure**

5.1.10 Energy Demand

5.1.10.1 Assess how climate change will impact application of federal, state, and local laws, regulations and policies on energy demand and use.

Climate change legislation will impact application of federal, state, and local laws, regulations and policies on energy demand and use. For example, increased pressure to reduce GHG will have impacts on laws, regulations, and policies related to natural resources. For this reason it is imperative to assess how climate change will impact application of federal, state, and local laws, regulations and policies on energy demand and use. **Action Type: Products, Education/Outreach. Cross-Cutting Topics: All**

5.1.11 Evolving Alaska's Jobs and Economy

5.1.11.1 Assess how climate change will impact application of federal, state, and local laws, regulations and policies on economic development activities.

Climate change legislation will impact application of federal, state, and local laws, regulations and policies on economic development activities. For example,

increased Arctic shipping and resource development will have impacts on laws, regulations, and policies related to natural resources and indigenous people. For this reason it is imperative to assess how climate change will impact application of federal, state, and local laws, regulations and policies on economic development activities. **Action Type: Products, Education/Outreach. Cross-Cutting Topics: All**

5.1.12 Information Collection and Dissemination

5.1.12.1 Continue to refine the "Cost of Climate Change" study recently completed by the UAA ISER.

The University of Alaska Institute of Social and Economic research is conducting a study to assess the costs of climate change to Alaska. This is an overarching economic analysis of the climate related impacts. This study should be completed. **Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: All**

5.1.12.2 Identify climate trends and downscale models leading to establishing environmental information, analysis tools, and design criteria for use in adapting to climate change.

This need is common among nearly all the TWG. To assess and plan for changing economic conditions as a result of a changing climate will require higher resolution climate modeling and monitoring information at more local levels. Additionally, there is a need to increase the accessibility of these data to government officials and businesses. Finally, there is a need to tailor these data to the needs of government officials and businesses. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: All**

5.1.12.3 Provide resources for good Digital Elevation Model (DEM) and GIS data, and current and high resolution imagery to establish a more robust information infrastructure to plan and adapt.

There is a need for improved Digital Elevation Model (DEM) and GIS data, and current and high resolution imagery to establish a more robust information infrastructure to plan and adapt. This information is needed to develop down-scaled models and to assess potential economic impacts. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: All**

5.1.12.4 Invest in monitoring and data dissemination programs to enhance information available for safe and efficient resource development.

Much data is currently available but for a variety of reasons is unavailable to researchers or decision-makers. There is an urgent need to invest in monitoring and data dissemination programs to enhance information available for safe and efficient resource development. **Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: All**

5.2 Health and Culture Research Needs (HC) TWG

Health and Culture can be divided into two research focuses, i.e. health which researches the risks associated with a changing climate and communities and culture which researches the risk to losing that which has endured and evolved with the people, their traditions and knowledge.

TWG Recommendations

The TWG forwarded the following adaptation policy options for consideration by the Climate Change Sub-Cabinet:

HC-1. Identify a central agency, as well as responsible individuals, to support rural communities in dealing with complex issues requiring coordination among multiple state and federal agencies, local governments, NGOs, and others.

HC-2. Augment surveillance and control programs for vector-, water-, and foodborne diseases likely to become greater threats because of climate change. Develop educational programs for the public, health care providers, environmental staff, and others on approaches to reduce emerging disease threats.

HC-3. Initiate a community health impacts evaluation mechanism to evaluate recommended adaptation and mitigation options to determine whether they could results in adverse health impacts and, if so, to recommend approaches to reduce these risks.

HC-4. Assess risks to rural sanitation and solid waste management from flooding, thawing permafrost, and other risks, or that is otherwise subject to changed conditions that significantly reduce performance in environmental health protection. Consider the modification, rebuilding, or relocation of sanitation infrastructure to protect human and environmental health.

HC-5. Assess archeological, historical, and cemetery sites at risk from climate change. In cooperation with appropriate local, regional, and statewide entities, assess archaeological sites at risk from accelerated coastal and river erosion; convene archaeologists, anthropologists, Alaska Native elders, and others to discuss how best to address and prioritize sites at risk; and develop a plan for the protection or recovery of important at-risk sites. Complete a statewide assessment of the gravesites most at risk; assist in identifying and opening new gravesites; convene a respectful discussion about gravesites and explore best practices; provide assistance for the relocation of existing at-risk gravesites.

RNWG Recommendations

To these policy options the following addition is recommended:

HC-6. Research mechanisms to insure that traditional knowledge and wisdom is integrated into research programs and research results are corroborated in understanding the climate change impacts to and opportunities for indigenous people and their culture.

Background for health research needs

Sentinel events and indicators will show risks to public health and indigenous people and fauna in areas where the climate is changing at an accelerated rate. The research must help to understand the exposure-response relationship associated with the indicator and the potential duration and extent of the event. This research will help to understand the link between the change happening and the potential risks beyond the sentinel event so that health models can be developed and risks estimated.

Health models will need to be refined to propose response to the sentinel events and account for risks to the health of the residents and the flora and fauna in the adjoining ecosystem. The models should provide a scientific methodology for conducting surveillance and establishing control in response to a "sentinel event". The models must be clear enough to enable local collection of health information that will fit into the scientific methodology and yet allow flexibility to researchers to adapt the research strategy and health models to accurately portray and understand the sentinel event and its link to changes in climate and environment.

Health impact assessments will be an essential research tool to adjusting the models to the indicators of sentinel events and the changes to health that are associated with changing climates and escalation of health risks with the sentinel event. How this happens and what happens over the duration of the event will need a monitoring protocol that is consistent with the scientific methodology yet designed for collection by the local health community members. Meeting this research component will allow the databases to be expanded on a community by community basis and refine the health impact assessments to address specific community needs.

The research matrix required in understanding the health risks associated with climate change must assess the factors causing the sentinel event. This should include, but not be limited to whether it is a water, food, insect or vermin borne vector. The matrix should recognize whether the event is part of range extension, as may be shown with icthyophonous or paralytic shellfish poisoning in fish and shellfish, wasting disease in the fauna, or tumors, asthma or infection in the people. This information will portray impacts on the physical and mental health of the people. It is at this point where health and culture research come together in a research matrix approach, as the health is directly linked to the subsistence culture and social well being of a traditional lifestyle.

Background for culture research needs

Research protocols that document the social impacts to community life of climate change are essential in addressing the questions of adaptation. Through the use of community social and health services, a research protocol can be implemented that meets the scientific needs while recognizing the communities' capabilities and insight. This includes the

integration of traditional knowledge and wisdom into the research questions so as to insure that what is seen is consistent with what is measured.

A standardized social network approach to research is recommended. This will allow consistency with research in other socio-cultural programs while allowing the research to adapt to the uniqueness of changes within the last generation. The social network will provide the data needed to identify communities at risk and the risks that are affecting the communities in the short and long term.

Modeling local economies from the standardized social network data will help in addressing the social and cultural impacts of climate change and link back to health risks. This will focus on the people and the community. Additional research will be needed to model the potential for a sentinel event or the probability of a failure in the solid waste and sanitation.

Monitoring will remain an essential part of the cultural research as it pertains to changes in cultural activities, accuracy and applicability of traditional knowledge, risks from failure of community sanitation, and occurrence and trends in vector borne illnesses. Such monitoring will provide the data to refine the models that can predict the sustainability of the communities and survivability of the traditional ways.

Research protocols must be designed to document and preserve the culture, including cultural and historic artifacts. This research should focus on preserving community identity while protecting the importance to the people and confidentiality allowed by law. Efforts should be included to continue to preserve the historic stories and catalog language as a means to insure that future researchers can understand the cultures of Alaska before technology and loss to climate change.

Correlation and verification of western science with traditional knowledge and wisdom and traditional ecological knowledge will be an integral part of the research protocols and outcomes. Specifically, this correlation and verification will focus on documenting the impacts of climate change on the cultures through loss of sea ice, change in subsistence living, and deterioration of subsistence foods. While western science can document the change, this research must link to that observed by the people in their communities and how today under climate change is different than that learned from their elders.

Research should also build upon long term research as collected by state and federal agencies, e.g. ADF&G Harvest Surveys. Continuing and expanding the analyses of this and comparable other data sets can provide the western science needed to understand how the changes are observed by the people and integrated into the culture.

Socio-economic research, like the ADF&G Harvest Surveys but across the other state and federal agencies, is an integral part of the research strategy that will deliver the reports upon which the impacts of climate change can be assessed. A statewide socio-economic research plan should be developed that encompasses the breadth of climate change on Alaska's culture and the local economies. This should include a structured dialog that

strengthens the understanding of the elders in providing traditional knowledge with the data collection and research protocols of modern science.

Within the questions of socio-economic research is the impacts of public policy on community sustainability. Research questions transcend the impacts of climate change to the issue of if public policy allowing action to protect the communities, allow subsistence lifestyles to continue, and allow timely adaptation to climate related events. Research into whether barriers to adaptation exist due to present laws and/or public sentiment. Assessing whether the regulatory framework for the harvest of flora and fauna, adapting infrastructure to protect in place or relocate, and insuring community health and sustainability is adequate or counter-productive will need information based on accurate research. An interagency research team may prove an effective tool for addressing such questions.

Research needs for health and culture also cross-cut to many of the other research needs, as assessing health risks and sustaining culture depend on having the same information as other research disciplines in adapting to climate change. Cross-cutting research needs can be characterized as:

Researchers need improved cross-agency coordination. Research to address climate change impacts on health and culture will benefit from research conducted to address questions in other disciplines. Methods to improve cross agency coordination and data sharing are identified in every discussion of research needs in adapting Alaska communities to climate change. Methods often used are seminars, research meetings, web-posting, and inter-agency working groups. Cross-discipline scientific review panels can expand the dialog in finding multiple applications in understanding changes and developing adaptation strategies. Together, this can expand the breadth of research, lead to applications in other disciplines and develop response strategies for adaptation.

Research plans, projects and results need to be made available to the communities to support understanding of impacts from and options in adapting to climate change. Addressing this research need requires internet tools for distributing the information as well as improving the feedback on the value of the research project and results. Culturally tailored materials are need to reflect on traditional knowledge and wisdom (better term?) and explain how the research plan, project, and/or results will build upon the local knowledge. This will foster dialog and improve community acceptance of the results and enable adaptive planning.

Research needs include developing an education component that supports observations of indicators and monitoring of changes that may provide a basis for understanding climate impacts. Education materials are needed to support workforce development and encourage interest in local students to be involved in the science and research that is being conducted to understand climate change. This includes vocational technical training curriculum, secondary education materials, and teacher training.

Health and Culture research needs recognize the importance of having accurate materials to plan future research. This includes downscaling models to the community level for various parameters. These include ultraviolet radiation for exposure risk assessments; weather patterns and water transport for contaminants and toxin transport; and exposure to dust and methane. Health and Culture research also recognize that environmental change needs to be accurately modeled for the impacts to communities from flooding and coastal inundation and permafrost thaw, slumping and erosion. These points are clearly outside the research needs of health and culture, yet are essential in understanding the impacts of climate on health and culture.

5.2.1 Overarching Research Needs

Overarching research needs for Health and Culture TWG activities include:

5.2.1.1 Develop regional economic models to quantify climate change impacts on communities and provide input to the NEPA process.

Communities cannot adapt to the impacts of climate change without state and federal assistance, which requires compliance with the NEPA process and recommended alternatives. Climate change is raising significant economic questions with investment in communities and sustainability. ***Action Type: Modeling, Products. Cross-Cutting Topics: Public Infrastructure and Economics***

5.2.1.2 Revise Flood Risk Maps.

Use projections for increased precipitation, loss of sea ice and the accompanied increase in storm activity over previously ice covered waters for the next 100 years to develop revised flood risk maps that will help guide communities and state agencies in making future planning and infrastructure development decisions. Allow for continual update of these maps to incorporate the expected ongoing refinement in climate projections over time. Communities cannot obtain flood insurance. Securing funding for improving and maintaining community will be difficult as lack of information and accurate data will require conservative attitudes towards investment and economic development. This will hinder economic development for the community. ***Action Type: Products. Cross-Cutting Topics: Public Infrastructure and Economics and Natural Systems***

5.2.1.3 Develop sea level rise projection maps for coastal areas throughout Alaska, accounting for local isostatic rebound in conjunction with global sea level rise predictions.

Work with coastal communities and the State of Alaska to incorporate this information into community and state planning efforts to better guide future development decisions. Allow for continual update of these maps to incorporate the expected ongoing refinement in climate projections over time. Communities are unable to accurately plan for economic development and assess risks from erosion or inundation. Public is developing inaccurate perception of sea level rise

and coastal inundation because of lack of accurate information and heavy press coverage. ***Action Type: Modeling. Products. Cross-Cutting Topics: Public Infrastructure and Economics and Natural Systems***

5.2.1.4 Downscale climate modeling projections to the local or regional level to aid communities in planning.

Alaska's communities will have significant challenges in adapting if climate modeling projections downscaled to the local or regional level are not available on which to base decisions. They will also have little incentive to adapt. Currently, Alaska Center for Climate Assessment and Policy (ACCP) has identified global circulation models (GCM) best suited to northern latitudes, and can downscale the model results to every community in the state. Disseminating this information to communities is a first step toward helping them to plan and tailor adaptation to their own specific needs and impacts. However, data gaps remain. Information on projected changes to permafrost and sea level at the local and regional levels is still lacking. Development of a statewide research grant fund could be used to focus the scientific community on filling data gaps critical to community adaptation. Develop Downscaled Climate Modeling for Municipalities. Communities are coping with changes as seen over time while decision makers are looking for more accurate information to plan and predict actions that will be required. Research that will downscale models is identified as one solution. ***Action Type: Modeling, Products, Education/Outreach, Data Management. Cross-Cutting Topics: Public Infrastructure and Economics***

5.2.1.5 Conduct a comprehensive inventory of the wide range of data collection, monitoring efforts, and research projects underway or planned in relation to the impacts of climate change on the environment.

The benefit to federal, state and municipal entities of having this information accessible in some form of centralized information portal, gateway, or web-based clearinghouse would be significant, most notably in terms of improved ability to make adaptation decisions intelligently and effectively. In turn, duplication of monitoring efforts could be avoided and government entities could provide feedback on specific data gaps, serving to drive future research objectives. Conduct a Comprehensive Inventory of Current Research, Monitoring and Data Collection Efforts. Overall perception that the communities and decision makers do not have adequate information on the research projects ongoing to make plans to adapt to changing climate. There is limited understanding of the timeline by which the research will conducted, analyzed and developed into applied research and information. With the days of Internet and modern communication technology, impacted Alaska communities need access to up to date information and the ability to help guide research projects. ***Action Type Data Management, Monitoring. Cross-Cutting Topics: Mitigation All***

5.2.1.6 Provide communities with social research on the cultural impediments and history of government.

This research need is being addressed in the Public Infrastructure Working Group. Providing this information to communities may provide insight into how to sustain communities and maintain community infrastructure to different cultural standards, while recognizing the challenges of weather and seasons. Community-based reporting and protocols can insure longevity in public and private investment while fostering agreement to maintain systems to higher standards. Costs and sources of funding are major issues in this area. ***Action Type: Modeling, Products. Cross-Cutting Topics: Public Infrastructure***

5.2.1.7 Conduct social and education research to develop culturally appropriate curriculums for maintaining public infrastructure and community property.

Develop economic forecast models that show the cost savings by not deferring maintenance or in determining where deferred maintenance goes from cost savings to higher costs. This is a continuation of the research needs associated with the public infrastructure TWG. ***Action Type: Education/Outreach. Cross-Cutting Topics: Public Infrastructure***.

5.2.1.8 Perform standardized social network research in select communities to understand potential impacts of relocation on social, sharing, economic and subsistence networks.

Standardized sampling methods for social networks, as being applied in different locations and for different cultures, can provide a tool by which the challenges facing Alaska communities can be better understood. ***Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Economic Activities and Natural Systems***

5.2.1.9 Use the SPOT satellite data system or others to track changes in permafrost extent and work to develop projection maps for changes in extent over the next 100 years, based on climate change projections.

Satellite data and permafrost extent mapping and modeling would serve to guide communities and state agencies in construction planning decisions, both for determining the location and means of construction of new projects as well as identifying those existing projects which may be at risk from thawing permafrost in the future. Satellite data will allow for continual update of these maps to incorporate the expected ongoing refinement in climate projections over time. Communities need accurate data to understand changes to their community and surrounding environment. This will support the traditional ways of life with modern mapping products. ***Action Type: Data Management, Monitoring. Cross-Cutting Topics: Public Infrastructure, Agriculture, and Economics***

5.2.1.10 Refine global climate models for better understanding of regional variations within Alaska.

Modeling will provide a better understanding of the effects of climate change. Improved monitoring and modeling data will allow for development and dissemination of environmental information and design criteria for use in adapting to climate change. ***Action Type: NA. Cross-Cutting Topics: NA***

5.2.1.11 Assess the degree and rate of thawing submarine permafrost deposits in coastal areas due to warming sea temperatures.

Study of the climate-driven instability of coastal permafrost is needed to evaluate the risk of subsidence and erosion and the consequent impact on human developments and ecosystems. Newtok relocated because of the thawing of subterranean and submarine permafrost. Other coastal communities in western, northwest and northern Alaska have comparable risk with retreat of sea ice and exposure of permafrost to wind induced waves. Research to identify susceptible communities and assess the rate of permafrost loss is needed. ***Action Type: Modeling, Monitoring. Cross-Cutting Topics: Public Infrastructure and Natural Systems***

5.2.1.12 Consider developing a series of television segments for Alaska Weather that provides climate change projection information and data on issues of specific importance to Alaska's rural communities.

Rural Alaska and the indigenous people have important stories to tell on how the changing climate is impacting the traditional ways of life. Developing a series of television segments would foster better understanding of how changes in future climate, both gradual and sudden, can impact communities and individual lives. This can become a catalyst for change in individual behavior. Research into these stories and observations will improve the sharing of traditional knowledge and wisdom while increasing the publics' understanding of climate change and the impacts to the health and culture of rural residents. *Priority: NA. Urgency:* Low as covered by other networks. Distribution to rural Alaska may be a different unmet need. ***Action Type: Education/Outreach. Cross-Cutting Topics: All***

5.2.1.13 Research and develop culturally appropriate curriculums and materials for traditional knowledge and local observations with accuracy of observations

Cross-cultural understanding of the impacts of climate change will benefit when prepared in culturally appropriate curriculum that recognizes the complimentary role and value of observations and scientific measurements with traditional knowledge. Developing this cross-cultural curriculum may be supported with social scientists who understand the scientific method and native leaders that are seeing the impacts of climate change on their traditional knowledge. Research conducted in developing this material will have a greater likelihood of community

buy-in, cultural acceptance and to be implemented. ***Action Type: Education/Outreach. Cross-Cutting Topics:*** **All**

5.2.1.14 Improve communications between federal scientists and state government agencies (such as the Alaska Departments of Fish and Game, Environmental Conservation, and Natural Resources) on climate science, the potential impacts, and data needs for those agencies concerning climate change.

State and Federal Science and Resource Agencies and stakeholders have concern that the information is not accurate or all inclusive. This leads to questions on whether decision makers do not make decisions or communities have insufficient information to make an informed decision. Regardless, with the number of working groups that have collaborated for decades there are still challenges in applying research results to public policy and social and cultural impacts. The Governor's sub-cabinet and working groups are an example of an effective method to address this issue. ***Action Type: Education/Outreach, Data Management. Cross-Cutting Topics: All***

Specific Research Needs

Specific research needs identified by the Health & Culture TWG are presented below. They are discussed in more detail in the appendix.

5.2.2 Subsistence Research

5.2.2.1 Decline and migratory shifts of major subsistence species and vegetation can significantly affect a wide range of cultural, community, and economic conditions. The effects of events must be assessed after an assessment is made of existing climate related socio-economic studies.

Assess socio-economic impacts of existing and emergent climate change events on culture, community wellness, subsistence, and overall economics. Assess socio-economic impacts of existing and emergent climate change events on culture, community wellness, subsistence, and overall economics.

The enculturation process of young hunters and gatherers through experienced adults can be severely disrupted with loss or disappearance of important subsistence species. Migration of wildlife may require extended subsistence trips, increasing costs and risks as well as substitution of expensive store bought foods. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: NA***

5.2.2.2 Standardized ADF&G Harvest Surveys.

This includes considerable social, demographic and economic information in addition to household harvest per species. Harvest surveys need to be accomplished in each of the villages designated with emergency status.

Action Type: Monitoring, Products, Education/Outreach, Data Management. Cross-Cutting Topics: Health and Culture, Economic Activities, and Transportation and Land Use

5.2.3 Social Impact Assessment

5.2.3.1 Regional assessments of existing social service infrastructure, staffing, budgets and delivery need to be accomplished at regional level as baseline to plan for increased demand.

Services are changing with the stress on rural communities that are increasing because of many factors, including climate change. Stressors include health, behavioral health, and culture with sustainability. Having accurate assessments based on research results and predictive models will allow decision makers to make plans for meeting these future needs. ***Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics:*** **NA**

5.2.3.2 Social Impact Assessments need to be conducted at regional and community level to provide information for Section III of the NEPA process, description of the affected environment.

Gathering social impact assessment information will be needed to complete impact assessments and provide preferred alternatives. By assessing the cultural impacts in an analytical manner, thorough documentation of the questions, responses and recommendations will be available to support the preferred alternatives. ***Action Type: Modeling, Products. Cross-Cutting Topics: NA***

5.2.3.3 Detailed interviews and oral histories need to be conducted to provide narrative information needed to assess the impacts of climate change and the potential impacts of different forms of relocation.

As stressors associated with climate change impact health and culture of rural communities and indigenous people, risks to cultures and oral histories exist. Insuring comprehensive collection and archiving will preserve heritage. This is critical as heritage is being lost with aging and passing of elders. These interviews and oral histories need to be placed in a comprehensive library and archive. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: NA***

5.2.4 Bio-Environmental Impact Assessment

5.2.4.1 Assess ADEC watershed contamination protection laws and source water protection program. Assess effectiveness of current monitoring and surveillance programs to identify and control new pathogens or increased contaminant infiltration/runoff from.

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks could alter the geographic range and incidence of a wide range of infectious diseases and can result in

contamination of food and water sources. A research program that assesses the effectiveness of current monitoring and surveillance programs, while identifying improvements given the uniqueness of changing climate and geographic ranges, is needed. ***Action Type: NA. Cross-Cutting Topics: NA***

5.2.4.2 Assess sanitation and solid waste disposal infrastructure and practices at risk from flooding, melting permafrost, and other risks, or that is otherwise subject to changed conditions that significantly reduce performance in environmental health protection.

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks could compromise sanitation and solid waste disposal infrastructure and render current practices ineffective. Research is needed in assessing the risk to existing facilities and identifying options for adapting the facility in the face of risks. Modeling of potential loss to erosion or flooding and associated risks to environmental health is needed. ***Action Type: NA. Cross-Cutting Topics: NA***

5.2.4.3 Work to quantify the climate warming impact from the potential release of methane hydrates in the Arctic due to warmer sea temperatures.

Study climate warming and methane hydrate deposits. ***Action Type: NA. Cross-Cutting Topics: NA***

5.2.4.4 Study the potential increase in bioavailability of persistent organic and transboundary pollutants, including pesticides, mercury, perfluorochemicals and flame retardants, which may be released from melting ice and snow and thawing soil as a result of climate warming in the arctic.

Transport of pollutants and toxins with changes in atmospheric flows and oceanographic currents are impacting Alaska. Evaluate the potential health impacts on humans, ecosystems from toxins, persistent organic chemicals and other pollutants, including their behavior in the food web. Develop projections as to whether these impacts and release rates can be expected to increase and to what degree in the future. Conduct the research in determining the extent and risk to health in the Arctic. ***Action Type: Monitoring. Cross-Cutting Topics: NA***

5.2.4.5 Study the interaction of increased UV exposure in the arctic on humans, animals and vegetation in conjunction with projected climate changes.

Climate change can change UV exposure that may affect human health and change plant and animal distribution. Research to study climate warming and Ultra-violet radiation, including monitoring plans will help to document the risks associated with the increased UV exposure. Research should include understanding the impact on people, flora and fauna, and traditional ways of life and culture. ***Action Type: NA. Cross-Cutting Topics: NA***

5.2.5 Cultural Resources Impacts

5.2.5.1 1) In cooperation with appropriate entities, complete an assessment of archaeological sites most at risk, and develop a plan for their protection or recovery. 2) Complete a statewide assessment of and response to the gravesites most at risk.

Research to improve the understanding of the potential cultural impacts of climate change on indigenous people must consider archeological sites. Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks will affect the stability of archeological sites and gravesites, requiring plans for protection or recovery. The magnitude of the problem will depend on a complete statewide assessment and a mitigation plan to reduce the loss and allow relocation. Developing a confidential but interactive data base should stem from this research. ***Action Type: NA. Cross-Cutting Topics: NA***

5.2.6 Community Capacity Assessment

5.2.6.1 1) Identify effective cooperative mechanisms to support rural communities in dealing with multiple rules and requirements. 2) In partnership with local communities, conduct an assessment of the capacity of communities to design and implement programs.

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks will present a wide range of challenges to rural communities that will require them to deal with multiple state and federal agencies, with overlapping and sometimes conflicting rules and regulations. Researching socio-economic and socio-cultural methods to equip rural communities in gaining assistance in designing and implementing programs that adapt a community is needed. ***Action Type: NA. Cross-Cutting Topics: NA***

5.3 Natural Systems (NS) TWG

The Natural Systems Technical Working Group (TWG) has developed a catalog of adaptation options related to the expected effects of climate change on Alaska's natural systems. This section presents research needs associated with the work group's recommendations on the relevant actions the State of Alaska could take to adapt to changes in Alaska's natural systems due to climate change. The research needs work group looked at adaptation options in the following areas: Fisheries, Wildland Fire, Freshwater Resources, Invasive Species and Disease, Fish and Wildlife Management, Forestry and Wood Biomass, Sustainable Agriculture, and Natural Hazards.

TWG Recommendations

The TWG forwarded the following adaptation policy options for consideration by the Climate Change Sub-Cabinet:

NS-1. Incorporate climate change into **fisheries** management and assist fishing communities and users in adaptation.

NS-2. Review and modify Alaska's **wildland fire** policy and programs.

NS-3. Address the effects of climate change on **Alaska's freshwater resources** through adaptive management, supported by improved hydrologic data.

NS-4. Reduce introduction and spread of **invasive species** in the context of climate change.

NS-5. Prepare for **adaptive management of fish and wildlife.**

NS-6. Develop capacity in new **forestry and wood biomass** opportunities.

NS-7. Support **local sustainable agriculture** in Alaska.

RNWG Recommendations

The RNWG recommended the following additional policy option relative to Natural Systems:

NS-8. Reduce risks to health, safety and property from **natural hazards** resulting from climate change.

Research Needs

5.3.1 Overarching Research Needs

Overarching research needs for Natural Systems TWG activities include:

5.3.1.1 Develop better hydrology data and models statewide.

Trend data and global climate models indicate a warmer and sometimes wetter climate for Alaska in the future. Planning for river navigation, flood hazard estimation, and cost-efficient engineering of public roads, culverts, bridges, water, and wastewater systems require accurate estimation of water flow volume and seasonality. Historic data and existing statewide coverage are inadequate for present and future needs. ***Action Type: Data Management, Modeling, Monitoring. Cross-Cutting Topics: Overarching***

5.3.1.2 Identify permafrost thaw hazards and incorporate into engineering guidelines.

Many of the scenario models used in IPPC reports suggest that widespread permafrost thaw will occur across the Northern Hemisphere in this century. Cracking roads and subsiding building foundations are common in some areas where permafrost thaw is occurring. Landslides and mudflows are also occurring on thawing wet hill slopes, sometimes blocking roads, rivers, and degrading fish habitats. Engineers, builders, and planners need accurate maps and forecasts for

planning. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Overarching***

5.3.1.3 Identify and research laws, policies, and regulations that could be modified to better support adaptation.

Many of the laws, policies, and regulations that direct management of public and private lands and waters are premised on stable climates, or at least on the ability to envision future conditions (e.g., ANILCA, ESA, CFR, CZMA). What will be the standard of successful resource management in a changing future? Can state and federal agencies preserve the unique and special values that are identified in legislation in the face of climate change? How will they develop adaptation strategies for fish, animals and plants when their natural climate zones move beyond management units, state and national borders? How can access to subsistence resources be ensured in light of changing resource availability, sedentary human settlement patterns, and the mix of agency rules and regulations? ***Action Type: Products. Cross-Cutting Topics: Overarching***

5.3.1.4 Implement local climate change scenario planning workshops in communities across Alaska (coastal, arctic, interior, etc.).

Alaskan's are receiving conflicting, sometimes sensational and frightening information about climate change from many sources. While environmental change has taken place in Alaska for a long time, much of the state's permanent development occurred before future climate change was given serious consideration. Recent trends and forecasts have made it increasingly apparent that future climate change needs to be factored into community planning. However, few communities really understand what additional changes to expect in their area, or how fast to expect them. As heard at the ACTEM climate change session, communities need updated mapping, photographs, and projections of environmental changes to be able to effectively plan for their adaptation to climate change. ***Action Type: Modeling, Products, Education/Outreach, Data Management. Cross-Cutting Topics: Overarching***

5.3.1.5 Identify and assess health and safety hazards resulting from climate change

Research is needed to identify risks and opportunities for early warning, avoidance, and hazard mitigation. Rapid climate change affects fire regimes and forest fuel hazards, physical hazards (glacial outbursts and river flooding, surging glaciers, avalanches, landslides, ground failures, solifluction, erosion, inundation, subsidence), invasive species (plants, animals, pests and diseases), species habitat loss and fragmentation, and vulnerabilities to spread of contaminants resulting from persistent organic pollutants (POPS) and permafrost thaw. ***Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: Overarching***

5.3.1.6 Coordinate data integration.

Decisions are being made without benefit of available data and redundant research activities are started for lack of access to existing data. Better access to existing data would be a cost-effective measure to provide more information for better decision making. ***Action Type: Data Management. Cross-Cutting Topics: Overarching***

5.3.1.7 Research changes to vital ecosystem services.

The cascading effects of large scale environmental change can affect critically important natural services and economic resources, such as water supply, air quality, ocean fisheries, etc. For example, large scale changes to boreal forest are expected, with uncertain effects to other factors. Information about potential "tipping points" could help to avoid situations where vital ecosystem services are no longer being provided (e.g. wildlife and fisheries population crashes). ***Action Type: Modeling. Cross-Cutting Topics: Overarching***

5.3.1.8 Fill gaps in geospatial data coverage, aerial photography, digital elevation models (DEM), and remote sensing data that are needed to assess and forecast climate change impacts.

There are highly important specific early needs to facilitate other data gathering efforts. For example, accurately represented coastal land elevations are needed for modeling how sea level rise will affect low lying coastal areas. ***Action Type: Products, Data Management. Cross-Cutting Topics: Overarching***

5.3.1.9 Conduct coastal mapping and shoreline characterization.

Baseline data is needed to enable coastal impact forecasting, scenario planning for sea level rise and coastal erosion, monitoring, trend analysis, and spill response following shipping accidents, which are expected to increase as sea ice diminishes in the Northwest Passage. ***Action Type: Products, Data Management. Cross-Cutting Topics: Overarching***

5.3.1.10 Assess, model, and monitor coastal impacts of changes to sea level and ice.

Coastal erosion is increasing with reduced sea ice cover and thawing permafrost. Rapid erosion is exposing buried infrastructure, undercutting road and building foundations, and destroying natural and cultural resources. ***Action Type: Modeling, Products, Data Management, Monitoring. Cross-Cutting Topics: Overarching***

5.3.1.11 Develop and refine down-scaled climate models.

Global Climate Model data is too coarse to inform communities and local resource managers about probable changes at local levels. ***Action Type: Modeling, Products, Education/Outreach, Data Management. Cross-Cutting Topics: Overarching***

5.3.1.12 Coordinate climate and ecosystem monitoring programs among agencies, organizations, and institutions.

Long-term datasets with reliable indicators and across large geographic areas (regional and continental scale) are essential to determine climate and resource condition trends. ***Long-term. Action Type: Products, Data Management, Monitoring. Cross-Cutting Topics: Overarching***

5.3.1.13 Work with communities to determine appropriate indicators of climate change and community impacts. Improve monitoring of key climate change indicators & effects, with emphasis on effects having large societal impacts. Monitor climate change indicators and their societal impacts.

Improved monitoring of key climate change indicators relevant to Alaska will allow for tracking of climate change effects and will contribute data to modeling and assessments. Monitoring of locally-appropriate indicators and development of thresholds is needed to determine when change is occurring to rapidly for communities to adapt to impacts related to climate change. This information is needed to inform assessments of societal impacts and support planning and adaptation. ***Action Type: Modeling, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Overarching***

5.3.1.14 Conduct research on protecting community water supplies and instream flows.

Freshwater runoff from snow and ice melt is a major source of drinking water for communities. Adequacy of future supplies cannot be assumed with climate change. ***Action Type: Modeling, Products. Cross-Cutting Topics: Overarching.***

5.3.1.15 Expand research and monitoring of contaminants deposition and bioavailability under changing climate.

Contaminants can affect health and survival of fish, wildlife, and people. Results from WACAP and other studies indicate higher than expected levels of contaminants even in remote areas. ***Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Overarching***

5.3.1.16 Acquire or produce vegetation maps that are usually compiled from satellite imagery. Ortho rectified imagery would show human improvements and vegetation. A base map is needed for the state.

Understanding changes in landcover types are critical to assessments related to fire, forestry, wildlife, fisheries, etc. GIS and maps are basic tools needed for many analyses. ***Action Type: Products, Data Management. Cross-Cutting Topics: Overarching***

5.3.1.17 Assess communications strategies for climate change information.

Poorly communicated information about climate change can cause more harm than good. ***Action Type: Education/Outreach. Cross-Cutting Topics: Overarching***

Specific Research Needs

Specific research needs are discussed in more detail in the appendix.

5.3.2 Fisheries

5.3.2.1 Synthesize current information about climate change impacts on fisheries and assess its reliability and degree of uncertainty.

Conduct fisheries ecological modeling. ***Action Type: Modeling, Products, Data Management. Cross-Cutting Topics: NA***

5.3.2.2 Conduct Arctic Ocean fisheries assessments.

Fisheries population shifts are occurring due to ecological change, and ship access is increasing with reduced sea ice. Commercial fishing in new areas would have uncertain effects to previously unaffected populations. ***Action Type: Modeling, Products, Monitoring. Cross-Cutting Topics: NA***

5.3.2.3 Increase real-time monitoring and forecasts of physical ocean conditions (winds, waves, sea ice, currents, temperature, salinity, pH, etc.).

Improved monitoring and forecasting of changing ocean conditions will inform modeling and forecasting of related biotic changes, as well as inform marine-based human uses. Physical data is needed to predict and explain biological responses. Information is needed about impacts of freshwater from glacial melt on marine ecosystems, to improve understanding of effects of climate change on marine ecosystems. Water temperature increases are correlated with oceanic regime changes and with locally reduced salmon returns and increased fish disease (e.g., *Ichthyophonus* in Yukon River salmon). Ocean acidification of the magnitude that has been occurring is expected to have significant impacts to food webs, and certain species (e.g. corals, shellfish). ***Action Type: Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

5.3.2.4 Research fisheries policy considerations.

Research what other countries, U.S. federal agencies and other states are doing to incorporate climate change considerations into commercial fishing policies, management, and other adaptations. Assess what is appropriate to Alaska conditions. ***Action Type: Products. Cross-Cutting Topics: NA***

5.3.2.5 Conduct physical, biological, and socioeconomic monitoring consistently over time to understand environmental change, distribution and abundance of freshwater, marine and anadromous species, and societal impacts.

Broad scale changes in fisheries species abundance and distribution are expected. Changing stream and lake biochemistry may drive freshwater ecosystem change and change the abundance and distribution of species of commercial or subsistence importance (as well as other effects.) Monitoring is essential to inform policy, management, and users' decisions. Data will support modeling and forecasting. The Anadromous Waters Catalog is the key tool for documenting freshwaters that are important to anadromous fish and to provide protection for these habitats. ***Action Type: Monitoring. Cross-Cutting Topics: NA***

5.3.2.6 Consider need for protected fish conservation areas.

Evaluate tools for fish species conservation. Expanding fisheries pressure can deplete target and by-catch populations and degrade habitats. Reduced sea ice increases the likelihood of increased fishing pressure in Arctic waters. ***Action Type: Products. Cross-Cutting Topics: NA***

5.3.3 Wildland Fire

5.3.3.1 Expand modeling of wildland fire, fuel, and smoke.

Fire hazards are expected to increase with rising air temperature, longer growing seasons, and increased soil dryness. Dense and long-lasting smoke from wildland fires can result in severe acute and chronic health impacts in affected communities. ***Action Type: Modeling. Cross-Cutting Topics: NA***

5.3.3.2 Review and coordinate wildland fire policies with Canadian counterparts.

Determine efficacy and ecological effects of different fire management policies. Current wildland fire policy is not Full Suppression. Research would inform policy makers about potential positive and negative effects to wildlife habitat of allowing wildland fires to burn. ***Action Type: Modeling, Products. Cross-Cutting Topics: NA***

5.3.3.3 Research Tundra fire effects and develop measures to reduce impacts.

Tundra fires are expected to increase as shrubs move into tundra and as soils dry from climate warming. Remote communities have limited fire fighting capacity. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: Health and Culture***

5.3.4 Invasive Species

5.3.4.1 Identify and develop methods to assess and control invasive and irruptive plant, animal, and diseases that are likely to become established, expand

their range, or be intentionally introduced in Alaska due to climate change.

Established terrestrial, aquatic, and marine species are shifting north into Alaska, while other species are also arriving from other seas and continents. Some new arrivals will compete with current species or carry parasites and diseases previously not present in Alaska. ***Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Forestry, Agriculture & Waste, Health & Culture***

5.3.4.2 Provide effective monitoring, forecasting and response to marine invasive species.

The number and distribution of invasive species is expanding in Alaska. Invasive species frequently out-compete valued native species and cause severe economic and ecological damage. Invasive marine species can arrive in ballast water, ship hulls and gear, through aquaculture/mariculture releases, and as a result of changing ocean conditions and migration patterns. ***Action Type: Education/Outreach, Data Management, Modeling, Monitoring. Cross-Cutting Topics: NA***

5.3.5 Fish and Wildlife

5.3.5.1 Improve wildlife and fisheries populations and harvest rate data and access.

Alaska's terrestrial, aquatic and marine ecosystems are changing, as are the natural habitats required by wildlife and fishery species. Scientists expect rapid change in some areas as trees and shrubs expand into tundra, as fires reduce the size and extent of coniferous forests, and as permafrost thawing and thermokarst formation change the distribution and size of wetlands. Alaska's rural population, tourism industry, and many businesses depend on healthy wildlife and fish populations for food and income. Accurate monitoring data and forecasts are needed to inform decision makers about resource management needs and options, including changes to laws, policies, and regulations. ***Action Type: Modeling, Data Management, Monitoring. Cross-Cutting Topics: Health & Culture, Economic Activities***

5.3.5.2 Develop projections of future changes to potential wildlife habitat that are likely to result from climate-driven changes to landscape, landcover (vegetation), wildfire frequency and intensity, permafrost thaw/thermokarst, and fragmented migratory corridors.

Climate change will have cascading effects on multiple physical, biological, social, and cultural resources. However, the scope and scale of those effects is largely undetermined. ***Action Type: Modeling, Products. Cross-Cutting Topics: NA***

5.3.5.3 Evaluate and improve methods for caribou population enumeration.

Subsistence communities need accurate information to adjust harvest patterns to changing wildlife abundance. Some herds are in decline and others may be. The accuracy and timeliness of caribou monitoring programs has been questioned by stakeholders and cooperators. ***Action Type: Modeling, Products, Data Management, Monitoring. Cross-Cutting Topics: NA***

5.3.5.4 Assess disjuncts between calendar dates for legal harvest, and actual biological behavior of species.

For example, moose hunters are concerned that legal harvest dates don't always correspond with available harvest opportunities. Managers are concerned that shifting a hunt into the rut period (when bulls are preoccupied with breeding) can increase hunting success, which could be problematic for low-density populations or those with a low bull: cow ratio. Improved methods for moose population enumeration are needed. ***Action Type: Products, Monitoring. Cross-Cutting Topics: NA***

5.3.5.5 Identify how "sentinel" ecosystems are changing.

Continued monitoring in those areas where there are already long-term records could provide valuable trend information. ***Action Type: Monitoring. Cross-Cutting Topics: NA***

5.3.6 Forestry and Wood Biomass

5.3.6.1 Research and monitor forest response after disturbance.

Research ecological "tipping points." Trees are moving into higher altitudes and higher latitudes as climate warms. Many common species are experiencing severe and recurring pest outbreaks (e.g., bark beetles, budworms, leaf miners) related to climate change (increased temperatures and transpiration, reduced soil moisture). Fire effects are increasing as flammable shrubs and trees expand into tundra, and as fire frequency increases in boreal forests. However, the full scope and trends has not been determined. ***Action Type: Modeling, Products, Data Management, Monitoring. Cross-Cutting Topics: NA***

5.3.6.2 Assess efficacy, economics, and ecological effects of salvage logging to produce timber and wood biomass fuels from fire- and insect-killed trees.

Climate change-related warming and drying is likely to result in more insect and fire-killed timber and biomass. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: NA***

5.3.6.3 Test various wood burning appliances and their air quality emissions in an arctic environment.

Increased use of wood and woody biomass as a "carbon neutral" heating fuel has potential to affect local air quality and resident health. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: Health and Culture***

5.3.6.4 Research net contributions of Alaska's natural areas to GHG release and sequestration.

Recent climate change is largely driven by greenhouse gas (GHG) levels. The effectiveness of cap and trade measures will also be affected by natural carbon sequestration and emissions. Understanding the relative contribution of sources of GHG compared to other human and natural sources is essential. Accurate modeling is critical for effective mitigation of atmospheric greenhouse gas emissions. Carbon emissions cap and trade systems are now being implemented to reduce global emissions of greenhouse gases. These systems are based on models of gas emissions and gas sinks. Current models cannot accurately determine whether Alaska's wild lands will sequester more carbon in vegetation than they release through wildland fires, oxidation of thawed organic permafrost, methane hydrates, etc. ***Action Type: Modeling, Products. Cross-Cutting Topics: Mitigation***

5.3.7 Sustainable Agriculture

5.3.7.1 Research agricultural products and practices suitable for changing conditions.

Research new agricultural product opportunities, technologies and best practices, including locally produced fertilizer and waste nutrient utilization (e.g., fish carcasses/processing waste), in order to prepare to capitalize on opportunities to expand sustainable agriculture in Alaska. Climate change may provide new opportunities in sustainable agriculture that may be of increased importance to food security as access to other food sources changes due to lost fish and wildlife harvest opportunities or increased costs for shipped foods. ***Action Type: Modeling, Products, Education/Outreach. Cross-Cutting Topics: NA***

5.3.8 Natural Hazards

5.3.8.1 Assess effects of climate on safe access for hunting, fishing and other subsistence activities.

Access to subsistence hunting and fishing on land and water is critical for survival in many areas. Accurate forecasting is important to enhance safety of travel in road-less areas. Changes in freeze-up and thaw timing and conditions continue to affect subsistence harvest opportunities and uses through inaccessibility and/or increased access hazards. Low river water may also preclude access. Changes in

safe access may require consideration of alternative access means, changes in season timing, or other adaptation. Access by traditional means may also damage resources when conditions change (e.g. ORVs or snow machines on wet thawed ground). ***Action Type: Modeling, Products, Education/Outreach, Monitoring. Cross-Cutting Topics: Health and Culture***

5.3.8.2 Update the Environmental Atlas of Alaska and Alaska Engineering Design Information System (AEDIS).

Engineers are sometimes using out-of-date environmental information in designing new facilities in Alaska, which may result in premature obsolescence or failure. ***Action Type: Products. Cross-Cutting Topics: Transportation and Land Use, Public Infrastructure***

5.4 Public Infrastructure (PI) TWG

The Public Infrastructure TWG identified and evaluated options and opportunities for the State of Alaska to enhance the resiliency and adaptive capacity of Alaska's public infrastructure to the current and potential future effects of climate change. They defined public infrastructure as the essential facilities and utilities under public, cooperative, or private ownership that deliver goods and services to Alaska's communities.

TWG Recommendations

The Public Infrastructure TWG recommends that State government adopt a systems-based vision for sustainable infrastructure that supports communities in an uncertain environment. This systems approach means shifting infrastructure planning and investment decision-making from a competitive and disconnected project-based orientation to a holistic, long-term, common outcome-based orientation. The TWG policy recommendations are:

PI-1. Create a statewide system for key data collection, analysis, monitoring, and access.

PI-2. Promote "No Regrets" Improvements

PI-3. Build to last. Build resiliency into Alaska's public infrastructure.

RNWG Recommendations

To these policy options the following additions are recommended:

PI-4. Include funding for long-term monitoring of infrastructure in operating budget.

PI-5. Develop and incorporate best practices for energy use reduction and greenhouse gas reduction into state agency policies and procedures.

Research Needs

5.4.1 Overarching Research Needs

Overarching research needs for Public Infrastructure TWG activities include:

5.4.1.1 Collect climate data and develop methodologies and capacity to enhance and increase the resolution of climate forecasting models.

Downscaled climate forecasts are needed so that Federal, state, and community planners & decision makers can establish: 1) time horizons within which they will need to address infrastructure fortification or relocation; 2) locations and designs of new infrastructure that accommodate these conditions; and 3) location-specific conditions that new infrastructure must be designed to accommodate. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

5.4.1.2 Develop and deploy effective mechanism(s) to increase the availability and maximize the exchange of authoritative, defensible, and timely information to support analysis and decision-making on issues of climate change adaptation & mitigation, sustainability, and resiliency.

Climate analysis information delivery and availability is decentralized and uncoordinated, creating inefficiency, duplication of effort, wasted money, and difficulty in locating information of consistent and acceptable quality for a variety of purposes. ***Action Type: Products, Education/Outreach, Data Management. Cross-Cutting Topics: NA***

5.4.1.3 Develop a mechanism to systematically identify, collect, and analyze the data that it needs to economically plan, develop, and manage its public infrastructure in a sustainable manner.

The state's current project-based focus on infrastructure development discourages investment in the systematic collection and evaluation of long-term post-construction performance data after construction. Infrastructure performance monitoring and modeling is necessary to effectively evaluate if and how infrastructure might be developed more sustainably in Alaska. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: NA***

5.4.2 Specific Research Needs

5.4.2.1 Analyze, develop, and update existing engineering and building codes and construction techniques for new infrastructure and structures in vulnerable areas.

Current designs likely do not incorporate the real risks and variability associated with climate change in Alaska. Consequently infrastructure may fail prematurely or require unnecessary expense to build and maintain, resulting in uneconomical and unacceptable risks to Alaskan communities. ***Action Type: Modeling, Products, Education/Outreach, Data Management, Monitoring. Cross-Cutting Topics: Energy Supply and Demand, Transportation & Land Use***

5.4.2.2 Establish an integrated baseline inventory on the location and condition of public infrastructure. Collect, assess and monitor data needed to develop sustainable solutions to adapt public infrastructure to the effects of a changing climate.

A complete inventory of public infrastructure (that is either now, or likely to be, at risk from the effects & hazards due to climate change) is needed in order to systematically identify public infrastructure vulnerability. Data that does exist is owned by several agencies and not effectively integrated and shared amongst. Inefficient duplication of effort is likely given the functionally separate organization and operations of State agencies. ***Action Type: Data Management, Monitoring. Cross-Cutting Topics: Energy Supply and Demand, Transportation & Land Use***

5.4.2.3 Identify, analyze, and use national and international research results and products as a basis for developing solutions and expanding best management practices in AK.

Employees of Alaska State agencies are not consistently clear about the role their agencies play in developing and supporting sustainable and resilient infrastructure. Performance measures of state agencies do not consistently recognize a systems approach and the value of sustainability and resiliency for state investments. State leaders have a tendency to manage public infrastructure funding decisions as expenses rather than investments. ***Action Type: Products, Education/Outreach. Cross-Cutting Topics: Energy Supply and Demand, Transportation & Land Use***

6 Glossary of Terms

ACCAP	Alaska Center for Climate Assessment & Policy
ACCS	Alaska Climate Change Strategy
ADCCED	Alaska Department of Commerce, Community, & Economic Development
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation & Public Facilities
AEDIS	Alaska Engineering Design Information System
AFS	Alaska Fire Service
AGDC	Alaska Geospatial Data Committee
ANHP	Alaska Natural Heritage Program
AOOS	Alaska Ocean Observing System
ASG MAP	Alaska Sea Grant Marine Advisory Program
BLM	US Bureau of Land Management
CCER	Climate Change Executive Roundtable
CCREL	US Army Corps of Engineers-Cold Regions Research and Engineering Laboratory
CNIPM	Alaska Committee for Noxious and Invasive Plants Management
DEM	Digital Elevation Model
DOD	US Department of Defense
DOE	US Department of Energy
DOI	US Department of Interior
EVOSTC	Exxon Valdez Oil Spill Trustee Council
FS	US Forest Service
FSP	Federal Subsistence Program
FWS	US Fish and Wildlife Service
GHG	Greenhouse gas
GINA	Geographic Information Network of Alaska
ISER	University of Alaska Institute of Social and Economic Research
JFSP	Joint Fire Science Program
NASA	National Aeronautics and Space Administration

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPRB	North Pacific Research Board
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NSSI	North Slope Science Initiative
NWS	National Weather Service
PRISM	Parameter-elevation Regressions on Independent Slopes Model
SNAP	Scenarios Network for Alaska Planning
State	State of Alaska
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
USCG	US Coast Guard
USGS	US Geological Survey
WACH	Western Arctic Caribou Herd

7 Research Needs Work Group Composition

Mitigation (M) Adaptation (A)	Name	Organization	Focus
A	Amy Holman	NOAA	Climate
A	Bill Streever	BP	Wildlife/O&G impacts
A	Bob Pawlowski	Denali Commission	Rural AK sustainability
M	Bob Swenson	DNR	Geologically hosted resources
A	Bob Winfree	NPS	Park Service
A, M	Buck Sharpton	UAF	Cross cutting
M	Chris Maisch	DNR	Forestry/Biological sequestration
A	Clint Adler	ADOT& PF	Co-Chair, Transportation
M	Clint Farr	ADEC	Emissions Inventory
A	Craig Fleener	ADF&G	Subsistence/Wildlife
A	Dan White	UAF Institute of Northern Engineering	Engineering/Hydro
M	Doug Vincent-Lang	ADF&G	Co-Chair, Fish and Wildlife
M	Jackie Holzman	FAA	Aviation
A	Jon Zufelt	Corps of Engineers	Infrastructure
	Kristie L. Ebi	ESS, LLC.	
A	Molly McCammon	AOOS	Oceanic/Atmospheric
M	Peter Crimp	AEA	Renewable energy

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Appendix A

Technical Work Group Reports

Full, detailed recommendation reports by RNWG ordered by TWG.

TWG: Energy Supply and Demand

4.2.1.1

Carbon sequestration research is needed to better understand the state's options for storing carbon in geologic formations. This research involves field investigation of likely sites as well as laboratory testing of formations that have the potential to fix the carbon (e.g., in carbonates).

Unique Identifier: 66

☐ Overarching Need

Why is this an issue?

Alaska has a major coal resource. New coal power plants or coal to liquids processes will likely either require carbon sequestration or be negatively impacted by carbon caps or taxes. In order to prepare the state for both managing the carbon dioxide it produces currently and for permitting of new carbon dioxide producing facilities, sequestration options must be available.

Describe the scope of the research need:

The scope involves field investigations of suitable sites, mapping, and equilibrium/reservoir of good candidates for sequestration. This likely covers the entire state, though areas of opportunity would be co-located with carbon producing units.

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.
Recommended action: Direct and fund state agencies (e.g., UA, ADNR) to investigate the potential for CO2 sequestration in geologic formations.

What research is being done/known?

No field research has been conducted in Alaska with the exception of the EOR, which is only one form of geologic sequestration.

What are the gaps in research?

Aside from spent oil and gas reservoirs, we have major gaps in our understanding of the potential sequestration formations, the long term viability of the formations, chemical reactions in the reservoir, and the costs associated with use of the formations.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Oil and Gas

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

ADNR, UA

TWG: Energy Supply and Demand

4.2.1.2

Unique Identifier: 65

☐ Overarching Need

Research should be conducted into value added carbon capture technologies such as carbon capture and use in greenhouses for food and energy production, carbon incorporation into high-tech products, such as carbon fiber or H2 storage, enhanced oil recovery, and carbon addition to H2 for fuels production. Many other options many be available. Research is needed to determine which opportunities hold the greatest promise for Alaska.

Why is this an issue?

In order to comply with future carbon caps, trading, taxation, and carbon dioxide reduction for mitigation purposes, the state needs options for carbon dioxide management. Beneficial use makes the most sense if reasonable options are available.

Describe the scope of the research need:

The research need ranges from basic research (e.g., carbon fibers), to testing and demonstration of greenhouse applications (e.g., algae for biofuels). Some of the opportunities, such as carbon capture in greenhouses might require applied research in year-round, low energy applications (e.g., LEDs).

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.
Recommended action: Direct and fund state agencies (e.g., UA, ADNR, Dept of Commerce) to investigate the potential for CO2 capture and management value-added products and technologies.

What research is being done/known?

Some research is presently being conducted in Alaska, though this research does not presently focus on fuels production. Much of what is being done is done through the University of Alaska or smaller private greenhouses such as that at the Chena Hot Springs Resort. The Office of Electronic Miniaturization at the University of Alaska is currently doing work on carbon fibers.
The Alaska Center for Energy and Power is working with the Fairbanks North Star Borough to develop a Food and Energy Research Station. This effort will include carbon capture in greenhouses producing both fuels and food for the region.

What are the gaps in research?

Gaps are different for the breadth of beneficial uses. It is not known how much carbon could be captured in greenhouses designed for high CO2 processing.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Oil and Gas

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

The University of Alaska (particularly the Alaska Center for Energy and Power, the Institute for Social and Economic Research, and the Agriculture and Forestry Experiment Station), private industry, state agencies

TWG: Energy Supply and Demand

4.2.1.3

Research is needed to improve efficiency from improved control and operation practices of existing generation capacity (e.g., diesel). This includes the management of hybrid systems which typically are very complicated from a management and control standpoint.

Unique Identifier: 64

☐ Overarching Need

Why is this an issue?

Carbon emissions can be reduced by increasing the efficiency of carbon producing processes such as diesel power generation and hybrid power systems. Here the goal is not to improve the efficiency of the diesel engine itself, but to introduce control strategies that would reduce the net carbon emissions from the diesel power plant without a reduction in supply.

Describe the scope of the research need:

Research into diesel and disel/hybrid systems could be accomplished in a diesel efficiency test bed. In the testbed, technologies and control strategies could be tested with the aim of more efficient operation, saving money and carbon.

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.
Recommended action: Direct and fund state agencies (e.g., UA, ADNR, Dept of Commerce) to establish a diesel test-bed.

What research is being done/known?

A collaboration to establish a diesel efficiency testbed has been proposed by the Alaska Center for Energy Power at the University of Alaska and the Alaska Energy Authority as part of the University's FY 10 capital budget.
A good deal of basic and applied research has been done on components to diesel power systems, such as the engine itself, but very little has been done to manage the complex hybrid systems so that they truly lead to efficiencies.

What are the gaps in research?

There is presently not test bed in existence for testing alternatives relevant to Alaska.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

UA (Alaska Center for Energy and Power), Controls companies (e.g., Siemens), other private industry, AEA

TWG: Energy Supply and Demand

4.2.1.4

Research into the best application and best management of a coal-to-liquids technology as well as carbon capture and beneficial use.

Unique Identifier: 192

☐ Overarching Need

Why is this an issue?

Research on the use of coal in the state of Alaska is needed to most effectively develop an abundant energy rich resource while achieving goals for mitigating climate change.

Describe the scope of the research need:

The scope ranges from laboratory testing to testing of field demonstrations.

Policy option or recommendation:

The state should support research, development and testing into alternatives for coal use coupled with carbon management.

What research is being done/known?

Research is being conducted in a variety of areas with Coal, but there is very little funding currently available.

What are the gaps in research?

The major research gap is how best to use the coal resource while still mitigating climate change.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Energy Supply and Demand

4.2.2.1

A resource assessment as needed, in addition to research and testing of low temperature power generation designs for power and heat, mineral recovery from geothermal brines, and ground source heat pumps. Additionally, research into uses for power at or close to geothermal prospects should be conducted. Such uses could include value added mineral refining, timber processing, or greenhouse food/energy production.

Unique Identifier: 63

☐ Overarching Need

Why is this an issue?

Many locations in the state could be good candidates for inexpensive geothermal power. The areal distribution and depth of the geothermal resource is unknown for Alaska except a few isolated locations. Without a basic understanding of the geothermal potential, there is little chance that developers will be willing to invest in a geothermal prospect. Exploration often accounts for ¼ to ½ of the cost of a geothermal power development project.

Describe the scope of the research need:

A statewide geothermal drilling program is needed. This program can start at known areas of high heat flow in Alaska. Coupled with the drilling program, applied research should be conducted on the extraction of minerals from brines and the extraction of heat and power from low temperature geothermal discoveries.

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.
The state should fund a geothermal resource assessment that could be conducted through a partnership of state agencies, industry and the University.

What research is being done/known?

There are a few private companies or individuals who are exploring or exploiting isolated geothermal prospects. Aside from the known developments, little information exists as to the state's geothermal potential outside of hot water surface expressions.

What are the gaps in research?

The geothermal potential of the state is unknown. It is also not known to what extent low temperature prospects can be used to provide heat or power.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

ADNR, USGS, AEA, UA (Alaska Center for Energy and Power, Institute for Social and Economic Research, Geophysical Institute).

TWG: Energy Supply and Demand

4.2.3.1

Unique Identifier: 61

☐ Overarching Need

To make hydropower an effective and efficient power alternative, research is needed into technologies for fuel switching (e.g., from gas to electric heat), pumped storage and integration, reducing adverse intake icing conditions, and integration schemes for incorporating small-scale hydro power in village settings where other generating technologies are being used.

Why is this an issue?

Hydropower has many different forms and has many issues that determine its ultimate effectiveness as a source of power. If some of these issues were resolved, more hydropower may be accepted in Alaska. Hydropower would be a critical element of the Governor's plan to reach 50% renewable power. In this section hydropower is limited to a water retention and passage through power generating turbines. In-river, tidal, and wave power is discussed in a subsequent section and is referred to as hydrokinetic power.

Describe the scope of the research need:

The scope is documented above. There is a range of applied research and testing needs from laboratory and field research to modeling.

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.
The state should fund a hydropower development fund that could support research and testing to support hydropower projects in Alaska.

What research is being done/known?

Some research is being done at UA but relatively little, and what is being done would benefit from integration with activities at state and federal agencies.

What are the gaps in research?

The main gaps in research on hydropower center around the application of technologies to different environments and different conditions as well as the performance and control.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

ADNR, ADFG, UA (ACEP, others), AEA, NOAA, USGS

TWG: Energy Supply and Demand

4.2.3.2

There is a need for resource assessment, research on the impacts of hydro on fish populations, hydrokinetic device testing, and optimization of hydrokinetic devices for the Alaskan environment (issues such as deployment, anchoring, ice effects, tidal energy capture, etc). Another area of research needed is the application of high pressure water in non-electrical generating applications such as mechanical grinding and processing.

Unique Identifier: 59

☑ Overarching Need

Why is this an issue?

Many of Alaska communities are on rivers or along coastlines where hydrokinetic devices could augment power provided by diesel or another source. Unfortunately without some research into the likelihood of success of hydrokinetic devices, very little funding will be dedicated to such prospects.

Describe the scope of the research need:

There is a range of applied research and testing needed from laboratory and field testing to modeling. In most cases, the research needs are very applied.

Policy option or recommendation:

It is recommended that the state support a hydrokinetic energy test center to serve as a facilities in which state agencies, industries, and citizens can get information on options for hydrokinetic energy production in Alaska.

What research is being done/known?

UA-ACEP has formed a hydrokinetic energy test center in Nenana, Alaska. This is coupled integrated with a complementary testing effort led by UAA in Girdwood, Alaska.

What are the gaps in research?

The main issues center around the application of the technologies to different environments and different conditions.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

ADNR, ADFG, UA (ACEP, others), AEA

TWG: Energy Supply and Demand

4.2.4.1

There remain significant issues with wind field modeling, grid integration, power storage, foundations, and de/anti-icing options for wind turbine blades in Alaska that require additional research.

Unique Identifier: 60

☐ Overarching Need

Why is this an issue?

Wind systems are being installed around Alaska. While they are producing power, many are not reducing the use of diesel as much as they could. This is largely a controls, grid integration, and power storage issue. The issue of foundations and de-icing are practical problems increase the cost of wind projects. These issues could be resolved with some applied research and development. Other issues relate to wind field modeling. Wind field models can provide information about variability in power production and are needed before a windfarm can be adequately sited.

Describe the scope of the research need:

The need here is for a test center that can test and demonstrate controls and storage technologies or designs before they are implemented in the field.

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.
The state should fund a wind-diesel test center that could serve as a partnership of state agencies, industry and the University.

What research is being done/known?

UA-ACEP has formed a Wind-diesel test center to address this. The center is presently building partners in industry and state agencies.

What are the gaps in research?

Gaps principally lie in the applied research, development and testing of technologies in Alaska for Alaska situations. Basic research on wind turbines is done elsewhere.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

UA (ACEP, GI, IARC), AVEC, AEA, REAP

TWG: Energy Supply and Demand

4.2.5.1

Unique Identifier: 62

☐ Overarching Need

On-going research is needed to find suitable biomass technologies for generating power in the smaller communities that could simultaneously provide space heating. The biomass produced heat could be coupled with greenhouse production of food and energy crops. Algae, for example, could be grown in concentrated masses in greenhouses and converted to biofuels. Heat, light and CO2 from biomass burning could fuel the greenhouse operation. Little has been done in this area to prove the economics or other benefits of such an operation thereby limiting investment. A field-scale demonstration site would encourage the development of biomass generated heat and power (incl. food and energy) in Alaska.

Why is this an issue?

There is a need to optimize biomass development opportunities for rural heat and power as well as investigating the opportunities to cultivate biomass. For example, if willows can be cultivated and harvested for use in heat and power generation, the land area required for biomass production would be significantly reduced compared to harvesting of native biomass stands.

Describe the scope of the research need:

A field scale demonstration site is needed to conduct research into biomass cultivation and combustion. The demonstration site should offer opportunities for the public, small communities and cooperatives to learn about biomass production as well as conversion to energy and beneficial use of the excess heat, power, and CO2.

Policy option or recommendation:

This falls under the combined ESD Policy Options 7,8,9.The state should provide funding support for a feed and energy research station.

What research is being done/known?

There is presently work in agriculture that could help support a food and energy research station. The FNSB is in the process of leasing land to the Fairbanks Economic Development Corporation to start such a test site. The Food and Energy Research Station would be located in the Fairbanks area and would serve the state as a demonstration site for biomass cultivation and conversion to heat and power.

What are the gaps in research?

No work has been done to field test cultivation of crops for energy nor the beneficial use of excess heat, power and CO2 for greenhouse production of food and fuel crops.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

Fairbanks North Star Borough, USDA, DCCED, UAF, AEA, Fairbanks Economic Development Corporation

TWG: Forestry, Agriculture and Waste Management 4.3.1.1

To develop a protocol for determining carbon sequestration rates, additionality for silvicultural treatments in boreal and coastal forests.

Unique Identifier: 116

☑ Overarching Need

Why is this an issue?

Carbon trading under a cap and trade system requires verification of carbon additionality above a baseline reference. This "additional" C can be sold as part of a mitigation strategy for a C producer that needs to exceed their cap. Silvicultural treatments need rigorous third party review to ensure they meet the needs of the market.

Describe the scope of the research need:

-Coastal and boreal forests need work completed on this topic -Should look at both above ground biomass and soil biomass and C pools

Policy option or recommendation:

FAW-1, Establish acarbon accounting system for forestry practices

What research is being done/known?

There is both policy development and research being done in this arena, but not specifically related to silviculture treatments in these ecosystems. Modeling will play a keyrole, but protocols for developing a baseline and C accounting over time need more attention. A good paper to review on this topic is "Managed Forests in Climate Change Policy: Program Design Elements

What are the gaps in research?

Soil dynamics are not well understood, especially in permafrost rich soils

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

There are several parties that should be include: state and federal forest management agencies and private land owners that undertake active forest management practices, native corporations, University of Alaska (U.A.) land trust, mental health trust. In addition, there are third party organizations that currently certify forest management practices on private and public lands that are exploring the concept of C certification. The Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) are two potential participants in implementation discussions. Carbon exchanges, such at the Chicago Climate Exchange (CCX) and other trading and broker organizations should also be consulted in this multi stakeholder effort.

TWG: Forestry, Agriculture and Waste Management 4.3.1.2

Refine global climate models for better understanding of regional variations within Alaska. Provide means to disseminate these data.

Unique Identifier: 189

☑ Overarching Need

Why is this an issue?

Better understanding of the effects of climate change. Improved monitoring and modeling data will allow for development and dissemination of environmental information and design criteria for use in adapting to climate change.

Describe the scope of the research need:

Refine global climate models for better understanding of regional variations within Alaska. Provide means to disseminate these data. Develop more detailed regional estimates of potential climate changes for Alaska using site specific estimates of temperature, precipitation, topography, etc. Establish means to effectively distribute details on varying climate changes statewide.

Policy option or recommendation:

None, but a research need identified by the FAW TWG

What research is being done/known?

Scenarios Network for Alaska Planning (SNAP) at the University of Alaska is working on refinement of various climate change models as they pertain to Alaska and some of the unique issues that need addressed.

What are the gaps in research?

Variables not assessed as part of SNAP and their current research effort.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers such as the Center for Knowledge Sharing on Climate Change and Arctic Issues, EPA, and other federal agencies.

TWG: Forestry, Agriculture and Waste Management 4.3.1.3

Assess contributions of CO2 & CH4 from melting permafrost to AK's GHG Emissions. Study of expected carbon losses during permafrost melt and addition of emissions to the AK GHG I&F.

Unique Identifier: 191

☑ Overarching Need

Why is this an issue?

Better understanding of the CO2e impacts of melting permafrost and appropriate representation in AK's GHG I&F. Potential for large impact to the I&F report if these areas are considered to be anthropogenic.

Describe the scope of the research need:

Review of existing modeling, if available, addition of results to the GHG I&F appendix for Forestry and Land Use. New modeling, if needed.

Policy option or recommendation:

None, but a research need identified by the FAW TWG

What research is being done/known?

Unknown

What are the gaps in research?

Unknown

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

University of Alaska research centers.

TWG: Forestry, Agriculture and Waste Management 4.3.1.4

Assess whether the Boreal forest should be considered managed or unmanaged and hence either considered either an anthropogenic or natural source (current consideration is as a natural source)

Unique Identifier: 190

☐ Overarching Need

Why is this an issue?

Determination of Coverage of carbon fluxes in the Boreal Forest as part of the Alaska GHG Inventory & Forecast. There is a potential for a large impact on the overall GHG emissions of the state if the Boreal Forest is considered a managed forest, and hence, an anthropogenic source of emissions.

Describe the scope of the research need:

Review IPCC materials on the definition of managed or unmanaged forests. Confer with in-state forestry experts to assess the proper classification of the Boreal Forest based on past and future management.

Policy option or recommendation:

None, but a research need identified by the FAW TWG

What research is being done/known?

None on this specific topic.

What are the gaps in research?

See scope of research need for discussion on this point.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UA Research Centers, State Foresters, USFS

TWG: Forestry, Agriculture and Waste Management 4.3.2.1

Unique Identifier: 119

☐ Overarching Need

Demonstrate that in arctic weather conditions, modern wood combustion appliances, such as wood pellet stoves, boilers and larger scale wood chip or co-fire facilities meet Environmental Protection Agency (EPA) particulate matter (PM-2.5) and other pollutant standards. This is very important for the communities of Fairbanks and Juneau which have been in violation of the new PM-2.5 standard and may have wood burning closures to help deal with the issue.

Why is this an issue?

In an arctic climate wood burning appliances need testing for particulate matter (PM), nitrogen oxides (NOx) and carbon monoxide (CO) to ensure public health is not negatively impacted. Like other combustion systems wood boilers emit a variety of pollutants, including particulate matter, nitrogen oxides, carbon monoxide, volatile organic compounds (VOC), sulfur dioxide (SO2), carbon dioxide (CO2) and other pollutants. Wood boilers emit PM, NOx, and CO in much greater quantities than the other pollutants. For this reason, these are the three pollutants to track and carefully monitor to determine potential impacts. Wood systems also emit greater quantities of CO2, however unlike fossil fuels; woody biomass is considered carbon neutral. (See 118 for a more detailed discussion on this concept).

Describe the scope of the research need:

There are several different scales to address, from individual home appliances, to mid-size boilers for larger public facilities, such as schools. There may also be a need to look at co-firing uses, such as electric utilities where coal and wood chips are combusted together.

Policy option or recommendation:

FAW-2, Allay concerns that wood burning has detrimental health impacts

What research is being done/known?

Cold Climate Housing Research Center (CCHRC) in Fairbanks is doing some testing in conjunction with the Fairbanks North Star Borough (FNSB). The military did some emission tests on co-firing with wood chips and coal at Fort Wainwright in the 1980's. The Western Forestry Leadership Coalition has published an issue brief that provides a good summary on this topic.

What are the gaps in research?

Unregulated wood burning appliances, such as outdoor wood boilers, and EPA approved devices in arctic conditions.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

Department of Environmental Conservation (DEC), EPA, local governments and the legislature could all have roles in the implementation of this option. Joint effort by private and public sector such as: stove manufacturers, wood fuel manufactures, Cold Climate Housing Research Center (CCHRC), retailers of wood combustions devices and the Cooperative Extension Service.

TWG: Forestry, Agriculture and Waste Management 4.3.3.1

Development of a protocol that assigns a carbon life to different types of wood products, including durable wood products.

Unique Identifier: 117

☐ Overarching Need

Why is this an issue?

Currently in most models that portray carbon flux between sinks and sources there is no allocation made for C storage as a tree moves from a log to a forest product. When the tree is harvested from the forest, it is treated as an emission. This is a simplification that is not accurate in the real world use of wood.
Products substitution; using wood instead of steel, concrete or other building products that have much higher C footprint then wood. Life cycle assessment studies have conclusively shown marked differences in energy requirements associated with different building materials and structures made from them, yet current carbon trading protocols don't make allowances for this type of sequestration or reduction of GHG emissions.

Describe the scope of the research need:

A national or international standard needs developed so that the C market has the ability to certify and verify amounts of C stored by wood products
Carbon budgets need developed for different types of building materials to accurately portray the gain or loss of C based on the type of product used as compared to wood products

Policy option or recommendation:

FAW-1

What research is being done/known?

There are several papers that discuss this topic and the issues surrounding the concept. Dovetail Partners, Inc. have published a report entitled: Wood Products and Carbon Protocols Carbon Storage and Low Energy Intensity Should Be Considered and in Chapter 3 of the Society of American Foresters publication: Forest Management Solutions for Mitigating Climate Change in the United States there are also several good discussions on these topics.

What are the gaps in research?

Complete literature review to identify gaps, may be mostly policy gaps.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

Wood product manufacturing businesses, state and federal forest management agencies and private land owners. Alaska Forest Association, other. National or state level review of issue

TWG: Forestry, Agriculture and Waste Management 4.3.3.2

Determine if woody biomass used in energy production is a carbon neutral fuel source, Scientifically demonstrate that woody biomass used as a fuel for energy is a carbon neutral fuel

Unique Identifier: 118

☐ Overarching Need

Why is this an issue?

Currently woody biomass is considered a carbon neutral fuel when compared to fossil fuels, such as coal, oil or natural gas. The combustion of all fuels produces CO2, but trees that are harvested for this purpose are replaced by new trees that sequester C from the atmosphere. Over time, the CO2 released by the combustion process will be captured again by the new tree crop. This concept is important because in the carbon trading market place, an offset credit can be generated by using a biomass fuel for a fossil fuel. It is a straight forward calculation to determine how much C is in a gallon of fuel oil or ton of coal and when you "offset" this fuel type with biomass you generate a credit that can be sold.

Describe the scope of the research need:

Scope is pretty narrow, need to demonstrate that this concept is valid or if not fully neutral by what percentage is it a Carbon neutral fuel?

Policy option or recommendation:

FAW-2

What research is being done/known?

Unknown, would benefit from a literature review

What are the gaps in research?

Not sure, it seems like a pretty straight forward problem that could be answered with current inventory and data. Needs re-worked from a Carbon perspective.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

Any biomass project would benefit so long as they are offsetting the use of a fossil fuel. Community governments, school districts, utilities, state or private institutions are all potential beneficiaries of this policy option. The research can be conducted at the University of Alaska , perhaps at the Center for Knowledge Sharing on Climate Change and Arctic Issues with assistance from staff at state and federal agencies.

TWG: Oil and Gas

4.4.1.1

Economic: Impact of various incentives to major capital improvement investment

Unique Identifier: 130

☑ Overarching Need

Why is this an issue?

This is an issue because incentives will drive a significant amount of private sector investment to reduce overall emissions and improve energy efficiency.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

There is no current research on this topic in Alaska

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy supply and demand

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

University, State Government; DNR, DOR

TWG: Oil and Gas

4.4.1.2

Economic:Short and long term value of carbon

Unique Identifier: 128

☑ Overarching Need

Why is this an issue?

Understanding the value of carbon will be critical in developing reasonable and affective policy for all CO2 mitigation activity. It will also be used to assess the economic impact of mitigation to the state.

Describe the scope of the research need:

The value of carbon on the local and global scale must be assessed for business models to have validity.

Policy option or recommendation:

The value of carbon must be determined to understand the impacts policy will have on commerce and state revenue. It will also be critical in order to design affective policy.

What research is being done/known?

Much research is being done on a national scale, yet understanding what the federal government will require is critical to the equation.

What are the gaps in research?

Pending regulation will have a huge affect on carbon values.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Oil and Gas

4.4.1.3

Economic: Potential impact of carbon mitigation efforts on royalty revenue stream coming to the State of Alaska from O&G production

Unique Identifier: 131

☑ Overarching Need

Why is this an issue?

Carbon mitigation costs will have a detrimental affect on the ultimate recovery of oil and gas in the state because of the, potentially large, impact on production costs and reduction of economically recoverable oil and gas.

Describe the scope of the research need:

Because the costs associated with carbon mitigation will be widely variant and dependant upon many factors, a broad scope of work must be accomplished.

Policy option or recommendation:

It is critical to understand the impacts of policy, if reasonable and non-damaging policy is to be developed

What research is being done/known?

A fair amount of national research is being done, but the impacts are very site specific.

What are the gaps in research?

Local variability and unique issue that will affect costs.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Oil and Gas

4.4.1.4

Technical: Regionally appropriate baseline mapping an monitoring of surface and subsurface (groundwater) hydrology

Unique Identifier: 127

☑ Overarching Need

Why is this an issue?

Most areas of the state do not have adequate data on hydrology and what the affects development might have on requirements and impacts of surface and subsurface water resources.

Describe the scope of the research need:

The need for hydrologic baseline research is ubiquitous across the state and includes water quality and quantity and is necessary for any type development, including renewable energy or sequestration.

Policy option or recommendation:

Affects on and availability of water resources must be considered in any policy development or recommendation.

What research is being done/known?

Relatively small areas of the state are now being mapped and analyzed, but are limited in extend.

What are the gaps in research?

Energy supply and demand, and any other associated with development.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

State and federal regulatory and research agencies and the University

TWG: Oil and Gas

4.4.1.5

Technical: Regionally appropriate baseline physical mapping and imagery including bathymetry

Unique Identifier: 126

☑ Overarching Need

Why is this an issue?

So much of the current research is based on a solid foundation of baseline topographic and basic mapping and remote sensing that it is difficult to perform modern analyses without up to date DEMs, orthoimagry, and detailed geologic mapping. Unfortunately, Alaska is woefully lacking in much of this most basic information, and when compared to all other states, and most other countries, Alaska is literally in the 'dark ages" when it comes to baseline data.

Describe the scope of the research need:

Numerous baseline data sets are needed

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Oil and Gas

4.4.1.6

CO2 storage: Evaluate capacity of geologic and biologic sequestration in different regions of the State of Alaska

Unique Identifier: 132

☑ Overarching Need

Why is this an issue?

Depending on what type of reductions mandates are adopted, understanding the capacity and location of viable sites, and the liabilities associated with those sites is critical.

Describe the scope of the research need:

The scope is limited to a few sequestration opportunities.

Policy option or recommendation:

Sequestration will be a limited option in many instances and should be carefully implemented. Government cannot mandate the existence of capacity

What research is being done/known?

The State DNR and federal DOE are enguaged in a statewide preliminary analysis.

What are the gaps in research?

Detailed subsurface information is lacking in most areas of the state that need capacity information once the federal and state mandates are set out.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand

Research category/type:

☑ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Oil and Gas

4.4.2.1

Economic: Short and long term value of natural gas

Unique Identifier: 129

☐ Overarching Need

Why is this an issue?

Understanding the value of natural gas will allow a comparison of other forms of power generation at operations and will drive investment decisions on energy source.

Describe the scope of the research need:

The scope of this need is focused on oil and gas operations.

Policy option or recommendation:

What research is being done/known?

Research on this topic is likely being done within the industry and will have different parameters depending on company and location.

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Industry and regulatory agencies

TWG: Oil and Gas

4.4.3.1

CO2 Storage: Evaluate enhanced hydrocarbon recovery options using CO2 flooding and pressure support

Unique Identifier: 134

☐ Overarching Need

Why is this an issue?

Enhanced Hydrocarbon recovery is one of the only CCS methods that derives economic benefit from the activity and increases ultimate recovery of a resource for the State.

Describe the scope of the research need:

The research on enhanced oil (EOR) and enhanced gas recovery (EGR) will be basin specific, and in many cases field specific.

Policy option or recommendation:

EOR and EGR feasibilities will help design incentive and regulatory programs

What research is being done/known?

Significant research in Nation, as well as within Alaska industry players.

What are the gaps in research?

How technologies can be applied to broader spectrum of fields, and specifically EGR.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Industry, University, State Agencies, Federal Agencies

TWG: Oil and Gas

4.4.3.2

CO2 Storage: Evaluate the feasibility of saline reservoir sequestration in non-marine basins prevalent throughout Alaska

Unique Identifier: 133

☐ Overarching Need

Why is this an issue?

CO2 storage in saline reservoirs may become an issue in Alaska after conventional reservoirs are saturated, or in areas where no convention reservoirs exist (e.g., interior Alaska)

Describe the scope of the research need:

Saline reservoir sequestration research in Alaska must include long-term viability, EPA groundwater standards, liability issues, and existence of reservoir.

Policy option or recommendation:

It is important to understand the capacities of storages areas across the state for development planning purposes.

What research is being done/known?

A significant amount of research on this topic is underway nationally, but given the limited applicability in Alaska very little has been done.

What are the gaps in research?

Failure liability and technical feasibility are the greatest gaps in this research.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Oil and Gas

4.4.4.1

Technical: Feasibility of various entrained and exhaust CO2 capture technologies for North Slope and Cook Inlet

Unique Identifier: 121

☐ Overarching Need

Why is this an issue?

Capturing CO2 from various exhaust systems will be a challenging effort and will need many new technologies.

Describe the scope of the research need:

Very broad and semi specific to source type.

Policy option or recommendation:

What research is being done/known?

A significant amount of research is on-going for specific applications, but will not transverse all needs.

What are the gaps in research?

Different applications will require different parameters and it will be very difficult to capture all scenarios.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Oil and Gas

4.4.4.2

Technical: Study where renewable energy sources co-exist with Oil and Gas operations

Unique Identifier: 122

☐ Overarching Need

Why is this an issue?

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Transportation and Land Use

4.5.1.1

Development of statewide tools for planning

Unique Identifier: 166

☐ Overarching Need

Why is this an issue?

Need statewide planning tools to systematically evaluate GHG emissions on future scenarios

Describe the scope of the research need:

Develop tools that support scenario evaluation for planning options.

Policy option or recommendation:

NA

What research is being done/known?

Unknown

What are the gaps in research?

Scenarios need to be developed that are specific to the Alaskan environment. National level models don't work in Alaska. Alaska is a very diverse state geographically and we need models that can be applied to specific projects.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Transportation and Land Use

4.5.2.1

Understand carbon cycle from cradle to grave to see if reducing tail pipe emissions is worthwhile. The carbon-cost of creating fuel needs to be included in the evaluation.

Unique Identifier: 140

☐ Overarching Need

Why is this an issue?

Decision makers need complete information to make valid data driven decisions. If only part of the carbon cycle is considered, the economics of decisions may not be realistic.

Describe the scope of the research need:

For each type of fuel, assess the total carbon cycle, including carbon outputs in the Alaskan environment to ensure the reduction in tailpipe outputs of carbon are not negated by the cost of producing or transporting the alternative fuel.

Policy option or recommendation:

T-5. Promotion of Alternative Fuel Vehicles
T-10. Alternative Fuels Research and Develpment

What research is being done/known?

No known research is being done on Alaska specific conditions.

What are the gaps in research?

How does the Alaskan environment impact the benefits of using alternative fuel vehicles? Do the transportation requirements for getting alternative fuels to Alaska significantly diminish the benefits of using alternative fuel vehicles?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Transportation and Land Use

4.5.2.2

Analyze the life-cycle GHG impacts of various alternative fuels in the Alaska context. Better understanding of the life-cycle GHG benefits of alternative fuels in Alaska

Unique Identifier: 34

☐ Overarching Need

Why is this an issue?

The life-cycle GHG impacts of alternative fuels depend heavily on emissions from fuel production and transport. Nearly all research to date has focused on the lower 48. GHG impacts in Alaska could be quite different. Need to understand which alternative fuels have GHG benefits in AK.

Describe the scope of the research need:

At a minimum, analysis should be done for:
- natural gas
- biodiesel
- ethanol

Policy option or recommendation:

What research is being done/known?

Modeling for US is being by Argonne National Labs, but is not specific to AK. Some states (such as CA) have done state-specific modeling.

What are the gaps in research?

life-cycle GHGH impacts specific to AK.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, DOE

TWG: Transportation and Land Use

4.5.3.1

Development of methods or tools to accurately estimate GHG impacts of transportation plans in AK.

Unique Identifier: 36

☐ Overarching Need

Why is this an issue?

Transportation agencies will soon be required to quantify GHG impacts of transportation plans. Tools and methods are being developed for lower 48. But arctic climate in AK might affect the GHG emissions from motor vehicles and necessitate tools or methods that are adapted to AK.

Describe the scope of the research need:

Develop tools similar to those being developed for the lower 48 with a focus on Alaska and the arctic. This should include the differences in how Alaskan's use vehicles. Many Alaskan communities are accessible only via aircraft. While the high energy prices are driving rural citizens to migrate to urban areas, the GHG emissions associated with additional VMT may offset the GHG emissions from aircraft. Therefore, the variety of transportation modes used in different parts of Alaska must be built in to the models.

Policy option or recommendation:

T-6. VMT and GHG Reduction Goals in Planning

What research is being done/known?

National research being done for U.S. EPA, TRB, FHWA.

What are the gaps in research?

No Alaska or arctic specific research

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska DOT&PF, AMATS and FMATS

TWG: Transportation and Land Use

4.5.3.2

Investigate potential to reduce fuel use and GHG emissions by coordinating transportation networks and commercial fishery openings.

Unique Identifier: 35

☐ Overarching Need

Why is this an issue?

Excess fuel use and GHG emissions occur because of poor coordination of fishery openings.

Describe the scope of the research need:

Better understanding of the potential to reduce GHG emissions by coordinating transportation networks and commercial fishery openings.

Policy option or recommendation:

What research is being done/known?

None

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska Department of Energy; Alaska Board of Fisheries (BOF); Alaska DOT&PF

TWG: Transportation and Land Use 4.5.4.1

Determine GHG impacts of replacing older marine vessel engines with newer engines.

Unique Identifier: 37

☐ Overarching Need

Why is this an issue?

Newer marine engine have lower particulate matter emissions due to federal standards. But their effect on GHGs is uncertain.

Describe the scope of the research need:

Develop tools for better understanding of GHG impacts of modernizing marine vessel engines. Analyze the potential trade-off of reducing particulate pollution with GHG outputs.

Policy option or recommendation:

What research is being done/known?

May be recent or ongoing research by US EPA.

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

AK DEC; Alaska Board of Fisheries (BOF)

TWG: Transportation and Land Use 4.5.5.1

Evaluate the actual reduction of GHG from a pilot study of continuous descent approaches to Ted Stevens International Airport.

Unique Identifier: 139

☐ Overarching Need

Why is this an issue?

Aviation in Alaska has a disproportionate impact on GHG emissions compared to other forms of transportation. Focusing on aviation reductions may be an area where large reductions can be realized.

Describe the scope of the research need:

Real time activities are underway to enhance safety and reduce fuel usage on arrivals to Ted Stevens International Airport. Assessment of these activities should be undertaken to evaluate the impact to GHG emissions.

Policy option or recommendation:

T-9. Aviation Emissions Reduction

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Transportation and Land Use

4.5.6.1

Analysis to determine what is required to increase citizen use of public transportation and increase conservation efforts.

Unique Identifier: 167

☐ Overarching Need

Why is this an issue?

Need to understand what actions by the government result in greater use of public transportation and greater conservation efforts.

Describe the scope of the research need:

Policy option or recommendation:

T-1. Transit, Ridesharing, and Commuter Choice Programs

What research is being done/known?

Unknown

What are the gaps in research?

Unknown

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.1

Develop higher resolution climate modeling and monitoring data and improve its accessibility and utility.

Unique Identifier: 88

☑ Overarching Need

Why is this an issue?

This need is common among nearly all the TWG. To assess and plan for changing economic conditions as a result of a changing climate will require higher resolution climate modeling and monitoring information at more local levels. Additionally, there is a need to increase the accessibility and utility of these data to government officials and businesses. Finally, there is a need to tailor these data to the needs of government officials and businesses.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.2

Assess statutory, regulatory, and policy frameworks and barriers to implementing climate change policy recommendations.

Unique Identifier: 89

☑ Overarching Need

Why is this an issue?

Many laws, regulations and policies on the federal, state, and local levels were developed before the signs of more rapid climate change were recognized. For example, resource managers in Alaska may need to revise Alaska policies relative to wildland fire management in light of the effects of climate change. Another example is the need to modify water quality standards that call for maintenance of water temperatures in cold water systems in light of warming temperature. The challenge for government leaders and businesses will be to adapt to a future made less certain due to a more rapidly changing climate. This will necessitate an evaluation of existing laws, regulations and policies and possible changes to institutional, legal and policy frameworks in an adaptive manner.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.3

Assess economic impacts of market-based approaches (e.g., cap and trade) to manage greenhouse gas (GHG) emissions and their impacts on the Alaskan economy.

Unique Identifier: 90

☑ Overarching Need

Why is this an issue?

Market-based approaches to manage GHG emissions can have a significant impact on many aspects of the Alaskan economy. It will be imperative to track these approaches as they develop and to proactively formulate strategies to adopt state approaches and, if necessary, adapt to adopted approaches.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.4

Systematically identify and address economic barriers to implementing climate change planning efforts

Unique Identifier: 91

☑ Overarching Need

Why is this an issue?

Uncertainty associated with climate change may result in barriers to implement identified climate change strategies/options and planning efforts. It is important to identify these barriers and strategies for addressing them. The uncertainty and risk of the current predictions should be well understood and incorporated in the decision process.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.5

Assess data and information (economic indicators) needed to develop or adapt short and long term planning tools to assess impacts of climate change on economic activities.

Unique Identifier: 92

☑ Overarching Need

Why is this an issue?

There is a lack of baseline economic information and data needed to develop or adapt both short and long term planning tools to implement identified climate change strategies and options. It is critical to identify and collect the needed economic indicators.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.6

Implement adaptive (scenario-based) planning tools that integrate economic indicators to improve climate change mitigation and adaptation decision-making and implementation.

Unique Identifier: 93

☑ Overarching Need

Why is this an issue?

Successful implementation of climate change strategies/options will require development and implementation of adaptive planning tools. These tools need to be probabilistic and scenario-based and integrate economic indicators.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.1.7

Catalog and assess new or expanded economic opportunities that may become available with climate change.

Unique Identifier: 94

☑ Overarching Need

Why is this an issue?

While some existing economic activities may be deleteriously affected by a changing climate, others may be benefited while still others may become established. For example, a warming climate may open new economic opportunities in the Arctic basin, including commercial fishing and transpolar shipping. A necessary first step towards developing these opportunities is to catalog and assess them.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.10.1

Assess how climate change will impact application of federal, state, and local laws, regulations and policies on energy demand and use.

Unique Identifier: 172

☐ Overarching Need

Why is this an issue?

Climate change legislation will impact application of federal, state, and local laws, regulations and policies on energy demand and use. For example, increased pressure to reduce GHG will have impacts on laws, regulations, and policies related to natural resources. For this reason it is imperative to assess how climate change will impact application of federal, state, and local laws, regulations and policies on energy demand and use.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.11.1

Assess how climate change will impact application of federal, state, and local laws, regulations and policies on economic development activities.

Unique Identifier: 173

☐ Overarching Need

Why is this an issue?

Climate change legislation will impact application of federal, state, and local laws, regulations and policies on economic development activities. For example, increased Arctic shipping and resource development will have impacts on laws, regulations, and policies related to natural resources and indigenous people. For this reason it is imperative to assess how climate change will impact application of federal, state, and local laws, regulations and policies on economic development activities.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.12.1

Continue to refine the "Cost of Climate Change" study recently completed by the UAA ISER.

Unique Identifier: 174

☐ Overarching Need

Why is this an issue?

The University of Alaska Institute of Social and Economic research is conducting a study to assess the costs of climate change to Alaska. This is an overarching economic analysis of the climate related impacts. This study should be completed.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.12.2

Identify climate trends and downscale models leading to establishing environmental information, analysis tools, and design criteria for use in adapting to climate change.

Unique Identifier: 175

☐ Overarching Need

Why is this an issue?

This need is common among nearly all the TWG. To assess and plan for changing economic conditions as a result of a changing climate will require higher resolution climate modeling and monitoring information at more local levels. Additionally, there is a need to increase the accessibility of these data to government officials and businesses. Finally, there is a need to tailor these data to the needs of government officials and businesses.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.12.3

Provide resources for good Digital Elevation Model (DEM) and GIS data, and current and high resolution imagery to establish a more robust information infrastructure to plan and adapt.

Unique Identifier: 176

☐ Overarching Need

Why is this an issue?

There is a need for improved Digital Elevation Model (DEM) and GIS data, and current and high resolution imagery to establish a more robust information infrastructure to plan and adapt. This information is needed to develop down-scaled models and to assess potential economic impacts.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.12.4

Invest in monitoring and data dissemination programs to enhance information available for safe and efficient resource development.

Unique Identifier: 177

☐ Overarching Need

Why is this an issue?

Much data is currently available but for a variety of reasons is unavailable to researchers or decision-makers. There is an urgent need to invest in monitoring and data dissemination programs to enhance information available for safe and efficient resource development.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.2.1

Develop economic analysis of potential rise or decline of oil and gas development on state revenues.

Unique Identifier: 95

☐ Overarching Need

Why is this an issue?

Oil and gas production provides significant revenues to Alaska. As such, any changes to oil and gas production can be expected to have significant impacts to the Alaskan economy. Climate change and resultant efforts to mitigate for it, or adapt to it, is expected to have impacts to oil and gas production. For example, development of cap and trade programs could have significant impacts on oil and gas production. Given the likelihood of such impacts it is imperative to develop economic analysis of potential rise or decline of oil and gas development on state revenues.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.2.2

Consider how potential rise or decline of oil and gas operation and maintenance may affect state revenues.

Unique Identifier: 96

☐ Overarching Need

Why is this an issue?

Climate change is expected to have impacts on oil and gas operations and maintenance. Under current tax structures, operation and maintenance costs can influence the amount of revenue the state receives from production. For this reason, it is important to determine how potential rise or decline of oil and gas operation and maintenance may affect state revenues.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Oil and Gas

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.2.3

Model coastal vulnerability to establish criteria for pipeline coastal transition set-backs and burial depths.

Unique Identifier: 97

☐ Overarching Need

Why is this an issue?

Climate change is expected to impact coastal zones through erosion and coastal inundation. This will require an assessment of the current permitting and oversight of pipelines and other operations in the coastal zone. This assessment will require a modeling of coastal vulnerability to establish criteria for pipeline coastal transition set-backs and burial depths.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Oil and Gas

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.2.4

Expand research on ice road and pad construction techniques and in-season monitoring to maximize seasonal use and minimize impacts.

Unique Identifier: 98

☐ Overarching Need

Why is this an issue?

Climate change is impacting the length of time ice roads and pads can be used on the North Slope of Alaska. Expanded research on ice road and pad construction techniques and in-season monitoring is needed to maximize seasonal use and minimize impacts.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Oil and Gas

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.2.5

Expand research on climate change impacts on permafrost engineering design.

Unique Identifier: 99

☐ Overarching Need

Why is this an issue?

Permafrost is being impacted by climate change. These impacts are affecting existing and planned structures. Design standards are inadequate to address these impacts. Expanded research on climate change impacts on permafrost engineering design is needed.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Oil and Gas

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.2.6

Develop new techniques to clean up oil spills in icy waters.

Unique Identifier: 100

☐ Overarching Need

Why is this an issue?

There is an interest in developing offshore oil and gas in Arctic areas. This increases the potential for oil spills in offshore areas that are being impacted by changing ice conditions associated with climate change. There is a need to develop new techniques to plan for and clean up oil spills in icy waters.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Oil and Gas

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.3.1

Assess economic potential for developing carbon-neutral energy sources

Unique Identifier: 101

☐ Overarching Need

Why is this an issue?

Federal legislation may likely call for a larger proportion of energy production to come from carbon-neutral sources (definition, e.g. including forest materials). In Alaska, little is known about the economic potential for developing carbon-neutral energy sources. Given this, it is imperative to assess the potential for developing carbon-neutral energy sources.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.3.2

Identify potential economies of scale and return on investments in developing renewable energy sources.

Unique Identifier: 102

☐ Overarching Need

Why is this an issue?

Little is known about the long-term economics associated with renewable energies. As there is an increased call for shifting energy production to renewable energy sources it is important to identify potential economies of scale and return on investments in developing renewable energy sources. This will allow better decision tools to be developed to inform the economic impacts of renewable energy sources.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.4.1

Research cost-effective techniques for construction, operation, and reclamation that will be responsive and useful in changed environmental conditions.

Unique Identifier: 103

☐ Overarching Need

Why is this an issue?

Energy conservation and renewable energy alternatives require metals and metal alloys. As renewable energies increase, this will increase the demand for metals. Since Alaska has world class metal resources, it can be expected that there may be increased interest in mining. It will be important to research cost-effective techniques for construction, operation, and reclamation that will be responsive and useful in changed environmental conditions.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Natural Systems, Energy Supply and Demand.

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.4.2

Assess engineering standards for tailings storage in Arctic/Subarctic climates.

Unique Identifier: 104

☐ Overarching Need

Why is this an issue?

Energy conservation and renewable energy alternatives require metals and metal alloys. As renewable energies increase, this will increase the demand for metals. Since Alaska has world class metal resources, it can be expected that they will be increased interest in mining. As new mines are developed it will be important to assess engineering standards for tailings storage in Arctic/Subarctic climates.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Natural Systems, Energy Supply and Demand

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.4.3

Develop economic analyses of potential rise or decline of mining and impact on state revenues.

Unique Identifier: 105

☐ Overarching Need

Why is this an issue?

Energy conservation and renewable energy alternatives require metals and metal alloys. As renewable energies increase, this will increase the demand for metals. Since Alaska has world class metal resources, it can be expected that they will be increased interest in mining. As this demand increases it will be important to develop economic analyses of potential rise or decline of mining and impact on state revenues.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Natural Systems, Energy Supply and Demand

Research category/type:

☑ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.5.1

Model sea ice and its effect on ocean transportation.

Unique Identifier: 106

☐ Overarching Need

Why is this an issue?

Climate change is reducing sea ice in the Arctic at varying rates. It is important to model sea ice and its effect on ocean transportation.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems, Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.5.2

Develop economic analysis of potential rise or decline of shipping and impact on state revenues.

Unique Identifier: 107

☐ Overarching Need

Why is this an issue?

Climate change is reducing sea ice in the Arctic, creating economic opportunities and localized costs. It is important to assess the impacts of increased shipping to Alaska and its economy.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems, Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.5.3

Identify trends that may influence impacts of shipping on the environment, hunting, fishing and communities.

Unique Identifier: 108

☐ Overarching Need

Why is this an issue?

Climate change is reducing sea ice in the Arctic and allowing for increased shipping. This will potentially influence the environment, hunting, fishing and coastal communities. As such it is necessary to identify trends that may influence impacts of shipping on the environment, hunting, fishing and communities.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems, Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.5.4

Increase ice-breaking capabilities in the Arctic.

Unique Identifier: 109

☐ Overarching Need

Why is this an issue?

Climate change is impacting the formation and breakup of sea ice in the Arctic. To increase the duration of shipping and provide for assistance in sea ice conditions, ice-breaking will be required. For these reasons it is imperative to Increase ice-breaking capabilities in the Arctic.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.5.5

Research innovative approaches and building techniques for supporting arctic shipping and developing sustainable ports.

Unique Identifier: 110

☐ Overarching Need

Why is this an issue?

Climate change is changing sea ice formation and breakup in the Arctic, which will change how ports are developed and shipping routes maintained. This will require research into innovative approaches and building techniques for supporting arctic shipping and developing sustainable ports.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.6.1

Assess the impact of climate change on existing rural transportation networks.

Unique Identifier: 111

☐ Overarching Need

Why is this an issue?

Much of Alaska's rural transportation network is non-road based, depending on frozen tundra and unfrozen river and lake routes for surface transportation. As a result, climate change can potentially significantly affect these networks. For these reasons, it is imperative to assess the impact of climate change on existing rural transportation networks.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.6.2

Develop economic analysis of potential costs associated with expected impacts to rural transportation networks.

Unique Identifier: 112

☐ Overarching Need

Why is this an issue?

Much of Alaska's rural transportation network is non-road based. As a result, climate change can potentially significantly affect these networks. With increases to costs of transportation, it is important to develop economic analysis of potential costs associated with expected impacts to rural transportation networks.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.7.1

Develop economic analysis of potential rise or decline of recreational, subsistence and commercial fishing.

Unique Identifier: 113

☐ Overarching Need

Why is this an issue?

Climate change will impact fish and their habitats to varying degrees. Some fisheries will benefit while others will be negatively impacted. Research into fisheries should support develop economic analysis of potential rise or decline of recreational, subsistence and commercial fishing.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural Systems, Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.7.2

Assess and model increased insurance costs.

Unique Identifier: 114

☐ Overarching Need

Why is this an issue?

Climate change is recognized as causing increased risks to private and government infrastructure. Insurance premiums are based on environmental conditions and projected risks. It will be important to assess and model insurance costs associated with risks perceived from climate change influences.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.8.1

Develop economic analysis of potential rise or decline of tourism and impact on state revenues.

Unique Identifier: 115

☐ Overarching Need

Why is this an issue?

Tourism is an increasing contributor to the Alaskan economy. It is unknown how a changing climate may impact tourism. It is important to develop economic analysis of potential rise or decline of tourism and impact on state revenues related to climate change.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural resources, Public Infrastructure, Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.8.2

Develop economic (scenario) analysis of potential national and international changes in patterns of people and freight movements.

Unique Identifier: 169

☐ Overarching Need

Why is this an issue?

Climate change is impacting natural systems throughout the Arctic, both in the terrestrial and ocean areas. The impact to these natural systems will likely change the patterns of movement of people and freight. It is important to develop economic (scenario) analysis of potential national and international changes in patterns of people and freight movements.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.8.3

Assess opportunities for development/enhancement of recreation due to climate change.

Unique Identifier: 170

☐ Overarching Need

Why is this an issue?

Climate change is impacting natural systems throughout the Arctic with changes to seasonal recreation. It is imperative to assess opportunities for development/enhancement of recreation due to climate change.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural resources, Public Infrastructure, Health and Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Economic Activities

5.1.9.1

Improve mapping and surveying to accurately and efficiently establish boundaries, address boundary disputes as needed and aid charting for safe navigation.

Unique Identifier: 171

☐ Overarching Need

Why is this an issue?

As climate changes, boundaries that are dependent upon physical features may be impacted. It is necessary to improve surveying and mapping to accurately display the land and land/water interface. This will support establishing boundaries and provide data to address boundary disputes. Improved charting for safe navigation and mapping for overland travel will be an ancillary product.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Natural resources, Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.1.1

Regional economic models to quantify climate change impacts on communities and provide input to the NEPA process.

Unique Identifier: 83

☑ Overarching Need

Why is this an issue?

Communities can not adapt to the impacts of climate change without state and federal assistance, which requires compliance with the NEPA process and recommended alternatives. Climate change is raising significant economic questions with investment in communities and sustainability.

Describe the scope of the research need:

Economic models are needed that address the cost to adapt communities to a changing climate. This includes costs to maintain the community to preserve the culture, increase medical services with potential events and stresses, and determine the sustainability.

Policy option or recommendation:

What research is being done/known?

An economic model has been built for the risk to public infrastructure. Other economic models have components of subsistence as a factor in determining economic value of impacted communities.

What are the gaps in research?

Economic value of culture and costs to replace traditional knowledge and wisdom and traditional ecological knowledge are gaps that requires quantification.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Economic Activities

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

US Army Corps of Engineers, EPA, BIA, NOAA and AK DCCED, DNR and DEC

TWG: Health and Culture

5.2.1.10

Refine global climate models for better understanding of regional variations within Alaska. Provide means to disseminate these data. Modeling. Better understanding of the effects of climate change

Unique Identifier: 29

☑ Overarching Need

Why is this an issue?

Improved monitoring and modeling data will allow for development and dissemination of environmental information and design criteria for use in adapting to climate change

Describe the scope of the research need:

1. Develop more detailed regional estimates of potential climate changes for Alaska using site specific estimates of temperature, precipitation, topography, etc. 2. Establish means to effectively distribute details on varying climate changes statewide

Policy option or recommendation:

Develop higher resolution climate monitoring and modeling

What research is being done/known?

SNAP

What are the gaps in research?

Variables not assessed as part of SNAP

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, other federal agencies

TWG: Health and Culture

5.2.1.11

Assess the degree and rate of thawing submarine permafrost deposits in coastal areas due to warming sea temperatures. Evaluate the risk of subsidence and erosion and the consequent impact on human developments and ecosystems. Study of Climate Driven Instability of Coastal Permafrost.

Unique Identifier: 76

☑ Overarching Need

Why is this an issue?

Newtok relocated because of the thawing of subterranean and submarine permafrost. Other coastal communities in western, northwest and northern Alaska have comparable risk with retreat of sea ice.

Describe the scope of the research need:

Standard permafrost measurement techniques will provide the data to develop assessments.
Research needs to be completed in conjunction with coastal mapping and establishing vertical control.

Policy option or recommendation:

What research is being done/known?

US Army Corps of Engineers has researched conditions at Newtok

What are the gaps in research?

Limited understanding

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure and Natural Systems

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

US Army Corps of Engineers, UA

TWG: Health and Culture

5.2.1.12

Unique Identifier: 78

☑ Overarching Need

Consider developing a television program similar to Alaska Weather that provides climate change projection information and data on issues of specific importance to Alaska's rural communities. Such a program would foster better understanding of how changes in future climate, both gradual and sudden, can impact communities and individual lives. This can become a catalyst for change in individual behavior. Research Ways to Improve Data Sharing Across Scales: Example: Increase Public Understanding and Recognition of Climate Change Impacts

Why is this an issue?

Public understanding of climate change and impacts to the health of the people and their culture is needed.

Describe the scope of the research need:

Research what is needed to present culturally accurate and appropriate materials and interviews for the program. Research sources of sponsorship and supporting materials.
Research network coverage and programs that my already be presenting information identified

Policy option or recommendation:

What research is being done/known?

Unknown, although non-profits and other entities outside the research community may be able to define what has been and is being done.

What are the gaps in research?

Research of the archive of Alaska climate change articles, programs and mini-series need to be completed.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.1.13

Research and develop culturally appropriate curriculums and materials for traditional knowledge and local observations with accuracy of observations versus traditional knowledge and wisdom. Resolving the question of how accurate are low tech monitoring versus local observations may need to be resolved through social science methods. Determining whether lowering standards for local observations for a culture based on observations is effective or creating further communication barriers may require social and cultural research.

Unique Identifier: 163

☑ Overarching Need

Why is this an issue?

Community buy-in and cultural acceptance needs to have the education and tools to be implemented.

Describe the scope of the research need:

Policy option or recommendation:

Education component shared system for infrastructure observations use workforce to provide information into database:
Option1: Look at low-tech monitoring techniques, satellite imaging
-Local data observations with less than full weather service standards
-New sensors w communications systems. Use vehicles as probes

What research is being done/known?

Research is ongoing in finding local community members and programs.

What are the gaps in research?

Local climate change monitoring may not be recognized as cross-cutting to cultures and linked to acceptance of traditional knowledge and wisdom as a standard for observations and communications. Research plans that show how the two work together may prove beneficial.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UA, ICC, NOAA, others

TWG: Health and Culture

5.2.1.14

Improve communications between federal scientists and state government agencies (such as the Alaska Departments of Fish and Game, Environmental Conservation, and Natural Resources) on climate science, the potential impacts, and data needs for those agencies concerning climate change.Research Ways to Improve Data Sharing Across Scales:Example: Bridge Gaps between State and Federal Science and Resource Agencies

Unique Identifier: 79

☑ Overarching Need

Why is this an issue?

Concern that the information is not accurate or all inclusive. Decision makers do not make decisions or communities have insufficient information to make an informed decision.
The other question is why is this an issue with the number of working groups that have collaborated for decades. Is it because the issue of climate change is so large and cross cutting that not all agencies are able to focus on the breadth of research needed. The Governor's sub-cabinet and working groups are an example of an effective method to address this issue.

Describe the scope of the research need:

Research is needed on the most effective way for data delivery and key word indexing, as disciplines speak in different languages.

Policy option or recommendation:

Establish and maintain a joint federal/state/public entity working group to develop guidance on interagency gaps.

What research is being done/known?

Unknown

What are the gaps in research?

No gaps in research. Gaps in priority use of research funding and networking opportunities, as well as leadership commitment of resources may be the critical gaps

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

Federal Executive Roundtable, Governor's Sub-cabinet, AGDC, ACCAP, International Forums, etc.

TWG: Health and Culture

5.2.1.2

Unique Identifier: 70

☑ Overarching Need

Revised Flood Risk Maps. Use projections for increased precipitation, loss of sea ice and the accompanied increase in storm activity over previously ice covered waters for the next 100 years to develop revised flood risk maps that will help guide communities and state agencies in making future planning and infrastructure development decisions. Allow for continual update of these maps to incorporate the expected ongoing refinement in climate projections over time.

Why is this an issue?

Communities can not obtain flood insurance. Securing funding for improving and maintaining community will be difficult as lack of information and accurate data will require conservative attitudes towards investment and economic development. This will hinder economic development for the community.

Describe the scope of the research need:

Updating the Precipitation Frequency Estimates (PFE) will require local collection of precipitation in each community. Developing education materials that encourage local monitoring and reporting of precipitation is needed. Analyzing storm frequency and intensity is an essential part of this effort. Ice retreat for coastal inundation and ice jamming for river flooding need to be documented for frequency and forecast based on hindcast of events.

Policy option or recommendation:

What research is being done/known?

National Weather Service is updating their cooperative observing network to compile precipitation data for updating Alaska PFE for more comprehensive data coverage.
DCCED is working to update Flood Plain Maps for NFIP.
DEM&HS is updating disaster risk maps based on past 27 years of history.

What are the gaps in research?

Data collection and analysis. Accurate contouring of rural Alaska communities on community maps.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Economic Activities, and Natural Systems

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.1.3

Develop sea level rise projection maps for coastal areas throughout Alaska, accounting for local isostatic rebound in conjunction with global sea level rise predictions. Work with coastal communities and the state of Alaska to incorporate this information into community and state planning efforts to better guide future development decisions. Allow for continual update of these maps to incorporate the expected ongoing refinement in climate projections over time. Sea Level Rise Projection Mapping.

Unique Identifier: 72

☑ Overarching Need

Why is this an issue?

Communities are unable to accurately plan for economic development and assess risks from erosion or inundation. Public is developing inaccurate perception of sea level rise and coastal inundation because of lack of accurate information and heavy press coverage.

Describe the scope of the research need:

Research needs to establish the vertical datum in coastal Alaska, particularly for western and northwestern Alaska and the north slope. Measurement must include accurate shoreline mapping to depict trends associated with erosion and accretion. Tidal measurements will be required to determine changes in the frequency of storm surges and provide the data to document sea level rise.

Policy option or recommendation:

What research is being done/known?

NOAA and USGS have ongoing programs. State is looking into digital mapping initiative (SDMI)

What are the gaps in research?

Costs of collecting data and establishing stations in western and northern Alaska.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Natural Systems, and Economic Activities

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

NOAA, USGS, AK DNR, DCCED and UA

TWG: Health and Culture

5.2.1.4

Unique Identifier: 73

☑ Overarching Need

Alaska's communities will have significant challenges in adapting if climate modeling projections downscaled to the local or regional level is not available on which to base decisions. They will also have little incentive to adapt. Currently, ACCAP has identified global circulation models (GCM) best suited to northern latitudes, and can downscale the model results to every community in the state. Disseminating this information to communities is a first step toward helping them to plan and tailor adaptation to their own specific needs and impacts. However, data gaps remain. Information on projected changes to permafrost and sea level at the local and regional levels is still lacking. Development of a statewide research grant fund could be used to focus the scientific community on filling data gaps critical to community adaptation. Develop Downscaled Climate Modeling for Municipalities.

Why is this an issue?

Communities are coping with changes as seen over time while decision makers are looking for more accurate information to plan and predict actions that will be required. Research that will downscale models is identified as one solution.

Describe the scope of the research need:

Research needs include more data collection and analysis as models can only be scaled to data density and longevity available.

Policy option or recommendation:

Cost/benefit analyses should be conducted to determine the value of downscaled models in the decision process, so that the value of a funding strategy can be realized and/or defended.

What research is being done/known?

NOAA, NASA, NSF, ONR, other public science agencies and many universities are downscaling models for accuracy and reliability.

What are the gaps in research?

Downscaled models are not accurate assessment tools for each individual community as a means to discuss and decide the socio-economic and cultural costs against a determinable timeline. Conducting social science applied research will take these from physical models to socio-economic models that will serve community needs in adapting to climate change.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

NOAA, NASA, IARC, UA

TWG: Health and Culture

5.2.1.5

A strong need exists for a comprehensive inventory of the wide range of data collection, monitoring efforts, and research projects underway or planned in relation to the impacts of climate change on the environment. The benefit to federal, state and municipal entities of having this information accessible in some form of centralized information portal, gateway, or web-based clearinghouse would be significant, most notably in terms of improved ability to make adaptation decisions intelligently and effectively. In turn, duplication of monitoring efforts could be avoided and government entities could provide feedback on specific data gaps, serving to drive future research objectives. Conduct a Comprehensive Inventory of Current Research, Monitoring and Data Collection Efforts.

Unique Identifier: 69

☑ Overarching Need

Why is this an issue?

Overall perception that the communities and decision makers do not have adequate information on the research projects ongoing to make plans to adapt to changing climate. There is limited understanding of the timeline by which the research will conducted, analyzed and developed into applied research and information. With the days of internet and modern communication technology, impacted Alaska communities need access to up to date information and the ability to help guide research projects.

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

Federal Agencies are maintaining data archives, Universities have catalogs, and national climate change programs have research plans and programs.

What are the gaps in research?

No gaps in research, just gaps in communication and documentation followed by limited time to conduct the research of sources while completing there own research.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.1.6

This research need is being addressed in the Public Infrastructure Working Group. Social research that will address the cultural impediments and history of government providing to communities may provide insight into how to sustain communities and maintain community infrastructure to different cultural standards, while recognizing the challenges of weather and seasons.

Unique Identifier: 165

☑ Overarching Need

Why is this an issue?

Community based reporting and protocols can insure longevity in public and private investment while fostering agreement to maintain systems to higher standards. Costs and sources of funding are major issues in this area.

Describe the scope of the research need:

Socio-economic research that addresses investment, operations and maintenance, and longevity based on climate impacts and limits in cash economies to maintain the investment.

Policy option or recommendation:

Education component shared system for infrastructure observations use workforce to provide information into database:
Option 3:
- move to probabilistic approach, make sure we can keep up with codes
- -No reward system for taking care of what you have.
- -Reward for destroying what you have through replacement
- -No systematic decision-making process
- -Fix from disaster—why build new when we can't maintain old?

What research is being done/known?

This area has been extensively discussed in the PI TWG. However the economic challenges of operations and maintenance versus construction requires additional research, economic modeling and cultural analysis.

What are the gaps in research?

Socio-economic and cultural research for the value of maintaining the communities infrastructure and visual appearance (social satisfaction) versus prioritizing use of funds versus other community needs. Research into the costs of deferred maintenance.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.1.7

Social and Education research to develop culturally appropriate curriculums for maintaining public infrastructure and community property. Develop economic forecast models that show the cost savings by not deferring maintenance or in determining where deferred maintenance goes from cost savings to higher costs.

Unique Identifier: 164

☑ Overarching Need

Why is this an issue?

This is a continuation of the research needs associated with the public infrastructure TWG.

Describe the scope of the research need:

Work with Alaska communities to document the investment in maintenance, the levels of deferred maintenance and the costs to repair or replace. This needs to be linked to the increased damage from freeze and thaw cycles during any winter period. Take results and develop workforce curriculum to stimulate people to invest in their community for social satisfaction through well maintained personal/private infrastructure. This will allow for a quality workforce in maintaining public infrastructure and competing for local work.

Policy option or recommendation:

Education component shared system for infrastructure observations use workforce to provide information into database:
Option 2: Get good inventory of what we have, condition, vulnerability and reliability
-How do you collect and summarize data, maybe web based
-Use as education tool. Educate people about value of maintaining infrastructure

What research is being done/known?

Need to check with state and federal agencies as well as economic research groups and ISER.

What are the gaps in research?

Gaps exist in assessing the level of deferred maintenance

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

AK DCCED, BIA, DOTPF, other agencies

TWG: Health and Culture

5.2.1.8

Standardized Social Network research needs to be accomplished in select communities to understand potential impacts of relocation on social, sharing, economic and subsistence networks.

Unique Identifier: 82

☑ Overarching Need

Why is this an issue?

Standardized sampling methods for social networks, as being applied in different locations and for different cultures, can provide a tool by which the challenges facing Alaska communities can be better understood.

Describe the scope of the research need:

Research needs to identify the methodology used in different locations and cultures of indigenous people and small remote communities facing a change to culture and lifestyle with climate change. Compare questions and approaches for appropriateness to challenges being faced in Alaska. Tailor standardized research to culturally appropriate materials for Alaska's indigenous people.

Policy option or recommendation:

Apply methods as being used for indigenous people around the world that are facing impacts from climate change.

What research is being done/known?

The Inuit Circumpolar Council Indigenous Peoples workshop in Anchorage as a significant reference point.

What are the gaps in research?

Review existing social network research data for Alaska communities and people that are at risk from impacts of climate change. Assess adequacy of research questions and methodology to insure it is appropriate for the challenges faced across Alaska's people. Develop deterministic models to predict sustainability, outmigration and other risks with changes to the environment from climate change.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Economic Activities and Natural Systems

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UA, ISER, ADF&G, DEC, Native Organizations

TWG: Health and Culture

5.2.1.9

Unique Identifier: 71

☑ Overarching Need

Using the SPOT satellite data system or others, to track changes in permafrost extent and work to develop projection maps for changes in extent over the next 100 years, based on climate change projections. Such data would serve to guide communities and state agencies in construction planning decisions, both for determining the location and means of construction of new projects as well as identifying those existing projects which may be at risk from thawing permafrost in the future. Allow for continual update of these maps to incorporate the expected ongoing refinement in climate projections over time.
Permafrost Extent Projection Mapping

Why is this an issue?

Communities need accurate data to understand changes to their community and surrounding environment. This will support subsistence

Describe the scope of the research need:

This is a data acquisition approach that is being discussed for the Statewide Digital Mapping Initiative

Policy option or recommendation:

What research is being done/known?

This is being done as part of private sector work in Alaska, as funded by federal, state, and private entities.

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Public Infrastructure, Forestry, Agriculture and Waste , and Economic Activities

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

UA, DNR, USGS and the SDMI team

TWG: Health and Culture

5.2.2.1

Unique Identifier: 80

☐ Overarching Need

Decline and migratory shifts of major subsistence species and vegetation can significantly affect a wide range of cultural, community, and economic conditions. The effects of events must be assessed after an assessment is made of existing climate related socio-economic studies. Assess socio-economic impacts of existing and emergent climate change events on culture, community wellness, subsistence, and overall economics. Assess socio-economic impacts of existing and emergent climate change events on culture, community wellness, subsistence, and overall economics.

Why is this an issue?

The enculturation process of young hunters and gatherers through experienced adults can be severely disrupted with loss or disappearance of important subsistence species. Migration of wildlife may require extended subsistence trips, increasing costs and risks as well as substitution of expensive store bought foods.

Describe the scope of the research need:

The need is statewide and should be focused on key subsistence species identified in cooperation with appropriate local, regional, and statewide Alaska Native entities.

Policy option or recommendation:

What research is being done/known?

see research need

What are the gaps in research?

There is a dearth of climate related socio-economic impact assessments

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UA research centers, Alaska Native regional and statewide organizations, federal and state agencies

TWG: Health and Culture

5.2.2.2

Unique Identifier: 81

☐ Overarching Need

Standardized ADF&G Harvest Surveys (which include considerable social, demographic and economic information in addition to household harvest per species) need to be accomplished in each of the villages designated with emergency status. Standardized ADF&G Harvest Surveys

Why is this an issue?

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.3.1

Regional Assessments of existing social service infrastructure, staffing, budgets and delivery need to be accomplished at regional level as baseline to plan for increased demand.

Unique Identifier: 84

☐ Overarching Need

Why is this an issue?

Services are changing with the stress on rural communities that are increasing because of many factors, including climate change. Stressors include health, behavioral health, and culture with sustainability. Having accurate assessments based on research results and predictive models will allow decision makers to make plans for meeting these future needs.

Describe the scope of the research need:

Research includes interagency and provider assessment of level of social services available, community assessment of the adequacy of services provided, and changes in nature of illnesses, behavioral health, and culture with changing climate. Research will require social economic models that can be used to substantiate agency programs and budget needs.

Policy option or recommendation:

What research is being done/known?

Review of state, federal and native entity operating budgets and programs will provide a base upon which further research will be needed. Assess the value of interagency coordination in assuring adequacy of services given all the stressors on rural communities.

What are the gaps in research?

A comprehensive review of existing services, costs, and potential needs with impacts from climate change.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.3.2

Social Impact Assessments need to be conducted at regional and community level to provide information for Section III of the NEPA process, description of the affected environment.

Unique Identifier: 85

☐ Overarching Need

Why is this an issue?

Gathering social impact assessment information will be needed to complete impact assessments and provide preferred alternatives.

Describe the scope of the research need:

Research is needed to develop standardized questions for social impacts in communities at risk from climate change. This will allow input to models for assessing level of risk and timeframe.

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

NOAA, MMS, USGS, BLM and USACE depending on lead on federal NEPA process. Community and Regional Native Corporations and Councils should be included to provide insight on level of risk. AK DCCED and DNR should be part of the research team.

TWG: Health and Culture

5.2.3.3

Detailed interviews and oral histories need to be conducted to provide narrative information needed to assess the impacts of climate change and the potential impacts of different forms of relocation. These interviews and oral histories need to be placed in a comprehensive library and archive.

Unique Identifier: 86

☐ Overarching Need

Why is this an issue?

As stressors impact health and culture of rural communities and indigenous people, risks to cultures and oral histories exist. Insuring comprehensive collection and archiving will preserve heritage. This is critical as heritage is being lost with aging and passing of elders.

Describe the scope of the research need:

Through networking with community leaders and native organizations, oral histories are preserved in a paper and electronic library.

Policy option or recommendation:

What research is being done/known?

UA maintains an active program in preserving traditional stories and language. Various native organizations continue to invest in collecting detailed interviews and oral histories.

What are the gaps in research?

A comprehensive archive of stories, language, and cultural artifacts and anecdotes needs to be explored for the present level of collection and probability of future success.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UA, Native Corporations and Associations, individual communities and families

TWG: Health and Culture

5.2.4.1

1. Assess ADEC watershed contamination protection laws and source water protection program. 2. Assess effectiveness of current monitoring and surveillance programs to identify and control new pathogens or increased contaminant infiltration/runoff from

Unique Identifier: 30

☐ Overarching Need

Why is this an issue?

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks could alter the geographic range and incidence of a wide range of infectious diseases and can result in contamination of food and water sources.

Describe the scope of the research need:

Policy option or recommendation:

Augment surveillance and control programs for vector-, water-, and foodborne diseases likely to become greater threats because of climate change. Improve understanding of the potential human health impacts of climate change

What research is being done/known?

What are the gaps in research?

See the research need

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, other federal agencies

TWG: Health and Culture

5.2.4.2

1. Assess sanitation and solid waste disposal infrastructure and practices at risk from flooding, melting permafrost, and other risks, or that is otherwise subject to changed conditions that significantly reduce performance in environmental health protection

Unique Identifier: 31

☐ Overarching Need

Why is this an issue?

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks could compromise sanitation and solic waste disposal infrastructure and render current practices ineffective.

Describe the scope of the research need:

Policy option or recommendation:

Assess sanitation and solid waste disposal infrastructure and practices at risk from climate and other risks that significantly reduce performance in environmental health protection. Improve understanding of the potential human health and cultural impacts of climate change

What research is being done/known?

What are the gaps in research?

See the research need

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, other federal agencies

TWG: Health and Culture

5.2.4.3

Work to quantify the climate warming impact from the potential release of methane hydrates in the Arctic due to warmer sea temperatures. Study Climate Warming and Methane Hydrate Deposits

Unique Identifier: 74

☐ Overarching Need

Why is this an issue?

Describe the scope of the research need:

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.4.4

Study the potential increase in bioavailability of persistent organic and transboundary pollutants, including pesticides, mercury, perfluorochemicals and flame retardants, which may be released from melting ice and snow and thawing soil as a result of climate warming in the arctic. Evaluate the potential health impacts on humans, ecosystems from these chemicals as well as their behavior in the food web, and develop projections as to whether these impacts and release rates can be expected to increase and to what degree in the future. Study of Climate Warming and Persistent Organic and other Pollutants.

Unique Identifier: 75

☐ Overarching Need

Why is this an issue?

Transport of pollutants and toxins with changes in atmospheric flows and oceanographic currents are impacting Alaska. Determining the extent and risk to health are a research need.

Describe the scope of the research need:

Monitoring changes in levels of toxins and linking to circulation models can provide insight into risks to human health

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

Monitoring protocols need to include specific toxins and transboundary pollutants

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

EPA, AK DEC, UA and native health organizations

TWG: Health and Culture

5.2.4.5

Study the interaction of increased UV exposure in the arctic on humans, animals and vegetation in conjunction with projected climate changes. Study Climate Warming and Ultra-violet Radiation.

Unique Identifier: 77

☐ Overarching Need

Why is this an issue?

Climate change can change UV exposure that may affect human health and change plant and animal distribution. This will affect culture.

Describe the scope of the research need:

Include UV radiation as an integral part of weather monitor stations.
Document changes in skin cancer, sunburn, and other exposure illnesses in native populations

Policy option or recommendation:

What research is being done/known?

What are the gaps in research?

Medical records of exposure and changes in levels of UV radiation need to be monitored

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Health and Culture

5.2.5.1

Unique Identifier: 33

☐ Overarching Need

Why is this an issue?

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks will affect the stability of archeological sites and gravesites, requiring plans for protection or recovery.

Describe the scope of the research need:

Policy option or recommendation:

1. In cooperation with appropriate entities, complete an assessment of archaeological sites most at risk, and develop a plan for their protection or recovery. 2. Complete a statewide assessment of and response to the gravesites most at risk. Improve understanding of the potential cultural impacts of climate change

What research is being done/known?

What are the gaps in research?

See the research need

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, other federal agencies

TWG: Health and Culture

5.2.6.1

1. Identify effective cooperative mechanisms to support rural communities in dealing with multiple rules and requirements. 2. In partnership with local communities, conduct an assessment of the capacity of communities to design and implement programs a

Unique Identifier: 32

☐ Overarching Need

Why is this an issue?

Increased temperatures, changing precipitation patterns, flooding, melting permafrost, and other climate change-related risks will present a wide range of challenges to rural communities that will require them to deal with multiple state and federal agencies, with overlapping and sometimes conflicting rules and regulations.

Describe the scope of the research need:

Policy option or recommendation:

Identify approaches, as well as responsible individuals, to support rural communities in dealing with complex issues requiring coordination among multiple state and federal agencies, local governments, NGOs, and others. Improve understanding of the potential health and cultural impacts of climate change

What research is being done/known?

What are the gaps in research?

See the research need

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, other federal agencies

TWG: Natural Systems 5.3.1.1

Develop better hydrology data and models statewide.

Unique Identifier: 53

☑ Overarching Need

Why is this an issue?

Trend data and global climate models indicate a warmer and sometimes wetter climate for Alaska in the future. Planning for river navigation, flood hazard estimation, and cost-efficient engineering of public roads, culverts, bridges, water, and wastewater systems require accurate estimation of water flow volume and seasonality. Historic data and existing statewide coverage are inadequate for present and future needs.

Describe the scope of the research need:

Improve the currently available hydrology (NHD) dataset so that accurate modeling can be accomplished to understand and develop forecasts to anticipate changing surface water bodies, surface and subsurface flow (volume, timing, and locations), composition (nutrients, sediment) in priority areas. Gather data on hydrologic parameters throughout the state to establish baselines, so the effects of climate change on these parameters (e.g., precipitation, snowpack, and streamflow) can be evaluated. Improve gauging and monitoring to determine water supply and seasonality.

Policy option or recommendation:

NS-3 Manage climate change impacts on watersheds and in-stream flows.

What research is being done/known?

USGS has a network of stream gages and has developed a list of locations for possible expansion in AK. The NSSI has been investigating remote sensing technologies for detecting flows.

What are the gaps in research?

Stream gage coverage is insufficient for accurate modeling in much of the state.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Overarching climate change information need.

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

USGS. IATCA

TWG: Natural Systems

5.3.1.10

Assess, model, and monitor coastal impacts of changes to sea level and ice.

Unique Identifier: 40

☑ Overarching Need

Why is this an issue?

Coastal erosion is increasing with reduced sea ice cover and thawing permafrost. Rapid erosion is exposing buried infrastructure, undercutting road and building foundations, and destroying natural and cultural resources.

Describe the scope of the research need:

Project, map and monitor coastal erosion impacts in the context of sea level rise, coastal uplift, reduced sea ice, subsidence from permafrost thaw, tides, storms, short-term (El Nino-type) components. Develop detailed sea level change models, projections, and impact maps; increase monitoring of coastal erosion in the context of sea level rise, coastal uplift, sea ice loss, subsidence, and permafrost thaw; and increase monitoring for real-time and forecasts of ocean conditions (winds, waves, sea ice, currents, temperature, salinity, pH, etc.). Assess coastal substrate/sediment susceptibility to erosion (rock, ice, soil). Develop detailed sea level change models, projections, and impact maps. Improve monitoring of key climate change indicators & effects. Monitor coastal erosion in context of changing sea level rise, coastal uplift, and sea ice loss. Improved monitoring and forecasting of sea level rise will inform modeling and forecasting of impacts. Increase monitoring of coastal erosion and storm impacts.

Policy option or recommendation:

Overarching climate change information need

What research is being done/known?

National Water Level Observation Network sites provide data for trends (http://co-ops.nos.noaa.gov/sltrends/sltrends.shtml). Numerous modeling efforts are underway relative to sea level, sea ice and permafrost. Coastal erosion has recently been quantified in several areas of the North Slope and NW Alaska.

What are the gaps in research?

Local isostatic rebound needs to be factored into models of sea level rise in formerly glaciated areas. DEMs are lacking for accurate coastline and inundation modeling. Need National Water Level Observation Network stations along west and north coasts; need technology developed to get these measurements in iced areas.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

AOOS, AGDC, NOAA, USGS, UAF, Land management agencies

TWG: Natural Systems

5.3.1.11

Down-scaled climate models

Unique Identifier: 39

☑ Overarching Need

Why is this an issue?

Global Climate Model data is too coarse to inform communities and local resource managers about probable changes at local levels.

Describe the scope of the research need:

Develop projections of future climate on a local scale for communities and land management units throughout Alaska, using scaled-down global climate model data and appropriate Alaska datasets (e.g., PRISM).

Policy option or recommendation:

Overarching climate change research need.

What research is being done/known?

SNAP and others are actively developing downscaled model data. Model outputs are available for most communities and land management units across Alaska.

What are the gaps in research?

Output needs to be generated for additional areas. Models need continual refinement to reflect new research findings and to correct assumptions. Expand these downscaling efforts to ocean environment (just starting in the Chukchi).

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

UAF SNAP, USGS, NOAA, FS

TWG: Natural Systems

5.3.1.12

Coordinated climate and ecosystem monitoring.

Unique Identifier: 38

☑ Overarching Need

Why is this an issue?

Long-term datasets with reliable indicators and across large geographic areas (regional and continental scale) are essential to determine climate and resource condition trends.

Describe the scope of the research need:

Develop a set of reliable physical and biological indicators of climate change (including species and phenology) and related community impacts, to identify the most effective ways to implement short-, mid-, and long-term status and trend monitoring across broad areas and multiple land management units. Consider low-tech monitoring techniques (and its adequacy), local data observations with less than full weather service standards, satellite imaging, new sensors with communications systems, vehicles as probes.

Policy option or recommendation:

What research is being done/known?

Many agencies already have long-term ecological research and monitoring programs that could contribute data, but comparability of observations of different variables collected by different methods is an issue. Many nongovernmental scientists (with universities, private companies, and corporations) also have environmental monitoring data that could contribute to overall understanding if it were to be made public.

What are the gaps in research?

Identification and adoption of a set of common physical and biological indicators across the state, nation, and worldwide is an early need for comparability of monitoring data. Intellectual property and other issues interfere with sharing of data.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

NPS, NOAA, USGS, EPA, AFS, ACCAP, AOOS, SAON, NEON

TWG: Natural Systems

5.3.1.13

Determine appropriate indicators of climate change and community impacts. Improve monitoring of key climate change indicators & effects, with emphasis on effects with large societal impacts. Monitor climate change indicators and their societal impacts

Unique Identifier: 1

☑ Overarching Need

Why is this an issue?

Improved monitoring of key climate change indicators relevant to Alaska will allow for tracking of climate change effects and will contribute data to modeling and assessments. Monitoring of indicators of community impacts related to climate change will inform assessments of societal impacts and support planning and adaptation.

Describe the scope of the research need:

1. Identification of appropriate indicators of climate change and of community impacts.
2. Development and implementation of routine, on-going monitoring of indicators.
3. Development and improvement of modeling capabilities for indicator prediction.4. Development of information and products for public use.

Policy option or recommendation:

Overarching climate change information need

What research is being done/known?

Relevant data has been collected by agency (ADF&G, Division of Forestry, USFWS), tribal managers (e.g., North Slope Department of Wildlife and Council of Athabaskan Tribal Governments) and University scientists (e.g., Long-term Ecological Research Sites) Examples of reports cards include:- Arctic Report Cards ((http://www.arctic.noaa.gov/reportcard/index.html) - Sea Ice Outlook (NOAA/PMEL)

What are the gaps in research?

Assessment of observed responses to determine the most sensitive indicators, that should be monitored and reported on.Gaps in monitoring of key climate change indicators may include: - ice type need to increase the density of climate change data sites - gaps in climate reference network (only 4 of 33 sites in AK installed)- monitoring trends in marine mammal species abundance and distribution

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

Alaska state agencies; University of Alaska; EPA, NOAA and other federal agencies

TWG: Natural Systems

5.3.1.14

Protect community water supplies and instream flows.

Unique Identifier: 26

☑ Overarching Need

Why is this an issue?

Freshwater runoff from snow and icemelt is a major source of drinking water for communities. Adequacy of future supplies cannot be assumed with climate change.

Describe the scope of the research need:

Identify water needs, supplies, and rights of Alaskan communities, domestic and commercial and ecological. Develop water supply scenarios to better understand the broad range of impacts of climate change on fresh water quantity, flow, seasonality and quality in Alaska. Assess community's current and future water needs. Assess water rights for community potable water supplies, "subsistence priority", and water fish and wildlife habitat. Assess sustainability of water flows used for hydropower and aquifer recharge, and in-stream flows. Identify areas where future water needs are likely to be insufficient, using assessment tools such as the Arctic Water Resources Vulnerability Index (AWRVI), and review appropriateness of long-term water management strategies for these regions.

Policy option or recommendation:

NS-3. Manage climate change impacts on watersheds and in-stream flows.
NS-6. Prepare for adaptive management of fish and wildlife.

What research is being done/known?

USGS and others operate river gages

What are the gaps in research?

Gather data on hydrologic parameters (e.g., precipitation, snowpack, streamflow) throughout the state to establish baselines, so effects of climate change on these parameters can be evaluated. Conduct legal analysis of water rights.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Health and Culture.
Public Infrastructure

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

ADF&G,ADNR,USGS,NOAA

TWG: Natural Systems 5.3.1.15

Expand research and monitoring of contaminants deposition and bioavailability under changing climate.

Unique Identifier: 178

☑ Overarching Need

Why is this an issue?

Contaminants can affect health and survival of fish, wildlife, and people.

Describe the scope of the research need:

Include consideration of Persistant Organic Pollutants (POPs) and mercury that are produced in other areas (by wildland fire, coal burning, etc.) and precipitate in arctic environments by global air circulation. Also consider potential for spread of contaminants result from permafrost thaw and erosion in historically contaminated areas (e.g., military dumps, legacy wells).

Policy option or recommendation:

What research is being done/known?

EPA and NPS have recently completed the Western Airborne Contaminants Assessment Program that had both expected and unexpected results about contaminants in remote areas of Alaska. The State has assessed contaminants in fisheries and subsistence foods. DOD has cleaned up several known contaminant sites.

What are the gaps in research?

Extent and locations of contaminated historic dumps are not fully delineated. Effects of climate change on bioavailability and biomagnifications, ecological, and human effects, are incompletely understood.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Overarching climate change information need

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

EPA, USGS, DOD, DNR, NPS

TWG: Natural Systems

5.3.1.16

Develop landcover base maps statewide

Unique Identifier: 183

☑ Overarching Need

Why is this an issue?

Understanding changes in landcover types are critical to assessments related to fire, forestry, wildlife, fisheries, etc. GIS and maps are basic tools needed for many analyses.

Describe the scope of the research need:

Need vegetation maps that are usually compiled from satellite imagery. Ortho rectified imagery would show human improvements and vegetation. A base map is needed for the state.

Policy option or recommendation:

Overarching climate change information need.

What research is being done/known?

Numerous mapping programs are underway, but purposes, coverage, scale, and details vary. GINA is compiling base maps for the North Slope

What are the gaps in research?

Currently only portions of the state have this information available.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

USGS, UAF GINA and all land management agencies

TWG: Natural Systems

5.3.1.17

Assess communications strategies for climate change information.

Unique Identifier: 186

☑ Overarching Need

Why is this an issue?

Poorly communicated information about climate change can cause more harm than good.

Describe the scope of the research need:

Determine the most effective information sources for communities to receive accurate and complete information about climate change.

Policy option or recommendation:

What research is being done/known?

The Alaska Immediate-Action Working Group has initiated a mini-grant program with six Alaskan communities in immediate risk of climate-induced erosion that demonstrates the feasibility of such a program.

What are the gaps in research?

Avoid or counter counterproductive "scary" and sensational information, as was sometimes the case information about avian influenza.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UAF Cooperative Extension Service, ASG MAP, NPS, FS, and FWS resource interpretation programs, teacher education, curriculum-based materials, on the ground.

TWG: Natural Systems 5.3.1.2

Identify permafrost thaw hazards and incorporate into engineering guidelines.

Unique Identifier: 54

☑ Overarching Need

Why is this an issue?

The IPCC predicts widespread permafrost thaw across the Northern Hemisphere in this century. Cracking roads and subsiding building foundations are common in some areas where permafrost thaw is accelerating. Landslides and mudflows are also occurring on thawing wet hill slopes, sometimes blocking roads, rivers, and degrading fish habitats. Engineers, builders, and planners need accurate maps and forecasts for planning.

Describe the scope of the research need:

Permafrost thaw. Identify trends and trajectories in active layer (seasonal thaw zone) depth and permafrost zones (i.e., continuous, discontinuous), and thaw hazards, through modeling, soil surveys, and studies of permafrost degradation. Include analysis of geotechnical data collected for construction projects, drill logs, and collect data from monitoring systems that have already been installed under many Alaska highways. Include coastal erosion vulnerability mapping, as permafrost stability is a major factor. Incorporate data into an updated published environmental atlas for engineers.

Policy option or recommendation:

What research is being done/known?

UAF has several permafrost and active layer monitoring programs underway. CRREL has incorporated some newer information into the GIS-based Alaska Engineering Design Information System (AEDIS).

What are the gaps in research?

Permafrost and active layer mapping is incomplete across much of the state and several potentially useful data streams remain uncollected or unanalyzed (e.g., geotechnical soil test data, highway thermister networks) . Models are in development but require soils mapping for precision and monitoring data for verification. Data published in the Environmental Atlas of Alaska is long out of date (1978), and there appear to be liability concerns preventing engineers from widely adopting unpublished AEDIS data.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

UAF, ACCAP, NRCS, ADOT, NSF

TWG: Natural Systems

5.3.1.3

Identify and research regulatory and policy issues.

Unique Identifier: 57

☑ Overarching Need

Why is this an issue?

Many of the laws, policies, and regulations that direct management of public and private lands and waters are premised on stable climates, or at least on the ability to envision future conditions (e.g., ANILCA, ESA, CFR, CZMA). What will be the standard of successful resource management in a changing future? Can state and federal agencies preserve the unique and special values that are identified in legislation in the face of climate change? How will they develop adaptation strategies for fish, animals and plants when their natural climate zones move beyond management units, state and national borders?

Describe the scope of the research need:

Identify inconsistencies in laws, regulations and policies that limit the abilities of the State, federal, Native and local agencies, businesses and individuals to effectively address and manage climate change impacts on natural resources.

Policy option or recommendation:

What research is being done/known?

Several DOI agencies have begun identifying laws, regulations, and policies that may limit their ability to address climate change issues. UAA law professor Julie Lurman Joly has researched regulatory barriers to facilitated migration of at-risk species into more favorable habitats.

What are the gaps in research?

Laws, regulations, and policies need to be evaluated relative to potential future scenarios, and with legal advice to determine whether there is sufficient flexibility for dealing with climate changes or whether changes are appropriate.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Overarching climate change information need

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

ACCAP, Federal and State regulatory agencies, with legal advice from agency solicitors

TWG: Natural Systems 5.3.1.4

Implement local climate change scenario planning workshops in communities across Alaska (coastal, arctic, interior, etc.).

Unique Identifier: 58

☑ Overarching Need

Why is this an issue?

Alaskan's are receiving conflicting, sometimes sensational and frightening information about climate change from many sources. However, few communities really understand what changes to expect in their area, or how fast to expect them. As heard at the ACTEM climate change session, communities need updated mapping, photographs, and projections of environmental changes to be able to effectively plan for their adaptation to climate change.

Describe the scope of the research need:

Improve accuracy and currency of mapping and aerial photography near communities, to assist communities with planning for adaptation to climate change. Apply models and develop scenarios of changes in climate, environmental hazards (erosion, wildfire, flooding) to facilitate future community planning. Workshops would include discussion of potential effects under a probable range of future climate scenarios, with discussion of how physical, biological, cultural, and social changes associated with rapid climate change would affect communities and resources.

Policy option or recommendation:

What research is being done/known?

University of Alaska is developing remote sensing and photographic products (Geographic Information Network of Alaska - GINA) and scenarios of future environment and risks (Scenarios Network for Alaska Planning - SNAP)

What are the gaps in research?

Fill critical gaps in photography, maps and scenarios. Improve accessibility of information to agencies and communities.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

SNAP, AOOS, GINA, ACCAP. Coordinate information and activities with federal agencies (e.g., USGS, NOAA, NASA) and Native organizations.

TWG: Natural Systems

5.3.1.5

Hazards identification and assessments.

Unique Identifier: 56

☑ Overarching Need

Why is this an issue?

Describe the scope of the research need:

Identify and research specific hazards, mitigation measures, and response capacity needed for dealing with effects of rapid climate changes on: fire regimes and forest fuel hazards, physical hazards (glacial outbursts and river flooding, surging glaciers, avalanches, landslides, ground failures, solifluction, erosion, inundation, subsidence), invasive species (plants, animals, pests and diseases), species habitat loss and fragmentation, and vulnerabilities to spread of contaminants resulting from persistent organic pollutants (POPS) and permafrost thaw.

Policy option or recommendation:

What research is being done/known?

USGS, CCREL, and UAF researchers are researching and monitoring selected hazards (e.g., Hubbard and Tweedmuir glaciers), and other researchers and resource managers are dealing with recognized hazards, where possible.

What are the gaps in research?

A comprehensive and specific assessment, to identify specific risks and locations, is lacking. Southeast Alaska is a priority area due to rapid glacial retreat and unstable soils.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

USGS, NOAA, CG, EPA, multiple federal and state agencies

TWG: Natural Systems

5.3.1.6

Data integration

Unique Identifier: 50

☑ Overarching Need

Why is this an issue?

Decisions are being made without benefit of available data and redundant research activities are started for lack of access to existing data.

Describe the scope of the research need:

Expand data integration and collaboration to facilitate increased access to information and ensure inter-operability of multiple data management systems.

Policy option or recommendation:

What research is being done/known?

Leslie Holland-Bartels of USGS has assembled a group to integrate applications with several public databases

What are the gaps in research?

Unpublished data held by federal and state agencies, academic scientists, and businesses is still not widely shared.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

USGS, AOOS, UAF-GINA, NPRB, NSSI, ADFG

TWG: Natural Systems

5.3.1.7

Changes to vital ecosystem services

Unique Identifier: 45

☑ Overarching Need

Why is this an issue?

Describe the scope of the research need:

Research potential impacts/ramifications of the changes to all affected resource types, including: atmosphere, cryosphere, hydrosphere, biosphere, and lithosphere the ecosystem services that they provide, and the societal impacts of these changes.

Policy option or recommendation:

NS-2. Review and modify Alaska's wildland fire policy and programs.
NS-3. Manage climate change impacts on watersheds and in-stream flows.
NS-4. Reduce introduction and spread of invasive species in the context of climate change.
NS-6. Prepare for adaptive management of fish and wildlife.
NS-7. Develop capacity in new forestry and wood biomass opportunities.

What research is being done/known?

Research, monitoring, and modeling is underway to determine status and trends and to forecast changes in some topics. Fire modeling is underway to anticipate changes in fire behavior.

What are the gaps in research?

The cascading effects of large scale environmental change need to be considered. What are the consequences of ecosystem changes to vital natural services and economic resources, such as water supply, air quality, ocean fisheries, etc. How will large scale changes in the boreal forest affect other factors? What are the potential tipping points, where vital services are no longer being provided (e.g. fish population crash).

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UAF, ACCAP, NSF ADF&G, USFWS, DOF

TWG: Natural Systems

5.3.1.8

Geospatial data needs, aerial photography, digital elevation models (DEM), and remote sensing data.

Unique Identifier: 42

☑ Overarching Need

Why is this an issue?

There are highly important specific early needs to facilitate other data gathering efforts. For example, accurately represented coastal land elevations are needed for modeling how sea level rise will affect low lying coastal areas.

Describe the scope of the research need:

Improve the currency and accuracy of aerial photography, DEMs, and remote sensing data available statewide for community and agency use in planning adaptation strategies for climate change. Ensure that new mapping meets needs of coastal and ocean community, as well as terrestrial needs.

Policy option or recommendation:

What research is being done/known?

Multiple agencies are acquiring imagery for particular purposes, but more coordination could result in better coverage and detail, potentially with less redundancy and lower overall cost.

What are the gaps in research?

Much of Alaska's area has not been mapped recently or to modern standards of accuracy. DEMs are required for appropriate orthorectification of imagery and to ensure an adequate base map is available for other resource mapping and analysis, including coastlines, fire, and wildlife.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

AGDC

TWG: Natural Systems 5.3.1.9

Coastal mapping and shoreline characterization.

Unique Identifier: 41

☑ Overarching Need

Why is this an issue?

Conduct an Alaska Shoreline Impact Assessment Project to establish a baseline of data on the existing biotic coastal resources and the projected impacts of sea level rise (including effects of tides, weather and short-term [El Nino-type] components). Characterize Alaska's coastal shoreline and coastal resources (e.g., NOAA ShoreZone), geomorphology, biology, cultural sites.

Describe the scope of the research need:

Complete baseline characterization of Alaska's coastlines (i.e., NOAA ShoreZone, geomorphology, biology, cultural sites) to enable coastal impact forecasting, scenario planning, monitoring, trend analysis, and spill response following shipping accidents, which are expected to increase as sea ice diminishes in the Northwest Passage.

Policy option or recommendation:

NS 6 Fish & Wildlife Management:(6.2) Coordinate state & federal management to adapt to mitigate climate change effects on species, when feasible.

What research is being done/known?

Much of Southeast and Southwest Alaska has been mapped through videography.

What are the gaps in research?

Northwest Alaska and some parts of Southeast (e.g., inner Glacier Bay) remain to be mapped. Mapping will require accurate DEM's for vertical control shoreline. Combine orthophoto mosaic data and oblique (ShoreZone) dataset to be able to use both. Access newly declassified defense imagery.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

AGDC, NOAA, USGS, NPS

TWG: Natural Systems

5.3.2.1

Synthesize current information about climate change impacts on fisheries impacts and assess its reliability and degree of uncertainty. Conduct fisheries ecological modeling.

Unique Identifier: 180

☐ Overarching Need

Why is this an issue?

Describe the scope of the research need:

Understand how productivity of coastal and estuarine systems may change and species composition shift in response to environmental changes and resource use. One connection may be to better understand the lack of recovery for herring, crab and shrimp fisheries along the Gulf of Alaska.

Policy option or recommendation:

NS-1. Incorporate climate change into commercial fisheries management and assist fishing communities and users in adaptation.

What research is being done/known?

Considerable research has been conducted on marine "regime change" due to "El Nino/La Nina" effects, that may be informative to modeling effects of long-term climate change.

What are the gaps in research?

Questions about some historic population shifts remain unanswered. Fisheries status and trend data is incomplete.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

UAF,NOAA/NMFS, NPRB, EVOSTC, USGS, NCCSP. Partnership between federal, state and university coastal labs and researchers. (John Piatt, Anne Hollowed)

TWG: Natural Systems

5.3.2.2

Arctic Ocean fisheries assessments.

Unique Identifier: 181

☐ Overarching Need

Why is this an issue?

Fisheries population shifts are occurring due to ecological change, and ship access is increasing with reduced sea ice. Commercial fishing in new areas would have uncertain effects to previously unaffected populations

Describe the scope of the research need:

Determine abundance and vulnerability of Arctic Ocean fish species, potential bycatch, and critical dependencies (e.g., marine mammals).

Policy option or recommendation:

NS-1. Incorporate climate change into commercial fisheries management and assist fishing communities and users in adaptation.

What research is being done/known?

Basic research has been completed on many Arctic species by academic researchers.

What are the gaps in research?

Status and trends of species with commercial potential is largely undetermined. Vulnerabilities of non-target species have not been determined.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

NOAA/NMFS, UAF, MMS

TWG: Natural Systems 5.3.2.3

Increase real-time monitoring and forecasts of physical ocean conditions (winds, waves, sea ice, currents, temperature, salinity, pH, etc.).

Unique Identifier: 13

☐ Overarching Need

Why is this an issue?

Improved monitoring and forecasting of changing ocean conditions will inform modeling and forecasting of related biotic changes, as well as inform marine-based human uses. Physical data is needed to predict and explain biological responses. Impacts of freshwater from glacial melt on marine ecosystem is needed to improve understanding of effects of climate change on marine ecosystems. Water temperature increases are correlated with oceanic regime changes and with locally reduced salmon returns and increased fish disease (e.g., Yukon River). Ocean acidification of the magnitude that has been occurring is expected to have significant impacts to food webs, and certain species (e.g. corals, shellfish).

Describe the scope of the research need:

Monitor and model potential change for ocean currents, temperature, salinity, and acidification. Temperature data has been collected for a long time at many tide stations (but we only have 2 tide stations in the Arctic), but the data is sparse across the Arctic, and oceanographic changes will need salinity data to understand what climate aspects are driving, changing oceanographic conditions. Add conductivity sensors to tide stations. Institute an ocean acidification monitoring program.

Policy option or recommendation:

NS-1. Incorporate climate change into commercial fisheries management and assist fishing communities and users in adaptation.

What research is being done/known?

AOOS is developing a cooperative network of observing stations.

What are the gaps in research?

Oceanic and coastal seawater monitoring remains limited.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

AOOS

TWG: Natural Systems

5.3.2.4

Fisheries policy considerations.

Unique Identifier: 179

☐ Overarching Need

Why is this an issue?

Describe the scope of the research need:

Research what other countries, U.S. federal agencies and other states are doing to incorporate climate change considerations into commercial fishing policies, management, and other adaptations. Assess what is appropriate to Alaska conditions.

Policy option or recommendation:

NS-1. Incorporate climate change into commercial fisheries management and assist fishing communities and users in adaptation.

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

NMFS, NPRB, ADFG.

TWG: Natural Systems

5.3.2.5

Conduct physical, biological, and socioeconomic monitoring consistently over time to understand environmental change, distribution and abundance of freshwater, marine and andadromous species, and societal impacts.

Unique Identifier: 14

☐ Overarching Need

Why is this an issue?

Broad scale changes in fisheries species abundance and distribution are expected. Changing stream/lake biochemistry may drive freshwater ecosystem change and changes in abundance and distribution of species of commercial or subsistence importance (as well as other effects.) Monitoring is essential to inform policy, management, and users' decisions. Data will support modeling and forecasting. The Anadromous Waters Catalog is the key tool for documenting freshwaters important to anadromous fish and providing protection for this habitat.

Describe the scope of the research need:

Establish long-term monitoring to document changes and trends in fish species abundance and distribution. Update the Anadromous Waters Catalog to document and protect waters that support anadromous fish. Research stream/lake biochemistry in order to improve understanding of effects of climate change on freshwater ecosystems. Increase research on stream/lake biochemistry impacts due to land cover conversion, permafrost degradation, and changing precipitation regimes within watersheds. (Contact Bruce Peterson, Woods Hole Marine Biological Lab, http://ecosystems.mbl.edu/Tide/contact/peterson.htm) Improve information available to fishery managers, participants in commercial and subsistence fisheries, and fishing communities. Monitor trends in marine and freshwater fish species abundance and distribution.

Policy option or recommendation:

NS-1. Incorporate climate change into commercial fisheries management and assist fishing communities and users in adaptation. NS-6. Prepare for adaptive management of fish and wildlife.

What research is being done/known?

Salmon runs are monitored relative to escapement goals.

What are the gaps in research?

Marine fisheries monitoring is limited. Many streams are also not monitored regularly. Effects of permafrost thaw are largely undetermined

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

ADFG, NMFS, AOOS, ACCAP

TWG: Natural Systems

5.3.2.6

Consider need for protected fish conservation areas. Evaluate tools for fish species conservation

Unique Identifier: 15

☐ Overarching Need

Why is this an issue?

Expanding fisheries pressure can deplete target and bycatch populations and degrade habitats. Reduced sea ice increases the likelihood of increased fishing pressure in Arctic waters.

Describe the scope of the research need:

Research potential need for protected areas to ensure sustainabiliity of species important to commercial or subsistence fisheries.

Policy option or recommendation:

NS-1. Incorporate climate change into commercial fisheries management and assist fishing communities and users in adaptation.

What research is being done/known?

A growing body of research shows significant benefits from establishment of marine protected areas. However, such decisions are not always made on firm scientific basis relative to needs of commercially important species.

What are the gaps in research?

Species status and trend data, and assessments of habitat quality and fishing pressure would greatly help.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

ADFG, NOAA, NPS, USGS, UAF

TWG: Natural Systems

5.3.3.1

Fire and fuel modeling.

Unique Identifier: 44

☐ Overarching Need

Why is this an issue?

Fire hazards are expected to increase with rising air temperature.

Describe the scope of the research need:

Conduct detailed modeling (including hind- and fore-casting) of wildland fire frequency, intensity, and areas, including likely effects on principle landcover types (e.g., conifers, deciduous, grass, tundra). Modeling is needed to assess future fire dynamics under a suite of potential future climate scenarios. What would happen under an increased fire protection strategy scenario as well as the current management action. Fine-scaled projections of future fire regime would benefit communities in preparing their Community Wildfire Protection Plans.

Policy option or recommendation:

NS-2. Review and modify Alaska's wildland fire policy and programs.

What research is being done/known?

Modeling is underway by UAF SNAP with the AFS. Other published models are also available (e.g., Bachelet et al. 2005)

What are the gaps in research?

Modeling is more refined for coniferous forests than for tundra or grassland.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UAF SNAP, ACCAP, JFSP

TWG: Natural Systems

5.3.3.2

Review and coordinate wildfire policies with Canadian counterparts. Determine efficacy and ecological effects of different fire management policies.

Unique Identifier: 10

☐ Overarching Need

Why is this an issue?

Current wildland policy is not Full Suppression. Research would inform policy makers about potential positive and negative effects to wildlife habitat of allowing wildland fires to burn.

Describe the scope of the research need:

Determine if mechanical fuel treatments are achieving the desired condition class change in the fuel type. Determine best landscape "mosaic" of burned and unburned areas for wildlife habitat, not just by landcover type, and incorporate information into policies. Monitor and research tundra fire effects, including the impacts of fire on winter caribou range and changes in vegetation patterns and succession caused by fire. This will require improved remote sensing of burn severity and depth of fire (e.g., deep fires on Yukon Flats).

Policy option or recommendation:

NS-2. Review and modify Alaska's wildland fire policy and programs.

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

TWG: Natural Systems 5.3.3.3

Tundra fire mitigation measures.

Unique Identifier: 184

☐ Overarching Need

Why is this an issue?

Tundra fires are expected to increase as shrubs move into tundra and as soils dry from climate warming. Remote communities have limited fire fighting capacity.

Describe the scope of the research need:

Evaluate mitigation strategies for communities in tundra-dominated ecosystems to create fuel breaks at the wildland interface (e.g., gravel perimeter road around community) to reduce risk of wildland fire spreading among structures, as well as spread of fire from communities into wildlands (e.g., escaped trash fires at dumps).

Policy option or recommendation:

NS-2. Review and modify Alaska's wildland fire policy and programs.

What research is being done/known?

Considerable experience has been gained on managing wildland fire – urban interface in other environments. UAF SNAP is modeling future fire scenarios.

What are the gaps in research?

Tundra and permafrost respond differently to fire and other ground disturbing activities than other environments. Modeling of tundra fire is less developed than for coniferous forests.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Health and Culture

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

AFS, JFSP, affected communities, UAF SNAP

TWG: Natural Systems

5.3.4.1

Identify and develop methods to assess and control invasive and irruptive plant, animal, and diseases likely to become established, expand their range, or be intentionally introduced in Alaska due to climate change.

Unique Identifier: 52

☐ Overarching Need

Why is this an issue?

Established terrestrial, aquatic, and marine species are shifting north into Alaska, while other species are also arriving from other seas and continents. Some new arrivals will compete with current species or carry parasites and diseases previously not present in Alaska.

Describe the scope of the research need:

Identify, model, and monitor and research specific risks to native species and ecosystems due to climate-driven expansion of invasive plant, animal, disease and pest species (terrestrial, freshwater, and marine), including potential transmission routes, trigger points, and conditions affecting establishment. Irruptive native pests that, under conditions of climate change, may expand rapidy and have comparable effects to invasive non-native species (e.g., bark beetles, "rocksnot" diatom) should also be considered. Identify mechanisms of long-dispersal of plants and animals in order to create barriers for invasives, while not interfering with movement of native species. Expansion into warmer and dryer areas where native species are stressed by climate change needs to be modeled, so that control measures can be designed and implemented where appropriate. Identify new species with high risk of arrival and spread. Assess laws and policies affecting introduction, spread, and control of invasive species. Support development of "best methods" guidelines for preventing spread of invasive species. Assess existing ballast water treatment and hull cleaning technologies for application in Alaska. Assess effectiveness of practices for new-roads maintenance equipment, schedules and methods in reducing the spread of invasive plants. Develop capacity for commercial production of native plants materials from local sources for revegetation projects to reduce the probability of exotic species becoming established following ground disturbance (construction, fire, etc.). Research benefits, ecological niche, potential invasiveness of potential "new" introduced species, including agricultural, horticultural, and forest vegetation better adapted to a warming climate. Public outreach and education are needed to reduce introductions in fishing areas and along recreational and subsistence trails. Definitions: An "invasive species" is a species that is non-native (alien or exotic) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. "Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity (Executive Order 13112).

Policy option or recommendation:

NS-4. Reduce introduction and spread of invasive species in the context of climate change.

What research is being done/known?

Alaska's invasive species plans address known risks for weeds, invasive species, and rodents, and are mostly focused on species with demonstrated high invasiveness through experience here or elsewhere: http://www.adfg.state.ak.us/special/invasive/invasive.php Criteria for ranking invasiveness have been developed for plants. Modeling has shown road, railroad, and trail corridors to be plant transmission zones, especially where they cross rivers and streams. Ballast water and recreational boating are among known aquatic hazards.

What are the gaps in research?

Disease organisms with high risks to agriculture and humans are largely recognized in the agricultural and human health fields, but are not fully considered in the context of climate change.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Forestry, Agriculture & Waste, Health & Culture

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

USGS, UAF, NMFS, CNIPM, ASG, ACCAP, FS, NRCS

TWG: Natural Systems

5.3.4.1

Provide effective monitoring, forecasting and response to marine invasive species

Unique Identifier: 12

☐ Overarching Need

Why is this an issue?

The number and distribution of invasive species is expanding in Alaska. Invasive species frequently outcompete valued native species and cause severe economic and ecological damage.

Describe the scope of the research need:

Monitor distribution and spread of marine species, Atlantic salmon, Spartina, green crabs, and invasive tunicates in Alaskan coastal waters. Develop and implement statewide monitoring program for disease irruptions and invasive species that affect fish and shellfish, including PSP, Vibrio and HAB

Policy option or recommendation:

NS 4 Invasive Species: implement statewide strategic plan of action to address invasives and erupted plants, insects, pathogens and marine invasivess.

What research is being done/known?

Information on the spread of marine invasive species in Alaska is largely localized or incidental.

What are the gaps in research?

Broad and consistent monitoring of marine invasive species, in time to take action, is largely lacking.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

DEC,State Public Health Dept.,EPA,NOAA,FDA

TWG: Natural Systems

5.3.5.1

Better wildlife and fisheries populations and harvest rate data.

Unique Identifier: 51

☐ Overarching Need

Why is this an issue?

Alaska's terrestrial, aquatic and marine ecosystems are changing, as are the natural habitats required by wildlife and fishery species. Scientists expect rapid change in some areas as trees and shrubs expand into tundra, fires reduce the size and extent of coniferous forests, and permafrost thawing and thermokarst change the distribution and size of wetlands. Alaska's rural population, tourism industry, and many businesses depend on healthy wildlife and fish populations for food and income. Accurate monitoring data and forecasts are needed to inform decision makers about resource management needs and options, including changes to laws, policies, and regulations.

Describe the scope of the research need:

Expand long-term monitoring, modeling, and use of traditional and local knowledge to understand how species abundance and distribution are changing. Develop criteria for triggering investigation of unexpected population changes. Develop projections of future changes to potential wildlife habitat that are likely to result from climate-driven changes to landcover (vegetation), wildfire frequency and intensity, and permafrost thaw, etc. Consider fire impacts from subsistence, historic, and TEK perspectives for holistically modeling fire effects. Prioritize subsistence and rare species based on current assessments (ADF&G wildlife conservation plan). Increase State/Federal cooperation in joint wildlife surveys, monitoring, and data management, especially for species with large home ranges (e.g., WACH WG, KBBPMG). Continue community/guild surveys (breeding bird, Christmas bird count) and available game surveys. Integrate High Latititude Ecological Survey (www.HLEO.org) with citizen reporting network (e.g., CARMA http://www.rangifer.net/carma/).

Policy option or recommendation:

NS 6 Fish & Wildlife Management:(6.2) Coordinate state & federal management to adapt to mitigate climate change effects on species, when feasible.

What research is being done/known?

ADFG and several federal agencies have ongoing population monitoring programs for many species. USGS, NPS, and FWS have implemented WildCast to model landcover and potential habitat change north of the Yukon River. Community harvest surveys that are conducted under ADFG protocols document historic and current consumption trends in many communities.

What are the gaps in research?

Frequency and precision of monitoring is insufficient to accurately estimate population status and trends for some species. Limited data sharing between State and federal agencies remains a constraint. Modeling of climate change impacts to wildlife is just beginning. Community harvest surveys are missing or out-of-date for many communities.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Health & Culture, Economic Activities

Research category/type:

☑ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

ADFG, FWS, NPS, NMFS, WACH WG, KBBPMG

TWG: Natural Systems

5.3.5.2

Develop projections of future changes to potential wildlife habitat that are likely to result from climate-driven changes to landscape, landcover (vegetation), wildfire frequency and intensity, permafrost thaw/thermokarst, and fragmented migratory corridors.

Unique Identifier: 16

☐ Overarching Need

Why is this an issue?

Climate change will have cascading effects on multiple physical, biological, social, and cultural resources. However, the scope and scale of those effects is largely undetermined.

Describe the scope of the research need:

Assess vulnerability of fish and wildlife ecosystems. Complete a vulnerability assessment to identify specific species, habitats, landscapes, ecosystem functions, and cultural resources that may be most sensitive to climate change, in order to prioritize allocation of scarce resources and improve management choice. Prioritize allocation of fish and wildlife management resources to ecosystems at highest risk from landscape changes.

Policy option or recommendation:

NS-6. Prepare for adaptive management of fish and wildlife.

What research is being done/known?

USGS has initiated WildCast research with NPS and FWS for areas north of the Yukon River. The State funded the ANHP to model species at risk 2 years ago, but we have not seen a product. USFWS has extensive experience in assessing risks to rare species.

What are the gaps in research?

Research relative to climate change risks is just beginning for most areas and species.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

Alaska state agencies, UA research centers, EPA, other federal agencies

TWG: Natural Systems

5.3.5.3

Evaluate and improve methods for caribou population enumeration.

Unique Identifier: 22

☐ Overarching Need

Why is this an issue?

Subsistence communities need accurate information to adjust harvest patters to changing wildlife abundance. Some herds are in decline and others may be. The accuracy and timeliness of caribou monitoring programs has been questioned by stakeholders and cooperators.

Describe the scope of the research need:

Evaluate reliability of conducting post-calving photocensus of caribou herds and alternate methods for assessing population abundance. Coordinate more between state and federal partners to incorporate "best methods" for accurate data, when caribou are not grouping for photo census. Evaluate improved census techniques. Use improved DEM data to determine caribou habitat use. Develop protocols for "citizen science" to document arrival, departure of species. Build habitat based models. Couple population data to climate trends, including tundra icing events. An international conference on census, herd composition, and trend methods is warranted to define scope problems and evaluate alternative methods (e.g., mark-recapture for population estimate, sampling effort and statistical power needed for detection of trend).

Policy option or recommendation:

NS 6 Fish & Wildlife Management:(6.1) Revise fish & wildlife management to adapt to effects of climate change.

What research is being done/known?

Periodic photocensus are conducted and caribou herd movement is tracked by GPS and radiocolars.

What are the gaps in research?

Photocensus may miss some groups leading to low estimates. Frequency and accuracy of census techniques may not be sufficient to detect the start of major population drops. Limited data sharing is a long-standing issue among cooperators.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

WACH working group, ADF&G, Canadian provincial agencies, universities, Scandinavians, Russians

TWG: Natural Systems

5.3.5.4

? Assess disjuncts between calendar dates for legal harvest, and actual biological behavior of species. Improve methods for moose population enumeration.

Unique Identifier: 24

☐ Overarching Need

Why is this an issue?

Hunters are concerned that legal harvest dates don't always correspond with available harvest opportunities. Managers are concerned that shifting a hunt into the rut period (when bulls are preoccupied with breeding) can increase hunting success, which could be a problem in low-density populations or those with a low bull:cow ratio.

Describe the scope of the research need:

Evaluate potential effect of allowing moose hunting during the rut on moose productivity. Evaluate tools or methods for wildlife species assessment. Conduct literature review about effects of temperature on rut timing and the potential effect of allowing moose hunting during the rut on productivity of moose. The most common request to date has been to shift moose hunting seasons later in autumn when weather is cooler (change to warmer weather in early September for parts of the Interior was documented by National Weather Service on request of Alaska Department of Fish and Game in 2008). Research on rutting behavior would require long-term observational studies, which would be challenging in boreal forest. Review data or model the potential effect of shifting moose hunting seasons into early October on the disruption of breeding success, particularly in low-density populations typical of many rural areas of Interior. Evaluate reliability of conducting population estimates or age-sex composition surveys for moose in autumn (before antler drop) compared with surveys in late winter.

Policy option or recommendation:

NS-5. Review State regulatory process for wildlife harvest to assure timely adaptation to changing conditions.
NS 6 Fish & Wildlife Management:(6.1) Revise fish & wildlife management to adapt to effects of climate change.

What research is being done/known?

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

ADF&G, USGS, UAF

TWG: Natural Systems

5.3.5.5

Identify how "sentinel" ecosystems are changing.

Unique Identifier: 182

☐ Overarching Need

Why is this an issue?

Continued monitoring in those areas where there are long-term records could provide valuable trend information.

Describe the scope of the research need:

Some operational surveys like ADFG small mesh survey in Kachemak Bay, have lost their operational need but provide an excellent indicator of ecosystem change.

Policy option or recommendation:

NS-6. Prepare for adaptive management of fish and wildlife.

What research is being done/known?

Long-term records of environmental and resource change exist for several areas, but some have been discontinued because their original purpose ended.

What are the gaps in research?

ADFG should review their data to see which data can be used to show ecosystem change and continue them for that purpose.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

ADFG

TWG: Natural Systems 5.3.6.1

Research and monitor forest response after disturbance. Research ecological tipping points.

Unique Identifier: 8

☐ Overarching Need

Why is this an issue?

Trees are moving into higher altitudes and higher latitudes as climate warms. Many common species are experiencing severe and recurring pest outbreaks (e.g., bark beetles, budworms, leaf miners) related to climate change (increased temperatures and transpiration, reduced soil moisture). Fire effects are increasing as flammable shrubs and trees expand into tundra, and as fire frequency increases in boreal forests. However, the full scope and trends has not been determined.

Describe the scope of the research need:

Document changes in treeline (fire risk/policy, wildlife habitat) and supply of commercial timber, and merge with fire history and insect outbreak data, especially in areas experiencing the most rapid change. Determine effects of changes in moisture and temperature on growth and survival of forest vegetation species important for commercial and subsistence uses, including response of vegetation after disturbance. Convene working group of scientists and managers to identify key forest vegetation species (fiber and food) and determine status of info needed to predict "tipping points" of rapid change/mortality (e.g., growth rings in spruce and birch approaching zero increment); Research and monitor response of vegetation after disturbance (e.g., fire, insect, disease, logging) For identified info needs, begin experimentation trials or monitoring protocols. Improve understanding of effects of climate change on forest ecosystems; prepare to capitalize on appropriate harvest opportunities.

Policy option or recommendation:

NS-2. Review and modify Alaska's wildland fire policy and programs.
NS-3. Manage climate change impacts on watersheds and in-stream flows.
NS-4. Reduce introduction and spread of invasive species in the context of climate change.
NS-5. Review State regulatory process for wildlife harvest to assure timely adaptation to changing conditions.
NS-6. Prepare for adaptive management of fish and wildlife.
NS-7. Develop capacity in new forestry and wood biomass opportunities.

What research is being done/known?

LANDFIRE classification of 2001 LANDSAT TM data is being completed now, update with finer resolution and ground-truthing of key communities is desirable (e.g., loss of alpine or low tundra). FS and UAF scientists have documented treeline change and pest outbreaks in many locations across the state.

What are the gaps in research?

Document changes in treeline (fire risk/policy, wildlife habitat) and supply of commercial timber (merge with fire history and insect outbreak mapping for age class); Provide focus on areas of most rapid change. Datasets should be merged, analyzed, and mapped in geographic information systems to show recent changes and indicate future trends.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

USFS, DNR Division of Forestry, USGS, National Park Service (Inventory and Monitoring Program)

TWG: Natural Systems

5.3.6.2

Assess efficacy, economics, and ecological effects of salvage logging to producing timber and wood biomass fuels from fire- and insect-killed trees.

Unique Identifier: 49

☐ Overarching Need

Why is this an issue?

Climate change related warming and drying is likely to result in more insect and fire-kiled timber and biomass.

Describe the scope of the research need:

Assess effectiveness, economics, and ecological effects of harvesting small diameter timber (insect- or fire-damaged). Research available types of harvesting equipment for small diameter timber and biomass to facilitate acceptance and use by local commercial contractors. Determine ecological effects of salvage logging (e.g., biomass, nutrient, and habitat removal, effects to soil, permafrost, invasive species). Identify practices that will help to ensure that salvage logging activities and replanting do not introduce invasive species.

Policy option or recommendation:

NS-7. Develop capacity in new forestry and wood biomass opportunities.

What research is being done/known?

A wide range of equipment and techniques have been developed for use in harvesting larger-diameter timber. Effects on soil fertility and erosion, wildlife and stream habitat from leaving or removing woody material following fires are generally well understood.

What are the gaps in research?

Technology transfer. Equipment and techniques need to be tested and adapted for use in Alaska and with smaller material. Effects of salvage harvests in subarctic environments may be less well understood.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

FS, DNR DOF, UAF

TWG: Natural Systems 5.3.6.3

Test various wood burning appliances and their air quality emissions in an arctic environment.

Unique Identifier: 185

☐ Overarching Need

Why is this an issue?

Increased use of wood and woody biomass as a "carbon neutral" heating fuel has potential to affect local air quality and resident health.

Describe the scope of the research need:

Test popular and experimental wood stove devices to rate their efficiency and determine effects on air quality under typical Alaska winter conditions.

Policy option or recommendation:

NS-7. Develop capacity in new forestry and wood biomass opportunities.

What research is being done/known?

Many wood and pellet stoves have been studied to determine air quality emissions, possibly under optimal fuel and burning conditions. The Cold Climate Housing Research Center (CCHRC) has tested high efficiency wood burning appliances in Fairbanks.

What are the gaps in research?

Testing needs to be completed with typical Alaska fuel wood sources and under Alaska air quality conditions.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Health and Culture

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

CCHRC

TWG: Natural Systems

5.3.6.4

Research net contributions of Alaska's natural areas to GHG release and sequestration.

Unique Identifier: 55

☐ Overarching Need

Why is this an issue?

Recent climate change is largely driven by greenhouse gas (GHG) levels. The effectiveness of cap and trade measures will also be affected by natural carbon sequestration and emissions. Understanding the relative contribution of sources of GHG compared to other human and natural sources is essential. Accurate modeling is critical for effective mitigation of atmospheric greenhouse gas emissions. Carbon emissions cap and trade systems are now being implemented to reduce global emissions of greenhouse gases. These systems are based on models of gas emissions and gas sinks. Current models cannot accurately determine whether Alaska's wild lands will sequester more carbon in vegetation than they release through wildland fires, oxidation of thawed organic permafrost, methane hydrates, etc.

Describe the scope of the research need:

Estimate and research net contribution to greenhouse gases (+ or -) to determine where Alaska lands and waters function as carbon sinks (e.g., forests) or sources (e.g., permafrost thaw, wildfire), as this is likely to become a national priority for mitigating and trading carbon emissions. Research the relative effects of forests, fire, and permafrost thaw on greenhouse gas emissions (e.g. CO2, methane) to inform policy decisions about sequestration options and wildland fire response in tundra and boreal forest environments. Develop protocols for certifying carbon storage and sequestration rates for boreal and coastal forests. The concept that wood fuels are carbon neutral should be thoroughly examined. This is a complex topic that involves carbon budgets and cycles in a dynamic environment.

Policy option or recommendation:

What research is being done/known?

Considerable research and modeling is underway at many levels. NSF funded researchers are also monitoring carbon flux on North Slope soils. Fire simulation modeling by D. Bachelet, et al. (2005) suggests that carbon emissions from forest fires will exceed carbon storage by the end of this century.

What are the gaps in research?

Models need to incorporate new and emerging information on emissions from permafrost, fires, methane hydrates, etc. Relative contributions of Alaska's natural areas are largely hypothetical, for lack of hard data on flux rates. Further research on burn intensity mapping and quantification of emissions from recent fires should be completed. Studies should look at both the long- and short-term emissions from fire and changes in the emission dynamics of permafrost response in boreal forest and tundra. Research on the relative contribution of GHG emissions from ecosystems that are independent of fire is also needed to put fire release of GHGs in context (e.g., release of methane CH4 from melting permafrost; it has >20 times the effect on climate warming than release of CO2).

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

UAF, NSF, USGS, NASA ACCAP, AFS, JFSP, FS,

TWG: Natural Systems

5.3.7.1

Agricultural products research. Research new agricultural product opportunities, technologies and best practices in order to prepare to capitalize on opportunities to expand sustainable agriculture in Alaska

Unique Identifier: 43

☐ Overarching Need

Why is this an issue?

Climate change may provide new opportunities in sustainable agriculture, that may be of increased importance to food security as access to other food sources change (e.g., due to loss of fish and wildlife harvest opportunities, or increased costs for shipped foods.)

Describe the scope of the research need:

Research and develop new agricultural products, technologies, and best practices to adapt effectively to changing climatic conditions, including agricultural opportunities for small and remote communities. Assess crops having potential for production locally. Assess soils for sustainability for agriculture. Test locally-produced natural products as soil supplements and agricultural fertilizer (e.g., fish waste, compost). Model frost and growing season. Research barriers to community gardening. Assess potential for inadvertent introduction and spread of invasive agricultural species, weeds, and pests.

Policy option or recommendation:

NS 1 Agriculture: Support and expand sustainable agriculture in Alaska at the local level
Implementation by: UAF, USDA, DNR DOA
NS-8. Support local sustainable agriculture in Alaska.

What research is being done/known?

undetermined

What are the gaps in research?

undetermined

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

DNR, USDA, UAF Cooperative Extension Service

TWG: Natural Systems 5.3.8.1

Assess effects of climate on access for hunting, fishing and other subsistence activities.

Unique Identifier: 17

☐ Overarching Need

Why is this an issue?

Forecasting is important to enhance safety of travel in road-less areas. Changes in freeze-up timing and conditions continue to affect subsistence harvest opportunities and uses through inaccessibility and/or increased access hazards. Low river water may preclude access. Changes in safe access may require consideration of alternative access means, changes in season timing, or other adaptation. Access by traditional means may also cause resource damage when conditions change (e.g. ORVs or snow machines on wet thawed ground).

Describe the scope of the research need:

Assess effects of temperature and rainfall patterns on river level for motor-boat access in autumn and the effect of temperature patterns on ice formation for winter travel on both freshwater ice and sea ice. Forecast sea-ice, river-ice and river flow levels relevant to hunter access. Improve forecasting of river level and sea- or river-ice conditions that affect hunter access. The travel relationships are complex, encompassing both natural sciences (climate, hydrology) and human behavior.

Policy option or recommendation:

NS-5. Review State regulatory process for wildlife harvest to assure timely adaptation to changing conditions.
NS 6 Fish & Wildlife Management:(6.1) Revise fish & wildlife management to adapt to effects of climate change.

What research is being done/known?

What are the gaps in research?

For ice travel & access - Request that NOAA in partnership with ADOT&PF develop the capability for improved, higher temporal and spatial resolution sea and river ice forecasts to enhance safety of winter travel in roadless areas (especially relevant to hunter safety.) For river travel & access - Review patterns of rainfall and trends in permafrost melt in river gauge levels in selected areas of the state to understand which indicators may be useful in predicting hunter access. Concurrent interviews with hunters in study sites to correlate firsthand observations in river travel difficulty would be instructive in understanding what proportion of a study areas has access restricted by low water levels for specific types of motor boats.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☑ Monitoring

Parties involved in implementation:

State, FSP, UAF, ACCAP, land management agencies
NOAA,ADOT&PF,USFWS,ADF&G,USGS,University

TWG: Natural Systems

5.3.8.2

Update the Environmental Atlas of Alaska and Alaska Engineering Design Information System (AEDIS)

Unique Identifier: 188

☐ Overarching Need

Why is this an issue?

Engineers are sometimes using out of date environmental information in designing new facilities in Alaska.

Describe the scope of the research need:

Update and republish the Environmental Atlas with current data, trends and projections of climate change effects.

Policy option or recommendation:

What research is being done/known?

The Environmental Atlas of Alaska was published in 1978 and remains a standard desk reference for engineers.

What are the gaps in research?

Data has been updated in electronic format, but engineers are apparently reluctant to depend on unpublished data, out of liability concerns.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Transportation and Land Use
Public Infrastructure

Research category/type:

☐ Modeling ☑ Products ☐ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

CCREL, ADT

TWG: Public Infrastructure

5.4.1.1

Collect climate data and develop methodologies and capacity to enhance and increase the resolution of climate forecasting models.

Unique Identifier: 68

☑ Overarching Need

Why is this an issue?

Downscaled climate forecasts are needed so that Federal, state, and community planners & decision makers can establish:
1) time horizons within which they will need to address infrastructure fortification or relocation;
2) locations and designs of new infrastructure that accommodate these conditions; and
3) location-specific conditions that new infrastructure must be designed to accommodate.

Describe the scope of the research need:

State scientists, engineers, & decision-makers need to collaboratively update inputs to, revise climatic models as needed, and use models to produce a time sequence of forecasts of expected conditions due to climate change.

Policy option or recommendation:

- Develop an adaptive climate change model for public infrastructure that supports development of strategies and approaches to identify short and long-term sustainable solutions to a changing climate.
- Develop and implement sustainable solutions to adapt public infrastructure that is currently at significant risk, and future infrastructure, to the effects of climate change.

What research is being done/known?

The University of Alaska has created and invested in the Scenarios Network for Alaska Planning (SNAP) program.

What are the gaps in research?

Alaska's climate data collection, management, analysis, and monitoring, infrastructure is sparse and inadequate to effectively meet this research need.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

University of Alaska (SNAP), ADOT&PF, ADF&G, ADNR, ADCCED, ADEC, DOI, FWS, FS, BLM, NOAA, NWS, AOOS,

TWG: Public Infrastructure

5.4.1.2

The State needs to develop and deploy effective mechanism(s) to increase the availability and maximize the exchange of authoritative, defensible, and timely information to support analysis and decision-making on issues of climate change adaptation & mitigation, sustainability, and resiliency.

Unique Identifier: 146

☑ Overarching Need

Why is this an issue?

Climate analysis information delivery and availability is decentralized and uncoordinated, creating inefficiency, duplication of effort, wasted money, and difficulty in locating information of consistent and acceptable quality for a variety of purposes.

Describe the scope of the research need:

Mechanisms to increase information availability and collaboration must maximize the diversity of information suppliers and users - including public and private agencies, rural and urban citizens, scientists, engineers, planners, and decision-makers. Investment in an information clearinghouse requires increased commitment to continuous maintenance of a dynamic, integrated, information exchange mechanism that seamlessly supports information suppliers and users. Key services include:

- Knowledge management (archiving, updating, synthesizing)
- Interactivity (user-customized information delivery)
- Rapid data updates

Policy option or recommendation:

The state should collaboratively develop, establish, and effectively maintain an integrated, interactive information clearinghouse for policy, science, engineering standards, public discourse, and data pertaining to sustainable development and resiliency in Alaska.

What research is being done/known?

The University of Alaska has created the Alaska Center for Climate Assessment & Policy (ACAP), developed a "Resilience and Adaptation interdisciplinary Ph.D. program, and invested in the Scenarios Network for Alaska Planning (SNAP) program. The Alaska Department of Transportation & Public Facilities and the U.S. Army Corps of Engineers Cold Regions Research & Engineering Laboratory (CRREL) has invested in the Alaska Engineering Design Information System (AEDIS). The University of Alaska has Developed the Geographic Information Network of Alaska (GINA).
Web 2.0 social networking tools, "Wikis", and GIS data conversion tools offer promising models.

What are the gaps in research?

Legal defensibility, data analysis conversion algorithms, and development of tools for management of distributed database elements are areas that need additional investment in research and development in Alaska.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☐ Monitoring

Parties involved in implementation:

University of Alaska, ADOT&PF, ADEC, ADNR, ADCCED, DOI, ADFG, Alaska Department of Law, Alaska Legislature, DOI, DOD, CRREL, and other government, private, and industry organizations.

TWG: Public Infrastructure 5.4.1.3

The state needs to develop a mechanism to systematically identify, collect, and analyze the data that it needs to economically plan, develop, and manage its public infrastructure in a sustainable manner.

Unique Identifier: 145

☑ Overarching Need

Why is this an issue?

The state's current project-based focus on infrastructure development discourages investment in the systematic collection and evaluation of long-term post-construction performance data after construction. Infrastructure performance monitoring and modeling is necessary to effectively evaluate if and how infrastructure might be developed more sustainably in Alaska.

Describe the scope of the research need:

Research is needed to:
- Identify barriers to scenario-based planning,
- Optimize investment in visualization tools for public involvement and planning,
- Determine which data and parameters are critical for increasing sustainability of infrastructure,
- Identify the best and most economical sources of data?
- Optimize investment in climate forecasting and modeling.
- Develop probabilistic models, planning, and design tools useful for planners, engineers, and decision-makers.
- Economically manage risk.

Policy option or recommendation:

The state should develop a strategic plan for data collection specifically to support planning, design, construction of sustainable public infrastructure. The strategic plan for data collection should directly support the State's comprehensive, integrated, and interagency asset management policy to guide public infrastructure planning and investment in Alaska.

What research is being done/known?

Implementable research on sustainable asset management is available from the Transportation Research Board of the National Academies. Other states have adopted best management practices that Alaska should emulate.

What are the gaps in research?

Those involved in the planning, financing, design, construction, and maintenance of public infrastructure in Alaska are not benefitting from knowledge that could be gained by systematic investment in collecting infrastructure performance data.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

ADOT&PF, CRREL, University of Alaska, Governor's Office of Management & Budget, Alaska Legislature

TWG: Public Infrastructure

5.4.2.1

Analyze, develop, and update existing engineering and building codes and construction techniques for new infrastructure and structures in vulnerable areas.

Unique Identifier: 120

☐ Overarching Need

Why is this an issue?

Current designs likely do not incorporate the real risks and variability associated with climate change in Alaska. Consequently infrastructure may fail prematurely or require unnecessary expense to build and maintain, resulting in uneconomical and unacceptable risks to Alaskan communities.

Describe the scope of the research need:

It is likely that building, electrical, mechanical, materials, and sanitation design codes will need further research and testing to include new data collection, analysis, and modeling. All of this will require long-term investment and potentially the creation of new programs.

Policy option or recommendation:

The State of Alaska should adopt a statewide public infrastructure risk management policy.

What research is being done/known?

The University of Alaska has created the Alaska Center for Climate Assessment & Policy (ACAP) and invested in the Scenarios Network for Alaska Planning (SNAP) program. The Alaska Department of Transportation & Public Facilities and the U.S. Army Corps of Engineers Cold Regions Research & Engineering Laboratory (CRREL) has invested in the Alaska Engineering Design Information System (AEDIS). The University of Alaska has Developed the Geographic Information Network of Alaska (GINA).

What are the gaps in research?

Many existing infrastructure planning and engineering criteria, codes, and standards were developed with data that does not include the effects of climate change, especially in Alaska. Additionally, many of these techniques are based on deterministic methods that have limited ability to capture the effects of recent changes and variability of climate change.

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand
Transportation & Land Use

Research category/type:

☑ Modeling ☑ Products ☑ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

Department of Transportation & Public Facilities, University of Alaska, Department of Commerce, Community & Economic Development, Local and Municipal Governments, Industry professional organizations. Alaska Legislature

TWG: Public Infrastructure

5.4.2.2

Establish an integrated baseline inventory on the location and condition of public infrastructure. Collect, assess and monitor data needed to develop sustainable solutions to adapt public infrastructure to the effects of a changing climate.

Unique Identifier: 67

☐ Overarching Need

Why is this an issue?

A complete inventory of public infrastructure (that is either now, or likely to be, at risk from the effects & hazards due to climate change) is needed in order to systematically identify public infrastructure vulnerability. Data that does exist is owned by several agencies and not effectively integrated and shared amongst. Inefficient duplication of effort is likely given the functionally separate organization and operations of State agencies.

Describe the scope of the research need:

The State needs to create an integrated inventory and document the condition of public infrastructure at risk due to the current and projected effects of climate change.

Policy option or recommendation:

The State should adopt a comprehensive, integrated, and interagency asset management policy to guide public infrastructure planning and investment in Alaska.

What research is being done/known?

1.ISER developed a preliminary and limited database of existing public infrastructure and projected the added cost (above normal wear and tear) from the effects of climate change on infrastructure at risk. See Larson, P.H., et al. (2008).
2. ADCCED's Division of Community and Regional Affairs (DCRA) maintains an online community databases that provide general information on community location, population, taxes, climate, history, culture, demographics, utilities, schools, health care, economy, transportation, contacts and capital projects and grants. Most of the public infrastructure is listed under the "Facilities, Utilities, and Services" data type. However, this information is limited and dated.

What are the gaps in research?

Existing State community and infrastructure databases are not comprehensive or contain insufficient information for asset management purposes. For example, the DCRA database does not provide information on the physical and environmental conditions (permafrost, river and coastal shorelines, etc.) that exist where the existing public infrastructure is located. Instead of maintaining a comprehensive database, ADOT&PF's archives data on individual transportation projects as they are built and does not regularly conduct condition monitoring. DCRA's Alaska Capital Projects Database was originally the "Rural Alaska Project Information Delivery System" (RAPIDS), which tracks capital funding for projects in rural Alaska. RAPIDS provided a place for agencies to list ongoing projects and collaborate with other agencies on project timing. In January of 2006, RAPIDS was changed to Alaska Capital Projects Database because the system is no longer exclusively for rural Alaska. The link to these databases: http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand
Transportation & Land Use

Research category/type:

☐ Modeling ☐ Products ☐ Education/Outreach ☑ Data Management ☑ Monitoring

Parties involved in implementation:

ADCCED, ADEC, ADOT&PF, NOAA, University of Alaska, Alaska Legislature,

TWG: Public Infrastructure

5.4.2.3

Identify, analyze, and use national and international research results and products as a basis for developing solutions and expanding best management practices in AK.

Unique Identifier: 141

☐ Overarching Need

Why is this an issue?

Employees of Alaska State agencies are not consistently clear about the role their agencies play in developing and supporting sustainable and resilient infrastructure. Performance measures of state agencies do not consistently recognize a systems approach and the value of sustainability and resiliency for state investments. State leaders have a tendency to manage public infrastructure funding decisions as expenses rather than investments.

Describe the scope of the research need:

State agency leaders and managers must make sustainability and resiliency an effective priority and develop guiding coalitions to create a supportive culture in their organizations.

Policy option or recommendation:

- Require that state agencies involved in infrastructure planning, development, delivery, operation, and maintenance include explicit support for the development sustainable and resilient infrastructure in their vision & mission statements and strategic plans.
- Identify and remove institutional barriers to innovation and collaboration.

What research is being done/known?

The Transportation Research Board has created many research products and guides to assist Transportation Departments.

What are the gaps in research?

If this is a Cross-Cutting issue, what other topics (TWGs) does it apply to?

Energy Supply and Demand
Transportation & Land Use

Research category/type:

☐ Modeling ☑ Products ☑ Education/Outreach ☐ Data Management ☐ Monitoring

Parties involved in implementation:

ADOT&PF, ADEC, ADFG, ADCCED, Alaska Department of Law, Governor, Alaska Legislature

Appendix B

Letter to Governor's Sub-Cabinet on Climate Change

December 3, 2008

To: Governor's Sub-Cabinet on Climate Change
From: The Interagency Hydrology Committee for Alaska
Subject: Hydrology Needs for Alaska

The Interagency Hydrology Committee for Alaska (IHCA) is an organization of technical specialists working for Federal, State, borough, and local governments and Federally recognized tribes, who coordinate the collection and interpretation of data related to water resources and climate throughout the State of Alaska.

As you are well aware, climate change, particularly current warming trends in the high latitudes, is leading to changes in Alaska's freshwater, estuarine, and marine environments. One of the best measures of the rate and magnitude of change, and perhaps the most impacted natural resource in terms of both timing and quantity changes, is in fact water volume and associated characteristics. For example, rivers and lakes freeze over later in the year and become ice-free earlier in the year, permafrost is thawing, and precipitation patterns are changing. Agencies and communities in Alaska have become increasingly aware of the emerging and potential effects of climate change. However, the authorities charged with protecting the public safety and managing natural resources in the best public interest require appropriate information and tools to take specific actions in response to and preparation for changing environments.

IHCA has developed the following list of topics that are especially important to detecting, quantifying, and adapting to climate-driven change and recommend that research and monitoring in support of state and local needs be encouraged and supported with the highest priority:

- Extent of permafrost and the effects of changing permafrost on subsurface hydrology, aquifer yield, and lake draining or formation;
- Baseline flow and water volume conditions of rivers and lakes versus changing spatial and temporal hydrologic patterns, such as changes in seasonality, flood magnitude, and drought severity;
- The spatial and seasonal distribution, timing, intensity, and state of precipitation;
- Freeze-up, break-up, ice thickness, and ice jams on lakes and rivers;
- Extent of glacier mass changes, the contribution of glacier melt to streamflow, and frequency of outburst floods;
- Geologic and geotechnical trends related to active layer detachments, mass wasting, and sloughing;
- Avalanche timing, prevalence, and trends;
- Socio-economic cost to address changing conditions of water availability and quality;
- Erosion and sediment transport effects resulting from changes in runoff patterns;
- Short and long term planning for water supply, demand, and support infrastructure to mitigate emerging and anticipated environmental change.

IHCA will be happy to provide additional details, including specific agency projects and outstanding needs that will benefit from the hydroclimatic research listed here. We are also happy to provide technical support to your group upon request.

Sincerely,

Steven A. Frenzel
Chair, Interagency Hydrology Committee for Alaska

16.

Press Releases

Melting ice could mean new riches

Jill Burke
Mar 1, 2010

"It's not a question of if but when."

That's what Mead Treadwell, chairman of the U.S. Arctic Research Commission, told a New York City crowd Monday about the prospect of a booming northwest passage.

Treadwell made the remarks during a moderated panel discussion, "Will the Bering Strait become the Panama Canal of the North?" hosted by the Council on Foreign Relations at Alaska House New York. (Alaska House is a nonprofit organization founded by Alaska Dispatch publisher Alice Rogoff to promote education about Alaska and its Native culture and foster economic development within the state.)

The day's discussion, which pulled together Alaska's congressional delegates, regional leaders and industry representatives, centered on the sense of urgency seemingly missing both in the state and nationwide for developing the infrastructure -- like deep water ports and international rules -- that will be needed to tap into a new hustling, bustling Bering Strait.

Two of the world's largest mining operations are above the Arctic Circle, including the Red Dog zinc mine in Alaska off the coast of Kivalina, according to Treadwell -- and the Arctic is poised to deliver even more resources. Minerals, fishing, oil and gas, exploration and science, and tourism all have northern footholds. Capturing opportunities related to those activities with the prospect of shorter shipping routes as ice recedes is something Americans need to be thinking about now, Treadwell said.

The challenge is building the infrastructure. Deep water ports are needed to accommodate large container ships and provide an anchor for the military presence that will need to increase to keep pace with a rise in offshore activity near the United States' northern coast.

Participants, including Rogoff, suggested that developing port infrastructure for Alaska's western coast, from Adak to Barrow, could be an economic boom as important to the state as the trans-Alaska oil pipeline, particularly when even a handful of new port jobs has the potential to pull villages teetering on the brink of economic failure into sustainability.

Alaska Sens. Lisa Murkowski, a Republican, and Mark Begich, a Democrat, attended the event and told participants they are aware of the critical role Alaska is poised to play in a changing Arctic environment. Murkowski is pushing for a Department of Defense and Homeland Security feasibility study for a deep water port off Alaska's shores.

"This study will determine whether it is in the strategic interest of the United States, as I believe it is, to build a port and where it might be located. A deep water port would not only serve our military and Coast Guard needs, but as we develop our offshore oil and gas reserves and see more shipping, tourism and vessel traffic in the Arctic, a deep water port could provide valuable support," Murkowski said.

A full transcript of the day's discussion will be posted online at the Council on Foreign Relations' Web site.

Contact Jill Burke at jill@alaskadispatch.com

Keyword Search Go

United States Senator Lisa Murkowski

Monday March 01 2010

Murkowski Speaks at Arctic Policy Roundtable at New York Council on Foreign Relations

NEW YORK - U.S. Sen. Lisa Murkowski, R-Alaska, helped lead a discussion on U.S. Arctic policy at a roundtable forum today at the Council on Foreign Relations in New York City. Also participating in the discussion was U.S. Sen. Mark Begich, D-Alaska, a number of Arctic policy experts and several Alaskans, including Mayor Edward Itta of the North Slope Borough. Following is a text of Sen. Murkowski's remarks as prepared for delivery:

"Good afternoon. It is my distinct pleasure to be back at the Council on Foreign Relations today to discuss one of my favorite subjects, the Arctic. As all of us in this room are aware, the United States is an Arctic nation because of Alaska. But, what does it mean to be an Arctic nation? I believe that the Federal Government is just waking up to this reality and we are frantically trying to define exactly what that distinction means. In my view, being an Arctic nation means that the United States has certain obligations and responsibilities in the region to the land, the water and the people. And we all need to help our nation understand what those are.

"The pace of change in the Arctic demands that greater attention be focused on the region. The implications of the dynamic changing Arctic for the residents and important U.S. security, economic, environmental, and political interests, depend on it.

"One of those responsibilities I spoke of is to have the necessary infrastructure in the region. I recently introduced legislation that directs the Department of Defense and the Department of Homeland Security to study the feasibility, location and resource needs for an Arctic deep water port. This study will determine whether it is in the strategic interest of the United States, as I believe it is, to build a port and where it might be located. A deep water port would not only serve our military and Coast Guard needs, but as we develop our offshore oil and gas reserves and see more shipping, tourism and vessel traffic in the Arctic, a deep water port could provide valuable support. I will insure that the Navy and Coast Guard actively consult with the communities and leaders of the region, as well as the State of Alaska.

"As we all are keenly aware, while the Arctic is becoming more and more ice free in the summer months, Arctic ice is not going to completely disappear. One of the major challenges that we face is our aging ice breaker fleet. I was able to get an appropriation to refurbish the Polar Star last year, and the Coast Guard has embarked on a study to determine whether we need to rebuild or replace our aging polar class vessels, but no matter the result of the study, we must have the commitment of the Administration and Congress that ice breakers are a national priority. And I will do all I can to advocate that position.

"Finally, I support a strong, bipartisan effort to ratify the United Nations Convention on the Law of the Sea. The United States is the only [illegible] treaty and we must act to [illegible] the U.S. to lead and to [illegible] strategic support [illegible]

Administration. As the only Arctic nation not a party to the treaty, failure to ratify continues to keep the United States at a disadvantage internationally and outside the process, without a seat at the table.

"Even though we are not a party to the Treaty, the United States is making progress on mapping our extended continental shelf. The results of Coast Guard ice breaker HEALY's hydrographic missions in the Arctic have been remarkable and I have supported this initiative with appropriations and legislation to authorize more funding. I was gratified to see the cooperation in the Beaufort between with the HEALY and the Canadian icebreaker the Louie St. Laurent. This is yet one example of international cooperation in the Arctic.

"While I was pleased that the United States released its long awaited Arctic Regional Policy in early 2009, implementation is still lagging. It may be necessary for Congress to step in and help move the process. While certain branches of the government, like the Navy and Coast Guard, are developing and implementing their portions of the policy, it is still not nearly to the degree I would like. Certainly other Arctic and non-Arctic nations are moving much more quickly to develop policies and support them, than we are.

"I believe we are at a very critical time in the Arctic. As many of us have identified, there are two paths we can go down in regards to international relations -- one is a path of competition and conflict, and the other is one of cooperation and diplomacy. This decision, and the direction it takes, will require vision and dynamic leadership, both at home and abroad. I believe the United States, as one of the most powerful Arctic nations, must step up and provide it.

"A changing Arctic brings risks and challenges to the environment and indigenous people of the region. But it also brings opportunity and awareness, and if we can work to identify and minimize the risks, and use the opportunities to better the lives of the people of the Arctic region, we can all prosper.

"Thank you and I look forward to a lively conversation this afternoon."

# # #

BOOKMARK PRINTER FRIENDLY

BROWSE BY: March 2010 GO

03/25/10 -
Murkowski Opposes Health Care Reconciliation Bill

03/24/10 -
Murkowski Meets with Coast Guard Commandant Nominee

03/24/10 -
Murkowski, Johnson Introduce Bill to Address and Reduce Fetal Alcohol Disorders

The Arctic Sounder

Published on March 18th, 2010

Opinion: Visit to New York, D.C. gets Arctic message across

By EDWARD ITTA

We Inupiaq like to say that the Arctic Ocean is our garden. It feeds us with its bounty of whales, seals, walrus, ugruk, fish and other subsistence foods. Our harvest is better in some years than in others. Weather, ice and ocean currents all affect the amount of "crops" we are able to feed to our families from year to year.

These are times of change for the ocean. Offshore oil and gas exploration is gearing up. We have seen plenty of evidence that climate change may cause dramatic shifts in the polar ice cap and in our weather. Receding ice could open up new shipping routes between Europe and Asia. We may see increased ocean traffic from commercial fishing boats and tourist ships.

What can we do about it? As mayor, I believe the borough should be engaged in the planning, monitoring, research and mitigation efforts that are being crafted right now as government agencies at all levels respond with a new sense of urgency to challenges and opportunities in the Arctic Ocean. That's why I spent the past week in New York and Washington, D.C. I joined Senators Begich and Murkowski in New York and the three of us made presentations on adapting to climate change in the Arctic to a group of policymakers, business people, scientists and journalists, who then participated in a roundtable discussion.

Policymakers are eager to hear our views, because they recognize that we have the most intimate knowledge of the Arctic and the most to lose if the ocean is not adequately protected. My message to them was that we don't want offshore development, but if it is going to happen, we insist on participating in decisions that will govern offshore activities and precautions. I showed them the Arctic policy principles adopted by ICC in 1984 as an example of longstanding Inuit leadership on protecting the polar region.

In Washington, I met with several of the highest officials in the Interior Department, including Interior Secretary Ken Salazar; his assistant secretary for Land and Minerals Management, Wilma Lewis; Liz Burnbaum, director of the Minerals Management Service (MMS); and Bob Abbey, director for BLM. I stressed that if the government is going to allow OCS activity, then it should set the bar very high when it comes to clean and cautious operations in the water.

I said that the shutdown requirement MMS wrote into Shell's Camden Bay permit is a good step in the right direction, since it gives that requirement the force of law for the first time. I argued for larger deferral areas around traditional Barter Island and Cross Island whaling areas, a moratorium on leasing new acreage, zero discharge of drilling wastes, a cumulative impacts analysis, and the need for better baseline science.

I invited Secretary Salazar to visit the North Slope this summer so he can get a first-hand look at some of the places that mean so much to our people. He agreed to pay us a visit in August.

At NOAA, I talked with two key officials about their efforts in preparing a new Environmental Impact Statement concerning the effects of oil and gas activities in the Arctic Ocean. Rather than the annual Incidental Harassment Authorizations (IHA) that are now issued, they are looking at doing five-year Incidental Take Authorizations. They believe it will build certainty and flexibility into their mitigation requirements, and I can see their point. I told them that we need more monitoring and study of the effects of noise on migrating whales. I discussed the Obama administration's new planning initiative for oceans and coastal areas with the head of the President's Council on Environmental Quality (CEQ). CEQ is spearheading the president's effort to deal with climate change. How this new ocean planning program will work is still something of a mystery, but it has a high priority in the administration. I focused on the need to be sensitive about traditional uses of the coastal and ocean areas and to make sure our voices are heard as these large-scale management programs are designed.

At the U.S. Fish and Wildlife Service, we discussed the ongoing management plan for Steller's eiders. I pointed out that our people are conservationists by nature and that education efforts about threatened species can be much more effective than hardball enforcement tactics. I thanked them for establishing a liaison position in Barrow (now held by Emma Huntsman) and said I look forward to better communication between the community and the agency.

Although I spent time with Senators Murkowski and Begich in New York, I was able to meet with each of them again in D.C. I also met with Congressman Young. In each case, I went over a range of issues that we can work on together, and I thanked them for legislation they sponsored in response to my eight-point OCS policy position.

All in all, it was a very productive week. If our voice is going to be heard in the halls of political power, it will be because we take our message to the decision makers and state our point clearly and forcefully. My staff and I will continue to engage with the agencies that shape the regulatory framework for North Slope activities of all kinds. In these challenging times,

these changing times, I want to make sure they can't forget our concerns as they plan the future in offices that are thousands of miles from the Arctic.

Edward Itta is mayor of the North Slope Borough.

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Minutes, Dec. 2, 2010, Barrow, Alaska

<TARGET><BILL></BILL><SUBJECT>Minutes, December 2, 2010, Barrow, Alaska</SUBJECT><COMM>ANW27</COMM></TARGET>

Commander
Seventeenth Coast Guard District
Juneau, Alaska 99802-5517

24 September 2010

Dear Representative Joule,

Thank you for extending the invitation for me to participate in the Northern Waters Task Force. As you indicated, the Coast Guard can only serve in a limited capacity to the Task Force as a liaison and will not participate in the deliberative process, express an viewpoint, or provide an endorsement on the appropriateness of any course of action, recommendation, or position developed by the Task Force. Acknowledging this limited role in which I have been requested to serve, I am accepting your invitation to participate on behalf of the Coast Guard and the Seventeenth Coast Guard District.

I look forward to attending the initial Task Force meeting on Friday, October 1.

Sincerely,

CHRISTOPHER C. COLVIN
Rear Admiral, U. S. Coast Guard

Rep. Reggie Joule
House District 40
Alaska State Capitol
Juneau, Alaska 99801-1182

During Session:
Alaska State Capitol
Juneau, Alaska 99801-1182
(907) 465-4833
Fax (907) 465-4586
1-800-782-4833
Representative_Reggie_Joule@legis.state.ak.us

During Interim:
P.O. Box 673
Kotzebue, Alaska 99752
(907) 442-3880
Fax (907) 442-3022

Alaska State Legislature
REPRESENTATIVE REGGIE JOULE

October 26, 2010

Ms. Nancy H. Sutley
Mr. John P. Holdren
Co-Chairs, National Ocean Council
Washington, DC 20503

RE: Nominations to the National Ocean Council's Governance Coordinating Committee (GCC)

Dear Ms. Sutley and Mr. Holdren,

I serve as Chair of the Alaska Northern Waters Task Force (NWTF). The Task Force was created last spring with the support of the Alaska Bush Caucus which is comprised of all rural legislators within the Alaska State Legislature. The NWTF met for the first time on Oct. 1, 2010. (For more information about the task force, please see: http://housemajority.org/coms/index.php?c=104). All 11 members of the Task Force live on or near a coastline and are impacted by changes in the ocean and along the coast. The duties of the task force as outlined in the enabling legislation are as follows:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;
(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;
(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and
(4) conduct hearings in the Northern region of the state to fulfill its purpose;

The task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration. As you can see from the

information provided, we share similar goals.

The NWTF is itself an Alaskan ocean policy body and the task force would like to either have a member of the task force on the GCC or have input on who is nominated to the GCC from Alaska. We realize the nomination deadline for the Governor's nominations was Oct. 8, but are hoping the NOC would still consider nominations from the task force by November 15, 2010.

Thank you very much for your time and for your consideration of our requests regarding the GCC. We look forward to working with the NOC and the GCC to ensure vibrant, safe, and responsible development of Alaska's northern waters. If you have any questions or concerns please feel free to contact me at (907) 350-5057.

Sincerely,

Reggie Joule

Representative Reggie Joule,
Bush Caucus and NWTF Chair
House District 40

National Policy for Stewardship of the Ocean, Our Coasts, and the Great Lakes

Dena'ina Center

600 W 7th Ave, Anchorage, AK

November 12, 2010

2:30-4:00pm

2:30–2:35 Welcome & Introduction of Speakers

Dr. Jim Balsiger, Regional Administrator, National Marine Fisheries Service of the National Oceanic and Atmospheric Administration

2:35–2:50 Overview of National Policy for Stewardship of the Ocean, Our Coasts, and the Great Lakes (NOP), including priority objectives and CMSP

Dr. Larry Robinson, Assistant Secretary of Commerce for Oceans & Atmosphere and Deputy Administrator of the National Oceanic and Atmospheric Administration; NOAA

2:50–3:10 Overview of Implementation Activities

Dr. Larry Robinson, Assistant Secretary of Commerce for Oceans & Atmosphere and Deputy Administrator of the National Oceanic and Atmospheric Administration; NOAA

Pat Pourchot, Special Assistant to the Secretary of the Interior for Alaska Affairs; Department of the Interior

Ms. Renee Wallis, Navy Region Northwest Environmental Director; Department of Defense

Captain Jason Fosdick, Commander, Coast Guard Sector Anchorage, U.S. Coast Guard; Department of Homeland Security

3:10-4:00 Question and Answer Period

Moderated by Jennifer Lukens, Acting Director, NOAA Coastal and Marine Spatial Planning Program

Speaker Biographies

Dr. Larry Robinson (National Oceanic and Atmospheric Administration and the National Ocean Council) Dr. Larry Robinson is the Assistant Secretary of Commerce for Oceans & Atmosphere and the Deputy Administrator of the National Oceanic and Atmospheric Administration. Before joining NOAA he was the vice president for research and a professor in the Environmental Sciences Institute at Florida A&M University (FAMU). Since 2001, he has served as director of the NOAA Environmental Cooperative Science Center (ECSC) headquartered at FAMU, which consists of a broad, multi-institutional consortium of predominantly minority-serving institutions. Between 1984 and 1997, Dr. Robinson served as a research scientist and a group leader at Oak Ridge National Laboratory. His work there included detection and assessment of special nuclear materials and application of nuclear methods in nonproliferation, environmental science, forensic science and the assessment of high purity materials. From 1997 to 2003, Dr. Robinson directed FAMU's Environmental Sciences Institute where he led efforts to establish bachelor and doctoral degree programs. In 2007, he became the first African-American to serve as the science advisor to the United States Department of Agriculture's Cooperative State Research, Education and Extension Service.

Pat Pourchot (United States Department of the Interior)
Pat Pourchot is the Special Assistant to Secretary of the Interior for Alaska Affairs. His work focuses on working with Interior's senior management in Alaska and Washington, D.C. and the Department's major Alaska constituencies. Prior to his position with the Secretary of the Interior he was the senior policy representative, for the Audubon in Alaska, where he worked with federal, state, local governments and non-profit conservation organizations on Arctic Alaska land use and ocean issues. Pat has lived in Alaska for almost 40 years, and has had a career rich with work in the State government. He has been both a State Representative, and a State Senator, as well as worked for the Governor's office, and held the position of State Commissioner of the Department of Natural Resources. He holds a Master's degree from Harvard University, in public administration, with a focus on natural resource policy.

Renee Wallis (U.S. Navy, United States Department of Defense)
Ms Wallis is the Director of the Environmental Support Office of Navy Region Northwest, and serves as the deputy Navy Regional Environmental Coordinator (REC) for Region 10. She has been working in the environmental field for 18 years in a variety of compliance and policy positions. Since taking her current position in July 2008, she oversees the regional Oil Spill Response program, Fleet operations environmental support, and Environmental Policy and Outreach, including building effective relationships with Native American tribes. Renee works closely with the Region 10 Department of Defense REC to coordinate and communicate unified DoD positions on issues that can affect military sustainment, and to develop cooperative partnerships with federal, state and local agencies, tribes, and non-governmental organizations that support environmental stewardship. Prior to moving to the environmental field, Renee spent five years in the Navy's Ocean Engineering Field.

Captain Jason A. Fosdick (U. S. Coast Guard, United States Department of Homeland Security)
Capt Fosdick currently serves as Commanding Officer, Coast Guard Sector Anchorage as well as Captain of the Port for Western Alaska. Captain Fosdick was commissioned in 1988, and has completed tours of duty in Virginia, California, Washington, DC, Alabama and most recently in Texas. His career has focused on marine safety and environmental protection. Captain Fosdick holds a Bachelor of Science degree from the United States Coast Guard Academy, and a Master of Science degree in Information Technology Management from the Naval Postgraduate School in Monterey, California. His military awards include the Meritorious Service Medal (two awards), the Coast Guard Commendation Medal (three awards), and various unit and service decorations.

Directs coordinate across multiple juris-dictions for stewardship of oceans & waters.
National Ocean Policy: 9 Nat'l priority objectives
1st time set of overarching policies
Creates NOC - 27 fed agencies / identifies 9 priority objectives / framework for CSMP.
NOC co-chairs Ocean Science & Tech / Ocean Resource Management
Objectives < How we do business
Areas of special emphasis
Need for CMSP: Defense, science, fishing, rec, energy & industry, navigation, conservation, aquaculture, uses regulated marine sector by sector
change approach use w/o exhausting / healthy eco-system.
CMSP =
9 regions - follows eco-systems / Alaska is one
Regional planning bodies. Alaska / Arctic Representative Governance Coordinating Committee (GCC)
overlaps w/ existing regional priorities & efforts -
Alaska's climate change strategy
Build on existing movements
NOAA - strategic plan 2012-2016. 3 of 4 goals aligned w/ NOC.
FY11 budget $16.77 mil for NOAA efforts CMSP / $20 mil for grants to implement CMSP
Ecosystem based management - Arctic LCC - research identification & research management. Arctic Climate Center - research cooperative science info together in useful way. Bring parties together -
USGS - study dec 2011. BOE Sound science mapping
DOD = critical to armed forces
Jennifer Larkin / NOAA / head of coastal mapping
Navy task force on shipping - what military support needed in future.
GCC = Join. Advisory plans - unknown -
Feb. March / National meeting -
Deadline

Whitehouse.gov / oceans

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A Message from ICC-AK President
Jim Stotts

Two new initiatives are moving ahead with the potential to impact long-term development in the Arctic marine environment. First is the US National Ocean Council and second is the State of Alaska Northern Waters Task Force.

Other Arctic marine policy initiatives are moving ahead from the Arctic states themselves, the Arctic Council, and other international organizations that will impact our part of the world. What's amazing is the speed with which these initiatives are moving forward. It's important to be involved because there might not be a second chance to have our perspective heard. Decisions are being made right now, with or without us. It's time to participate and be involved.

The National Ocean Council (NOC) was established on July 19 to oversee the implementation of a comprehensive nation¬¬al policy for the stewardship of U.S. oceans, coasts and the Great Lakes. The new national policy identifies nine priority objectives for the NOC to pursue for effective coastal and marine spatial planning to address conservation, economic activity, user conflict and sustainable use. The NOC was created by recommendation of the U.S. Interagency Ocean Policy Task Force and is comprised of high-level U.S. government officials.

The NOC is directed to establish an eighteen member Governance Coordinating Committee (GCC). The GCC will consist of officials from State, tribal and local governments. Three of the eighteen members will be at-large tribal officials. Hopefully, one of the three chosen will be an Alaska Native. This initiative is brand new and holds promise for a better way to manage our nation's oceans and coastal areas.

The Northern Waters Task Force (NWTF) was established on March 26 by the Alaska State Legislature to facilitate regional coordination and State of Alaska leadership in the development of U.S. policy related to Arctic marine transportation, national security and resource development. The NWTF is comprised of legislators from northwest Alaska, Arctic community leaders and key federal agencies. Sadly there is no representation from tribal organizations.

The NWTF aims to assess and facilitate the creation of a joint state and federal entity to coordinate U.S. and Alaska interests that result from the opening of Arctic waters. This joint federal/state commission would guide interagency and inter-jurisdictional actions in the Arctic and provide an opportunity for Alaska's legislature and Arctic communities to be proactive in shaping this body and ensure Alaska's unique interests are represented.

So, here's a chance to once again raise our concerns. The NWTF would benefit from a tribal presence. The standards and conditions that need to be in place prior to opening Arctic waters for development need to be discussed and agreed to. The work already done by the Arctic Council needs to be considered in any review by either the NOC or NWTF. Finally, the local and indigenous citizen viewpoint must be a real part of the discussion. They are the ones most at risk if something should go wrong. The Coastal Zone Management program needs to be revisited and local government authority should be strengthened.

DRUM

Inupiaq: QILAUN
Siberian Yupik: SAGUYA
Central Yupik: CAUYAQ

UPCOMING EVENTS

November 7, 2010
Inuit Day!

November 9-10, 2010
Arctic Council EPPR Working Group Meeting • Arlington, Virginia • www.arctic-council.org

November 29-December 10, 2010
UNFCCC COP 16 • Cancun, Mexico • http://cc2010.mx/en

January 11-12, 2011
Inupiat Community of the Arctic Slope Environmental • Justice Conference • Barrow, Alaska

January 17-21
Arctic Council AMAP Working Group Meeting • Tromso, Norway • www.arctic-council.org

January 17-21, 2011
Alaska Marine Science Symposium • Anchorage, Alaska • www.alaskamarinescience.org

January 22-23
PAME Workshop on Ecosystem Approach to Managements • Tromso, Norway • www.arctic-council.org

January 26-28, 2011
Arctic Frontiers Conference • Tromso, Norway • www.arcticfrontiers.com

February 7-11, 2011
Alaska Forum on the Environment • Anchorage, Alaska • www.akforum.org

February 9-11, 2011
Kivgiq Messenger Feast • Barrow, Alaska • www.north-slope.org

February 22-24, 2011
Bering Straits Regional Conference • Nome, Alaska • www.kawerak.org

February 23-24, 2011
Inuit Leaders Summit on Resource Development • Ottawa, Ontario • www.iccalaska.org

May 12, 2011
Arctic Council Ministerial Meeting • Nuuk, Greenland • www.arctic-council.org

May 16-27, 2011
UN Permanent Forum on Indigenous Issues • New York, New York • www.un.org/esa/socdev/unpfii/index.html

ICC Executive Council, Photo Courtesy of Carl Christian Olsen (Puju).

Executive Council Meets in Greenland

By ICC Alaska Staff

The Executive Council held its first meeting since last summer's General Assembly on September 28-29 in Nuuk, Greenland. The major topic of discussion was ICC's work plan for the next four years based on the Nuuk Declaration adopted last summer.

The first agenda items discussed were the Chair and Country Report Aqqaluk Lynge, ICC Chair, reported there are staffing and funding challenges for the near term for ICC Greenland that should be solved by next year. He will attend a summit of foundations in Copenhagen in November to discuss funding possibilities. He plans to concentrate on the indigenous human rights dimension during his term, including the rights of indigenous children. He will also be involved in issues concerning the European Union such as the seal skin ban. He has begun work on Inuit pan-arctic media cooperation.

Tatiana Achirgina, Chukotka President, spoke on progress in Chukotka. The Chukotka Inuit regional organization joined the Public Chamber of the Government of Chukotka in August, which is a milestone. She discussed recent developments on the Beringia National Park and the need to allow traditional reindeer herding and hunting activities in and around the park. She announced that for the first time in 20 years Russian Inuit will be allowed to hunt polar bears. Work to revitalize marine mammal hunting in Chukotka also looks promising. Finally she mentioned continuing work on the project "Ulyuvut" (our language). This project aims to preserve language and culture and generate interest among the younger generation.

Duane Smith, Canada President, reported on developments in Canada. The Canadian Inuit lawsuit against the European Union on the seal skin ban continues. The Canadian government recently apologized to Inuit for the forced relocation of Inuit from Nunavik to Grise Fiord and Resolute Bay. A new Minister of Indian Affairs and Northern Development, John Duncan, has been appointed. The Canadian government has unveiled a new international Arctic policy. Finally there were updates on Canada's continuing work on fundraising, Arctic languages, health issues, contaminants, biodiversity and the state of the Arctic Ocean.

continued on page 6

Introducing the Newly Elected Members to the Executive Council

By ICC Alaska Staff

From Greenland, Hjalmar Dahl

Hjalmar Dahl is originally from the community of Qaqortoq in Southern Greenland. He has a long history with ICC. From 1981-2007, Hjalmar served as the Special Assistant to the first President of ICC and as head of the ICC Greenland office. He has been a member of the ICC Advisory Committee on United Nations issues, and has specialized on the rights of indigenous peoples for several years. He was directly involved in creation of the UN Permanent Forum on Indigenous Issues, and was on the ICC negotiating team that worked for the adoption of the UN Declaration on the Rights of Indigenous Peoples in 2007. For many years he was politically active at the grassroots level and was involved in creating the Inuit Ataqatigiit political party in Greenland. One of the main objectives of the party is to strengthen Inuit unity across the Arctic and to create closer cooperation and exchanges on educational and cultural issues. He received a degree from the Danish School of Pedagogy in 1974. In 2007, he received a degree from the Danish School of Journalism on communication.

From Canada, Kirt Kootoo Ejesiak

Born and raised in Iqaluit, Nunavut, Kirt Ejesiak has extensive experience in the public and private sector and is committed to solutions for improving the lives of Inuit. Kirt has an extensive background with the Nunavut Government and has represented Nunavut in many capacities at the regional, national and international level. He has been Chairman of the Board of the Iqaluit Museum; he served as deputy mayor of the city; and he was appointed Vice-Chair of Nunavut Trust. He has also worked for NTI, Kakivak, ITK, Pauktuutit, and he served as President of the Inuit Non-Profit Housing Board in Ottawa. In 2005, Kirt became Nunavut's first student at Harvard University when he was awarded a Fulbright scholarship to attend the Kennedy School of Government at Harvard. He completed his Masters of Public Administration there. Prior to his MPA, Kirt was Chief of Staff and Principal Secretary to the Premier of Nunavut. Kirt is currently working in Iqaluit and is Creative Director and CEO of Uqsiq Communications, a multi-media communications firm, and is managing partner of Gallery by the Red Boat.

From Chukotka, Elvira Tyunikova

Elvira Tyunikova comes from the Avatmit Eskimo clan, belongs to the Ankalin family, and was born in the village of Sireniki in the Chukotka region. Elvira first chose a career as an educator and studied at a pedagogical institute, but later found that she was more interested in administration and management. She changed career paths and completed her education at the Saint Petersburg Institute of Engineering and Economics, specializing in municipal and public administration. Elvira Tyunikova was a delegate to the 10th ICC General Assembly and became the Director for ICC Chukotka in the Provideniye Region. The region is recognized as the most diverse group of Russia's Inuit, and they have already entrusted Elvira to represent their interests at General Assemblies of the ICC for the second time.

From Alaska, Vera Metcalf

Vera Kingeekuk Metcalf was born and raised in Savoonga on St. Lawrence Island, Alaska. She now lives in Nome and has been the Director of the Eskimo Walrus commission (EWC) with Kawerak, Inc. since 2002. She continues to promote local community participation in research that involves a community's natural and cultural resources. As the EWC Director and with support of the nineteen commissioners representing coastal Alaska Native communities, she began several community-based projects documenting local traditional ecological knowledge and resource management practices, which she proposes as effective Pacific walrus management tools. As EWC Director, Vera is currently chair of the Pacific Walrus Conservation Fund and serves as the Special Advisor on Native Affairs on the Marine Mammal Commission. She also represents EWC on the Indigenous People's Council for Marine Mammals, which was formed to "identify and address marine mammal issues of common concerns." Vera is also currently on the steering committee of UAF's Alaska Center for Climate Assessment and Policy and recently served as a member on the US Arctic Research Commission (USARC). The USARC develops Arctic research plans and policy recommendations for the President of the United States. Finally, Vera served as a member of the Native American Graves Protection and Repatriation Act (NAGPRA) Review Committee, which recommends and advises the Secretary of the Interior on regulations and disputes. During these years, she documented and presented the results of community-based research used for repatriation purposes.

INUIT CIRCUMPOLAR COUNCIL

ALASKA OFFICE

3000 C STREET, STE. N201
ANCHORAGE, AK 9503

PHONE: (907) 274-9058
FAX: (907) 274-3861
www.iccalaska.org

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The Inuit Circumpolar Council (ICC) is an international non-governmental organization (NGO) representing the Inuit of Alaska, Canada, Greenland, and Chukotka. ICC Alaska, along with other members, strives to strengthen, protect, and develop Inuit rights in the circumpolar region.

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Northern Waters Task Force minutes – December 2, 2010

Members:
Representative Reggie Joule – Chair
Senator Bert Stedman – Vice Chair
Senator Donny Olson
Representative Bob Herron
Representative Bryce Edgmon
Chris Hladick
Chuck Greene
Dave Kubiak
Mayor Edward Itta
Captain Adam Shaw, USCG (on behalf of RADM Colvin)
Larry Hartig, Commissioner, DEC
(Rep. Seaton on phone as interested legislator)

Speakers:

Jimmy Stotts	Inuit Circumpolar Conference- Alaska
Johny Aiken	Alaska Eskimo Whaling Commission
Todd Sformo	North Slope Borough (NSB) Dept of Wildlife Management
Jason Herremia	NSB Dept of Wildlife Management
Barrett Ristroph	NSB Law Department
George Olemaun	Inupiat Community of the Arctic Slope (ICAS)
Debby Edwardson	Ilisagvik College
George Edwardson	ICAS
Gordon Brower	NSB Planning Department
Ethel Patkotak	Self

Representative Joule convened the meeting at 12:00 (check time) with introductory comment regarding the Task Force and the importance of hearing from the people that depend on the northern waters. Members in attendance introduced themselves.

Jimmy Stotts, President of the Alaska chapter of the Inuit Circumpolar Conference (ICC) addressed the Task Force from prepared remarks (attached) that defined the ICC and its purpose in strengthening unity among Inuit of the Arctic, promote Inuit rights and interest at the international level, develop and encourage long term policies that protect the Arctic environment, and seek full and active partnership in the political, economic, and social development of the Arctic. For 30 years, ICC has been pushing for Inuit influence over all activities affecting the people, homeland and environment.
After discussing concerns for a pro-development attitude of the State of Alaska and concerns for involving local people, he noted the importance of Arctic Council and the ICC's permanent participant status, encouraging the Task Force to stay informed of the work of the Arctic Council and particularly the human dimension. Jimmy offered 8 recommendations to the Task Force as follows:

1. Include a tribal presence on the task force
2. Put strong local influence back into Coastal Zone Management (CZM)
3. Realize Arctic offshore development is international in nature
4. Science and traditional knowledge should form the basis for decisions
5. Focus on offshore development must be holistic, not lopsided
6. Inupiat must benefit from development, beyond jobs

7. Seriously consider the NSB's offshore oil and gas policy (eight points)
8. Expand the task force mandate to review the environmental side of Arctic Ocean resource development

Jimmy concluded by noting that the ICC Inuit Leadership Summit on Resource Development on February 23-24 in Ottawa Canada to discuss offshore oil and gas development, uranium mining, and the social and environmental impact assessment process.
In addition to his written testimony, a copy of the Inuit Arctic Policy will be forthcoming to Rep. Joule.

Senator Stedman commented that CZM was a broader, statewide issue and also is complicated by the President Executive Order. He noted that the legislature will be working on this but may take more than one session.

Representative Herron questioned as to whether a multi-lateral treaty for the Arctic, similar to the Antarctic made sense thus keeping the governance close at hand.

Mr. Johny Aiken, Executive Director, Alaska Eskimo Whaling Commission (AEWC), provided a powerpoint presentation (to be posted) on the Alaska Whaling Commission, the distribution of bowhead whales and the challenges of whaling and working in heavy ice. The presentation was a repeat of the presentation made to BOEMRE in their July OCS Forum (transcript attached). His key points were:

- Migratory paths of the whales are known and well mapped
- Conflict avoidance agreements were effective for working together
- Heavy ice and pressure ridges make work very difficult
- Heavy ice requires the best technology and feeling is that the industry is not ready for those conditions in remote Alaska
- Deepwater Horizon showed even with infrastructure, how difficult controlling and containing an oil discharge is, making the point that Alaska and industry are not ready for work away from Prudhoe Bay
- Support Liberty directional and extended reach drilling as a way to avoid conflicts with whales and environmental risk

Johny concluded his comments noting that the AEWC strongly supported CZM and wanted to insure there was a community voice in development.

Todd Sformo and Jason Herremia, NSB Department of Wildlife Management provided an powerpoint presentation overview of the wildlife research and management. Todd provided a reference to "50 More Years Below Zero" section on "Science and Community: Inupiat Contributors to the Laboratory's Effectiveness" for "*Introduction to Alaska's Original Naturalist*" and "*Historical Perspectives on Inupiat Contributions to Arctic Science at NARL*" was made as to the importance of collaborative help. (I believe the quoted passage was from Kenneth Toovak, Sr. as he evaluated his career of collaboration with scientists: *I was scared of White people...I stayed to myself. Pretty soon, those folks started coming around to talk to me, asking questions. I started to get to know these people I had been scared of. We started to share the different things we know. This sharing became a very important part of my life. It wasn't easy...But, we kept on sharing knowledge...Scientist wanted my help...they felt good when I*

helped them on the ice. So I made myself available to them, and we went on sharing" (Toovak, 1992: 19)). The key point made by Todd was that the people of Barrow have been working to combine traditional knowledge and western science for over 50 years and are committed to many years more. Jason discussed the different research work of the Arctic Science Center, with a subsistence focus for the animals used by the community. The bowhead whale remains the primary research focus, with recognition of their extended age (180-200 yrs old). The Center has also expanded into collecting baseline disease assessments in ice seals and monitoring caribou populations. A recent focus has been on assessing the health of subsistence users as diets and climate conditions change. The center also tracks ESA listing as they pertain to local populations and subsistence (polar bears and ice seals). A plea was made for grant funding sources, as training is moving forward for the young people as they are the future of Barrow collaboration in science.

Senator Olson asked about narwhal research in the eastern Beaufort sea and Canada. It was noted that this was out of the area researched and little information existed at the NSB, although contacts with Canadian collaborators could help find information.

Barrett Ristoph, NSB Law Department spoke of her efforts to support policies of the NSB, including the Planning Department for the Alaska Coastal Management Program to improve the program and specific work on land use codes for the nearshore areas to streamline the permitting process. Barrett talked about wildlife co-management, climate issues, and her work with the AEWC, ICAs and others for Memorandums of Understanding and joint comments for federal and state actions.

Representative Herron raised the success of the Migratory Bird Treaty as an analogy to CZM. He noted that CZM worked for decades and with the issues facing Alaska could provide protection comparable to the Migratory Bird Treaty. Barrett commented that she did not see the aspects of international treaties in the CZM analogy. Representative Herron commented on CZM and states right and noted the importance of using the time available to resolve local governance and states' rights (This point may be mistaken in my shorthanded notes and memory).

George Olemaun talked on behalf of the Inupiat Community of the Arctic Slope (ICAS) prov9ided written comments (attached) that highlighted the relationship between the Inuit/Inupiaq people survivability and the natural resources. George talked on the ocean for survival and the importance of subsistence for the future. He noted that the marine mammals, fish and birds were circum Arctic Ocean and of dependence in Alaska from Kaktovik to Unalakleeet, with no compromise to be made for their safety. George stressed to keep the "Human Factor" upfront as the Inupiat are "who we are versus who we represent". By following guiding principles people can adapt for natural change and economic need. He concluded by recognizing the "persistent presence" of Inupiat people in the Arctic.

Debbie Edwardson, Director Workforce Development (?), Ilisagvik College, introduced the College mission as 2 fold, addressing human resource needs for the North Slope and perpetuate Inupiat language and culture for the students. She recognized the encroaching development needed attention from policy makers and professionals to insure community involvement and felt that Prudhoe Bay missed the mark in local hire of workforce. Debbie talked about the Marine Mammal Observer

Stewardship Program (background article, although not provided, at http://www.thearcticsounder.com/article/1045ilisagvik_colleges_marine_mammal_observer) and requested support from the NWTF as the program brought traditional Inupiat science together with NMFS in addressing the MMPA in the Arctic. She expressed concerns that these "observers" were a "token presence" and that in cases the observations were not respected and encouraged trust in the knowledge of people that have watched the marine mammals for decades. Debbie continued with sharing the accredited programs including USCG licensing that were AFN respected. On the subject of forthcoming regulations and the ability to comment, she highlighted the respect of the traditional knowledge of elders and their closeness to the sea.

Representative Joule commented on the proactive programs of Ilisagvik College and the investment of capital for "People Involvement" as the programs move forward.

George Edwardson, President, ICAS, stressed to keep the people and the authority at the table when looking at the animals and community dependence. With high unemployment rates people depended on subsistence to meet needs. George talked about jurisdiction of the tribe and how there was an analogy between UNCLOS and the Alaska constitution as the governance of the Inupiat people was linked to the animals and thus extended beyond state waters into federal waters and those waters agreed to by UNCLOS.

Gordon Brower, NSB Planning Department, provided remarks reflecting on Johny Aiken's presentation that pictures tell the story. He encouraged the task force to address ocean concerns as the ocean feeds the community. CZM was of significant interest as tools to reinforce local perspective, but cautioned that it was different across states. He encouraged reauthorization of the ACMP to strengthen local involvement and facilitate co-management in the EEZ. Concerns were noted for the migratory paths of bowheads and oil development and issues associated with nearshore re-zoning of the NSB. Respect was given for the importance of economic development and the success of Liberty and others and noted a balanced approach of jobs and risk mitigation. Examples included North Star being stuck in moving ice and the interest in an ordinance for ice capable barge system on the North Slope. Gordon asked for improved learning tools for better managing offshore development and looked for an offshore advisory panel and advanced technology in nearshore development. Gordon concluded with advice to the committee on finding balanced development.

Representative Herron noted a press conference on CZM as the Governor and colleagues move forward and asked whether "local control" or "local input" was preferred. Gordon commented that "local input" was a priority outside state waters and that the goal was to protect the bowhead whale.

Ethel Patkotak spoke on behalf of herself as a resident of Wainwright and a student of Mt. Edgcomb boarding school and having returned to Barrow after 20 years away from the North Slope. Ethel noted her 2 law degrees and work for indigenous people. In recognizing the value of the Task Force, she encouraged an understanding of the urban-rural to coastal-inland divide as community survival was no different between challenges with oil and gas fluctuations, salmon disasters and crash of the timber industry. In each case, endurance of the people is key and finding ways for sustainable local economies.

These included understanding a migratory versus mixed economy that cross-cuts subsistence versus economic activity. Ethel continued with guidance on keeping sigh on history, including the Exxon Valdez oil spill and the role of the RCAC's and OPA-90. The Gulf of Mexico needs to be looked at with fresh eyes to see who or what was overlooked and the voids or gaps in the scientific process. Ethel continued in expressing concerns for the use of statistics, whether shown in federal and industry expenditures, science in not understanding the Arctic, and how studies often need to be redone as site or subject specific to validate the statistical findings. In concluding, Ethel encouraged the Task Force to look back and see what is driving activities and look forward with defensible values.

After taking public testimony, Representative Joule looked to the Task Force members for closing comments.

Commissioner Hartig as the Administration's member noted the value of field hearings in risk decisions. He compared his use of market risk with the Permanent Fund Dividend versus DEC in environmental risk decisions. Clearly, the DEC environmental risk remains the ones of his greatest concern.

Senator Olson commented on his concerns for oil and ice and his fear of an incident. He noted the grave concerns logically presented at the hearing and noted looking to discussions of policies in the session between Legislators and Commissioners.

Captain Shaw, on behalf of RADM Colvin, appreciated the advocacy for balance between subsistence and development. The USCG maintains preparedness for oil spills and is working to insure input from local users. He introduced Joel Casto as the USCG Tribal Liaison for District 17 and encouraged working with him.

Representative Edgmon complimented those providing testimony for their passion and eloquence and how it mirrors the discussions he hears on Pebble. He recognized the importance of lifetime of resources behind these discussions. Representative Edgmon looks forward on making progress on CZM.

Representative Herron concurred with Representative Edgmon noting the Kuskokwim maintain salmon integral to the Yupik culture. He concluded with a compliment to Mayor Itta for his hospitality.

Mayor Itta complimented Senator McGuire for taking time to hear from the people in a cross-border Arctic Caucus meeting as it was relevant and timely. He reflected on Jimmy Stotts words for a national debate on energy and climate change as exploration in the Arctic is allowed. He concluded with a compliment of having the Task Force hearing in conjunction with PNWER.

Senator Stedman noted CZM discussions in January and the input focus. He noted that Ketchikan had lost its local subsistence rights and that Sitka was at risk and looks forward to resolutions of the issues in his communities.

Dave Kubiak complimented Senator Stevens for his appointment and appreciated the Barrow allies with equal concerns on the issues expressed before the Task Force.

Chris Hladick noted his community's role in oil and gas versus shipping and expressed the importance to insure the USCG is ready for the Arctic. He noted the risk for ships in the Bering Sea and cognizance of the correct skills, crews and sea lanes in managing shipping issues.

Chuck Greene encouraged the Task Force to understand what the final outcome will look like, as the issues are not part of a perfect process. He commented on the holistic process in balancing pro-development for input versus control and consideration of sustainability. This hearing reflected good cross section of the grass roots nature of public input and what it represents to the state.

Representative Joule concluded the comments encouraging attendees to continue with written comments. He respected the service of the Task Force members to the state and that sevice and reciprocity went hand in hand. Expanded services often include layer upon layer of government, but he hoped that the process offered to be participatory. The community ability to input often mitigates the needs for courts. This Task Force process offers to keep the input public and time is available given the CZM discussion in the Legislature and the National Ocean Council activities, although there is not a luxury of time. Representative Joule concluded by thanking the members and the attendees in the hearing.

The hearing adjourned at 2:15 (check time).

Northern Waters Task Force (December 2010)
By Jim Stotts, ICC Alaska

Thank you for this opportunity to address the Northern Waters Task Force (NWTF). Thank you for making the effort to visit Barrow which is on the front line for resource development in the US portion of the Arctic Ocean.

My name is Jim Stotts and I'm President of the Alaska chapter of the Inuit Circumpolar Council (ICC). Our membership includes Inuit from the North Slope, Northwest, Bering Straits and Southwest Delta regions of the state. Internationally, the ICC represents 160,000 Inuit from the United States, Canada, Greenland and Russia.

As a recognized non-governmental organization with consultative status to the United Nations, and a permanent participant to the Arctic Council, ICC is very much aware of activities going on in the Arctic at both the national and international level.

ICC's purpose is: to strengthen unity among Inuit of the Arctic; to promote Inuit rights and interests at the international level; to develop and encourage long term policies that protect the Arctic environment; and seek full and active partnership in the political, economic, and social development of the Arctic.

In other words, ICC pushes for Inuit influence over all activities affecting them and their homeland, on land, air and sea. This has been ICC's mission for 30 years. It's fitting to note that the ICC started right here in Barrow, through the vision of Eben Hopson Sr, the first Mayor of the North Slope Borough.

The NWTF is just starting its work and this is only its second hearing. So, timing is perfect to get things started out right, to ensure that the task force develops a balanced perspective moving forward. In ICC's opinion, the State of Alaska needs a more balanced perspective when it comes to development in northern waters and the Arctic Ocean.

We believe the State's approach is too favorable on the side of development. In other words, resource development trumps all other considerations, including cultural, social and environmental considerations. We hope the task force will be able to get beyond this lop-sided approach and come up with some ideas that the Inupiat can get behind. Without a balanced focus this could end up being a wasted effort.

Sadly there is no representation from tribal organizations on the task force. The task force would benefit greatly from a tribal presence. The Arctic Council, the inter-governmental organization of the eight Arctic nations, charged with developing Arctic policy, has indigenous people's organizations as permanent participants. The newly formed US National Ocean Council also calls for a tribal presence. The State of Alaska should consider doing the same. This would give the State greater credibility and acceptance with the Inupiat which is sorely needed at this time.

In HCR-22 which establishes the NWTF, the duties of the task force are spelled out as: 1) assess and facilitate the creation of a joint state and federal commission to oversee development of state and federal northern ocean waters; 2) facilitate regional coordination, cooperation, and outreach regarding creation of the commission to keep local stakeholders informed and incorporate their input into the process; 3) identify and coordinate mutual concerns of federal, state, and local agencies, and international interests in the creation of the commission. These are the three duties of the task force.

The task force shall carry out these duties by holding hearings in the northern region of the State, providing recommendations regarding the creation of the joint commission, and delivering reports to the legislature with legislative proposals for consideration in January 2012. In a nutshell this is the mandate of the NWTF.

I would be remiss if I didn't mention the fact that the State of Alaska missed an excellent opportunity to address one of the most important concerns raised by local authorities when the State failed to act, last legislative session, to

strengthen Coastal Zone Management. Local influence was, in effect, rubbed out. In our opinion, the State decided to follow industry's lead and made the wrong decision, again.

From ICCs perspective it appears the State doesn't trust local people and has decided that it will make the decisions that affect them on their behalf. It's no wonder the Inupiat are losing trust in the State to help them with their problems and concerns. This task force will have to wrestle with this local perception as it moves ahead trying to develop recommendations that Inupiat can support. Again, a balanced approach is necessary. Cultural, social and environmental issues must be considered at the same time as economic and resource development issues.

A few words about the Arctic Council, the Council has been and continues to be involved in developing Arctic policy in many areas, including areas that directly impact Arctic indigenous peoples. For example, on February 16th, there will be a meeting of the Health Ministers from the eight Arctic nations in Nuuk, Greenland. The Alaska State Commissioner of Health and Social Services will be invited to this meeting based on ICC Alaska's recommendation that he be invited. ICC Alaska knows the State will accept the invitation in the spirit in which it's made. We hope this will lead to mutual cooperation on the many health issues facing the Arctic. At least, it's a chance.

I mention this is to illustrate that Inupiat are and have been involved for many years in the process of helping create Arctic policy at the national and international level. Policies that protect the environment while allowing for sustainable development. Our understanding of sustainability includes the notion of cultural sustainability. We are fighting to keep our culture alive in this modern world. We will not back down. Some of you realize this already.

The United States and its Arctic Council partners are addressing important matters facing the Arctic. Offshore oil and gas and other Arctic Ocean developments, such as Arctic marine shipping, are just two of the topics being discussed. Other matters such as environmental protection, biological diversity, and climate change are also on the front burner.

The Arctic Council discusses many other topics that ICC chooses to call the "Human Dimension". The human dimension includes topics of great concern to the Arctic's indigenous peoples and residents at the community level, including: education, health, language and culture, community energy and infrastructure needs, pollution and toxic contamination, scientific research and traditional knowledge, just to name some of the issues being discussed.

I suggest the NWTF needs to be informed on the workings of the Arctic Council, including the perspectives of its permanent participants. The Council has already done much great work on the issues before this task force. It appears development of the Arctic Ocean will take a cooperative international approach rather than each Arctic nation going its own way. This means the State of Alaska will have to cooperate within this larger framework or get left behind or left out of the discussion. Please don't take this as a threat, it's simply my observation. This process is pretty far down the track already.

Early indications are that the US National Oceans Council will take a similar holistic approach to development as well. The task force probably should keep this in mind and keep itself informed on what's going on at the National Oceans Council. Again, we think this is good advice.

Okay, now for some specific recommendations:

1) **Include a tribal presence on the task force**
2) **Put strong local influence back into Coastal Zone Management**
3) **Realize Arctic offshore development is international in nature**
4) **Science and traditional knowledge should form the basis for decisions**
5) **Focus on offshore development must be holistic, not lopsided**
6) **Inupiat must benefit from development, beyond jobs**
7) **Seriously consider the NSB's offshore oil and gas policy (eight points)**
8) **Expand the task force mandate to review the environmental side of Arctic Ocean resource development**

In closing, I want to mention that the ICC is facilitating and hosting an Inuit Leader's Summit on Resource Development February 23-24 in Ottawa, Canada. The three topics of discussion are: offshore oil and gas development, uranium mining, and the social and environmental impact assessment process.

This Summit will bring together Inuit leaders from our four countries to discuss these important topics. The State of Alaska Commissioner of the Department of Natural Resources will be invited to the Summit to listen to what Inuit are thinking. This will be a great opportunity for networking. We hope the State will be able to attend.

Thank you for your time and good luck as you move forward. If ICC can be of help in the future please just let us know. I will be forwarding a copy of the Inuit Arctic Policy to Representative Joule for the task force's consideration. We call it the bible. If you have any questions, I'll be happy to try to answer them at this time.

Johny Aiken testimony from BOEMRE hearing in Anchorage, as he noted this is same presentation presented to the Northern Waters Task Force

http://www.boemre.gov/forums/documents/AnchorageTranscript26Aug10.pdf

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MR. AIKEN: Good morning, everyone. First of all, I would like to thank Director Bromwich and the Bureau of Ocean Energy Management, Regulation and Enforcement for holding this forum and to give us a chance to speak on how we feel about offshore activities in the Arctic.

My name is Johnny Aiken, and I am the executive director of the Alaska Eskimo Whaling Commission. I am from Barrow, Alaska and was born and raised there and have been whaling with my father for over 40 years. AWC has 11 whaling villages, and my presentation is focused on whaling and our environment. I do not want to take too much of your time, so I will make my presentation as brief as possible. I have a lot of pictures, and I think that looking at pictures tells a better story than words can say. So I just wanted to give you an idea of our environment and the culture we enjoy as a result of what our environment has to offer us as a people.

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This is a photograph of Harry Brower's whaling crew and a whale he harvested not very long ago. As most of you know, Harry Brower is the chairman of the Alaska Eskimo Whaling Commission and was not able to be here because of his busy schedule.

This is a slide that shows where the whales are in different times of the year. The yellow low is where the whales are in the wintertime. According to the tagged whales, we have learned that the yellow is the area where the whales winter every year. The green is showing you that during -- the green is during the spring when the whales start migrating north towards Canada, and that is when our spring whaling begins.

For Barrow, our whaling activities begin in mid to late April. I think the migration starts as early as January or February. The pink is where the whales summer in Canada. And the brown is where the whales start migrating south in the fall.

This slide shows the areas where seismic leasing and drilling are to occur in the Chukchi Sea and the Beaufort Sea should this program be opened. Here is where Shell's Beaufort Sea campaign is -- here is where Shell's Beaufort Sea campaign is to drill the Sivulliq project in the near future if allowed.

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I lost it, sorry. This slide shows where a lot of whale sighting occurred during 1979 and 2005 -- between 1975 and 2005. All the dates are whale sightings -- all the dots are whale sightings, I'm sorry. The yellow is the Kaktovik's bowhead use area, and people in Nuiqsut use area. The red lines indicate Nuiqsut's whaling GPS

tracking where they hunt, the red lines there inside all those dots.
This slide shows where Sivulliq is going to be located in the brown circles. And the gray indicate where deflection -- whale deflection distances from the center. The center being the Sivulliq project. Each circle represents a distance, and the distances are 6, 9, 15 and 19 miles. Those lines depict the use areas for Nuiqsut. As you can see, Sivulliq is right in the path of the migrating whales in the fall.
On this slide our lines, which -- depict the tagged whales and the lease areas. This is in the fall. As you can see, many whales migrate through the lease area.
Work in the Arctic will mean work in heavy ice, and we are concerned that there may not be technology to be working in the ice-infested waters. Ice is -- it can be a very strong -- it's something that you've got to be real careful with, and it's not going to be easy to work in the ice should a spill occur.

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This slide here shows typical ice structures in the winter. We have a lot of pressure ridges nearshore which tells us how powerful moving ice can be. As you can see, some of these pressure ridges can be pretty huge. For our whaling crews, a lot of work is involved in building trails to the open lead. Every year crews go out and build a trail to the open lead. Sometimes it can take weeks to get to the lead. We cannot use any heavy equipment. All the work is done by hand, labor, ice picks, and using heavy equipment may be too dangerous.
Our ocean, the Arctic Ocean, has many animals and fish, with the most important being the whale. The whales travel through any kind of ice conditions, whether it be closed or open. Many have calves either in the spring or the fall migration. We know whales can live under the ice when there is no water to be seen. We have seen air holes, such as this, even in three to four feet of thick ice. If oil is under the ice, the whales are sure to be there.
And this is a picture of a whale breathe through the ice. Should an oil spill occur, many animals will be impacted, probably much more than what happened in the Gulf. Since ice has receded in recent years because of global warming, hundreds of walrus have been found on beaches along the Arctic coast. I believe this photograph

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is located between Point Lay and Point Hope. Polar bears are a concern, too. I can't imagine a polar bear tarred with oil. I don't think it would ever survive if it had oil on its coat in the wintertime.
In the Arctic, we have our share of storms. Along with the storms comes erosion of our coastline. Here we see the same area before the storm. These are the same houses. In August of 2000 we had one of our biggest storms. The worst storms we had were in 1963 when we saw houses and fuel tanks floating along the coast. In October

2006, we had bad storms also. Some of these storms destroyed erosion control structures. This is in Wainwright. Almost straight offshore are the lease areas. This is a slide on the Liberty Project, and the reason I wanted to show this is because we need to find better technology if we're going to develop offshore oil and gas. Right now I believe that we are not ready to develop offshore oil and gas in the Arctic where it will be much harder to respond to an oil spill. The oil industry had a hard enough time in the -- in their response in the Gulf spill where there was no ice, where temperatures and weather were not an issue. It's extremely cold in the Arctic, and I can't imagine having to respond to a spill where there is ice and where it gets too cold for equipment. We need to wait until there is technology which is capable of responding to oil spills in the Arctic.

Thank you, Commissioner.

History and occupation of the Arctic Ocean

We, Tagiuqmuit/Ocean people, have occupied the Arctic Ocean which circumvents the Arctic Circle from Greenland to Canada to Alaska to Russia to the Scandinavians for millennium(s) using the natural resources for sustenance and clothing with our traditional knowledge gained through starvation, illnesses and natural disasters that enabled us to master the survival techniques that we have acquired to assure that we survived to the present.

The Inupiaq/Inuit are the original occupants from Greenland to Russia depending on our ocean for all our needs supplemented with plants and caribous from the land. The dependence on our ocean includes the Nunamuit/Inland people when their subsistence resources diminished to the point of starvation they moved to the coastal areas for sustenance knowing that the ocean would provide with the abundance of animals and the guidance of the Taguiqmuit for their survival.

With the knowledge that we have learned we teach our children as we were taught from our parents how to be caretakers of our ocean, land and air animals just taking what is needed and to assure that our sustenance will be fulfilled as much as the sustenance of our subsistence resources will be fulfilled now and into the future.

The whales, the marine mammals; polar bears, walrus, oogruks, fish and waterfowls that we depend on for subsistence from Kaktovik to Unalakleet, from the Beaufort Sea to the Chukchi Sea and to the Bering Sea use the Far North for rearing and brooding of their young which must not be compromised or the consequences that will be felt within our area will also be felt far beyond the realm with dire catastrophes to the wellbeing of all.

What I have stated with this letter is to let all of you understand that there is a Human factor and that you respect us for who we are as much as we respect who you represent as the Arctic Caucus Leadership Forum. The Far North must not be an item to discuss at a dinner table it must be in the forefront to establish the guiding principles to assure that it is managed with the utmost care with the changes that are being brought forth to address the Economic needs and the natural changes that are occurring.

Quyanaq / Thank you

George Olemaun

Northern Waters Task Force

	Name	AFFILIATION
(1)		
(2) Johnny Aiken	Jimmy Stotts	ICC - ALASKA
	Todd Sformo	NSB Dept. Wildlife
(3)	Jason Herreman	NSB Dept. Wildlife Mgmt
(4)	Barrett Ristroph	NSB Law
	~~Adlarett H~~	~~Nuiq Assembly~~
(5)	Georg Oleman	ICAS
	~~Trish Ohleen~~	~~Army Corps of Engineers~~
	~~Jeet Casto~~	~~USCG Tribal Liaison~~
	~~Bob Patkotak~~	~~Inupiat Commission~~
(6)	Debby Edwardson	Ilisagvik College
(7)	George Edwardson	ICAS
(8)	Gordon Brower	NSB Planning
(9)	Ethel Patkotak	self

NORTHERN WATERS TASK FORCE

-TIMMY - PREPARED REMARKS

- ICC - BALANCED PERSPECTIVE-
  TOO FAVORABLE - RESOURCE DEVELOPMENT
  ADD TRIBAL PRESENCE-
  - US NATIONAL OCEAN COUNCIL-
    REQUIREMENTS - DUTIES HCR 22
  - CONCERNS - STRENGTHEN COASTAL ZONE MGMT
    - ICC - FAILED BY EXCLUDING INDUSTRY LEAD
DEVELOPMENT - CULTURAL-SOCIAL-ENVIRONMENTAL ISSUES EQUALLY
ARCTIC COUNCIL - HEALTH
  INUPIAQ INVOLVEMENT - SUSTAINABILITY CULTURAL
  - WORKINGS OF ARCTIC COUNCIL - COOPERATIVE INTL APPROACH
  - FOLLOW - NATIONAL OCEAN COUNCIL-
RECOMMEND TASK FORCE - ① TRIBAL PRESENCE
② CZM LOCAL GOVERNANCE
③ HOLISTIC OFFSHORE USE
④ INUPIAQ BENEFIT - 8 PTS NSB
ICC ARCTIC POLICY ③ - RECORDS

STEDMAN - CZM - BROADER - STATEWIDE
+ PRESIDENT E.O. - WORKING ON - MORE THAN 1 SESSION
SYSTEM CREATING TENSION-

HERRON - SIMILAR MULTI LATERAL TREATY FOR
ARCTIC LIKE ANTARCTIC
- KEEP GOVERNANCE CLOSE AT HAND

WEB POSTING

TONDY AIKEN - POWERPOINT - E.O. ALASKA ESKIMO WHALING COMM

JULY BOEMRE.

Conflict avoidance agreement

- HEAVY ICE -

OTHER THAN MAPS - MANY STUDY FROM CLIMATE CHANGE

- SUPPORT LIBERTY DIRECTIONAL DRILLING EXTENDED REACH

GOLF ANALOGY + INFRASTRUCTURE -

INDUSTRY NOT READY =

AWC - STRONG SUPPORT FOR CZM:

COMMUNITY VOICE IN DEVELOPMENT

- TODD TYSON - USFS -

50 MORE YEARS BELOW ZERO - BOOK

INTRO TO ALASKA ORIGINAL NATURALIST

+ INUPIAT CONTRIBUTION TO ARCTIC SCIENCE

- Collaborative help quote -

TYSON - ARCTIC SCIENCE CTR -

SUBSISTENCE DIV RESEARCH DIV -

- BOWHEAD WHALES FOCUS

EXTENDED AGE - 180-200 YRS -

ICE SEALS - BASELINE DISEASE

CARIBOU

HEALTH ASSESSMENT OF SUBSISTANCE USERS

EDA LISTINGS -

GRANT FUNDING SOURCES -

YOUNG PEOPLE + FUTURE

OLSON - NORWAIL RESEARCH - EASTERN BEAUFORT - CANADA -

Ristogh
BARRETT ~~LISTKOFF~~ - LAW DEPT NSB
SUPPORT POLICIES ← ACMP - PLANNING IMPROVE PROGRAMS
WILDLIFE - CO-MANAGEMENT - BIRDS
LAND USE CODES - NEARSHORE & STREAMING
- CLIMATE ISSUES
- AEWC, ICAS, OTHERS - JOINT COMMENTS MOU
NEGRON - MIGRATORY BIRD TREATY -
CZM WORK FOR DECADES - ISSUE FACING ALASKA
PROTECTION COMPARABLE - MOU MIGRATORY BIRD
- STATES RIGHTS - TIME AVAILABLE
GEORGE - ~~NSB~~ - ICAS -
- NATURAL RESOURCES + SUSTAINABILITY
INUIT / INUPIAQ -
OCEAN SURVIVAL -
FUTURE FOR SUBSISTANCE - GRAND KIDS
CIRCUMPOLAR ARCTIC OCEAN - MARINE MAMMALS, FISH + BIRDS - KOTZEBUE TO UNALAKLEET
NO COMPROMISE OF THEIR SAFETY -
KEEP HUMAN FACTOR AS WHO ARE WE
WHO REPRESENT - BOTH NUIQSUT + KAKTOVIK
GUIDING PRINCIPLES - ECONOMIC NEEDS NATURAL CHANGE
- PERSISTENT PRESENCE OF INUPIAQ PEOPLE

DEBBIE - ILISAGVIK COLLEGE + EDUCATION
2 ND MISSION - HUMAN RESOURCE NEEDS - NORTH SLOPE LANGUAGE
- PERPETUATE INUPIAQ CULTURE/VALUES
- FACE ENCROACHING DEVELOPMENT
- POLICY MAKERS + IMPACTS
PROBLEM BOY - MISSED MARKS -
- TRAINING - MARINE MAMMAL OBSERVER STEWARDSHIP PROGRAM

MARINE MAMMAL OBSERVER GUIDELINES -
SUPPORT FROM NMFS
TRADITIONAL INUPIAQ SCIENCE -
MELDED KNOWLEDGE FOR NMFS MMPA -
"TOKEN PRESENCE" - TRUE AUTHORITY VS LOOD
ANALOGIES OF OBSERVATIONS NOT RESPECTED -
- SUPPORT ACCREDITED PROGRAM - USCG LICENSING
TRAINING - AFN RESPECTED -
REGULATIONS FOR COMMENT
TRADITIONAL KNOWLEDGE FROM ELDERS -
"SEEDS OF GARDEN"
REGGIE - PROACTIVE FOR PROGRAMS - ILISAGVIK CAPITAL
"PEOPLE INVOLVEMENT" - ATTENTION TO
MOVING FORWARD
Debbie - THANK YOU -
INUPIAQ COMMUNITY OF ARCTIC SLOPE
GEORGE EDWARDSEN - ICAS -
KEEP PEOPLE & AUTHORITY AT TABLE
WHEN LOOKING AT THE ANIMALS - DEPENDENCE
- UNEMPLOYMENT RATES - SUBSISTENCE DEPENDENCE
- UNCLOS & CONSTITUTION SAVAGY

GORDON BROWER - NSB PLANNING
NO PREPARED STATEMENT -
- PICTURES TELLS STORY
TASK FORCE - ADDRESS OCEANS - WORLD CAPT EXPERT
FEED COMMUNITY -
CZM - TOOLS + TASK FORCE -
RE-INFORCE LOCAL PERSPECTIVE

GORDON

CZM - DIFFERENT ACROSS STATE
- RE-AUTHORIZE - STRENGTHEN LOCAL
- CO-MANAGE INTO EEZ
MIGRATORY PATH OF BOWHEAD & OIL DEVELOPMENT
CONCERN & USE - NEARSHORE - REZONING -
ECONOMIC DEVELOPMENT - RESPECT - PIONEER LIBERTY + OTHERS
BALANCED APPROACH - JOBS & RISK MITIGATION
- NORTH STAR - STUCK IN MOVING ICE
- ICE CAPABLE - BARGE SYSTEM - ORDINANCE
& LEGISLATIVE TOOLS FOR BETTER MANAGING
OFFSHORE ADVISORY PANEL -
ADVANCED TECHNOLOGY IN NEARSHORE
- ADVICE TO COMMITTEE - BALANCED DEVELOPMENT

VERSION - CZM - PRESS CONFERENCE -
GOVERNOR & COLLEAGUES - MOVE FORWARD -
"LOCAL CONTROL" VS "LOCAL INPUT"
GORDON - "LOCAL INPUT" PRIORITY OUTSIDE
STATE WATERS
- PROTECT BOWHEAD MIGRATION

ETHEL - SELF - WAINWRIGHT - BOARDING SCHOOL NOT EDGECOMB
LOOK BACK AT BARROW AFTER 20 YRS
2 LAW DEGREES - INDIGINOUS PEOPLE
- VALUE - TASK FORCE -
URBAN-RURAL TO COASTAL-INLAND DIVIDE
- COMMUNITY SURVIVAL - SALMON CRASH - TIMBER CRASH - OIL & GAS FLUCTUATIONS

ENDURANCE

ELIZABETH -
SUSTAINABLE LOCAL ECONOMY
- MIGRATORY VS MIXED ECONOMY
- CLOSE CUTTING - SUBSISTENCE VS ECONOMIC
KEEP SIGHT ON HISTORY +
- EVOS - RCAC - OPA 90
GULF OF MEXICO - FRESH EYES
- SEE WHO/WHAT OVERLOOKED
VOIDS/GAPS SCIENTIFIC PROCESS
- CONCERN USE OF STATISTICS -
FEDERAL + INDUSTRY AGENCIES EXPENDITURES
- SCIENCE - NOT UNDERSTANDING ARCTIC -
- STUDIES NEEDING TO BE RE-DONE - SITE/SUBJECT SPECIFIC (STATISTICAL ACTIVITIES)
- LOOK BACK + SEE WHAT DRIVING
- LOOK FORWARD WITH DEFENSIBLE + VALUES

- COMMENTS -
HARTIG - ADMIN MEMBER - FIELD HEARINGS RISK DECISION
MARKET RISK VS DEC ENVIRONMENTAL RISK
OLSON - CONCERNS OIL + ICE - FEAR
- GIVE CONCERNS LOGICALLY PRESENTED
POLICIES IN SESSIONS - LEGISLATORS + COMMISSIONS
CRAFT USCG - ADVOCATE BALANCE SUBSISTANCE + DEVELOPMENT
USCG PREPAREDNESS - OIL SPILLS
INPUT FROM LOCAL USERS - JOEL - TRIBAL LIAISON
EDMON - PASSION + ELOQUENCE - MIRRORS PEBBLE DISCUSSION
LIFETIMES OF RESOURCES
- MAKING PROGRESS ON CZM

HERRON -

CONCUR WITH EDGMON - KUSKOKWIM MAINTAIN SALMON IN YUPIK CULTURE -
COMPLIMENT TO MARIAN ITA

ITA - SENATOR MCGUIRE - HEAR FROM PEOPLE - CROSS BORDER ARCTIC COUNCIL
RELEVANCE + TIMELINESS -

JIMMY STOTT LOONEY - NATIONAL DEBATE -
ENERGY + CLIMATE CHANGE -
EXPLORATION IN ARTIC ALLOWED - ASSOCIATED WITH POWER

- STEDMAN - CZM - JANUARY - INPUT FOCUS
KETCHIKAN LOST SUBSISTENCE RIGHTS - SITKA AT RISK
RESOLUTION OF ISSUE IN COMMUNITIES

DAVE ~~ROW~~ KUBICK - GARY STEVENS APPT - COMPLIMENT
BARROW - IMPRESSED - ALLIES - MY CONCERNS EQUALLY / MOVE FORWARD

CHRIS HLADICK -
OIL + GAS - VS SHIPPING - INSURE USCG READY FOR ARCTIC
BERING SEA - RISK FROM SHIPS - COAST GUARD SKILLS / COAST GUARD LANES
COGNIZANCE OF SHIPPING ISSUES

CHUCK GREENE - UNDERSTAND WHAT FINAL OUTCOME WILL LOOK LIKE - NOT PERFECT PROCESS -
KEY WORDS - HOLISTIC - PRO DEVELOPMENT - INPUT V CONTROL - SUSTAINABILITY - GRASSROOTS
REPRESENT PEOPLE OF STATE - GOOD CROSS SECTIONS

JUDGE - CONTINUE WITH WRITTEN COMMENTS
- ~~PEOPLE~~ SERVICE TO PEOPLE OF STATE -
SERVICE + RECIPROCITY - VS EXPANDED SERVICES
- LOYAL ~~TO~~ UPON LAYER OF GOVT

OFFER TO BE PARTICIPATORY -
COMMUNITY ABILITY TO INPUT -
MAKE IT WITHOUT NEEDS FOR COUNTY
OFFER TO KEEP INPUT PUBLIC -
TIME BUT NOT LUXURY OF TIME - NATIONAL OCEAN COUNCIL
LEGIS INVOLVED AS POLICY BODY -
ENGAGE AGENCIES & CONDUCT FOR INFO -

Bob Pawlowski

From: St.John, Courtney CIV OPNAV, N2/N6F54B [courtney.st.john@navy.mil]
Sent: Tuesday, November 30, 2010 9:21 AM
To: Bob Pawlowski
Subject: RE: Task Force Climate Change Strategic Outreach Plan

Bob,

That sounds perfect, and thanks for your help!

All the best,
Courtney

-----Original Message-----
From: Bob Pawlowski [mailto:BPawlowski@denali.gov]
Sent: Tuesday, November 30, 2010 11:55
To: St.John, Courtney CIV OPNAV, N2/N6F54B
Subject: Re: Task Force Climate Change Strategic Outreach Plan

Courtney:

I understand and will share with her the information in hard copy and advise her that I am tracking it and will keep her informed of relevant events.

Will that meet your needs?

Bob

Sent from my iPhone

On Nov 30, 2010, at 5:52 AM, "St.John, Courtney CIV OPNAV, N2/N6F54B" <courtney.st.john@navy.mil> wrote:

> Bob,
>
> Thanks for asking first. I would prefer if you would only send the staffer the strategic outreach plan in the attached PDF format and ask that she not distribute beyond her own use. We like to maintain awareness of who this list of activities goes to and keep it within the federal government if possible. If she has any questions, please tell her to contact me directly.
>
> Thank you,
> Courtney
>
>
> Courtney St. John.
> Climate Change Affairs Officer, Task Force Climate Change.
> Office of the Oceanographer of the Navy.
> 202.762.0576.
> courtney.st.john@navy.mil
> courtney.stjohn@navy.smil.mil
>
>
>
> -----Original Message-----

> From: Bob Pawlowski [mailto:BPawlowski@denali.gov]
> Sent: Monday, November 29, 2010 15:28
> To: St.John, Courtney CIV OPNAV, N2/N6F54B
> Subject: RE: Task Force Climate Change Strategic Outreach Plan
>
> Courtney:
>
> I would like to share this calendar with the Representative Reggie
> Joule's staff (Christine Hess) as she is handling the information for
> the Alaska Northern Waters Task Force and has been a lead in the
Arctic
> aspects of Climate Change. Representative Joule's district is
Northwest
> Alaska and the North Slope, so naval activity is of interest.
>
> Thanks for any guidance.
>
> Bob Pawlowski
> Legislative Liaison to the Denali Commission
>
> -----Original Message-----
> From: St.John, Courtney CIV OPNAV, N2/N6F54B
> [mailto:courtney.st.john@navy.mil]
> Sent: Monday, November 29, 2010 10:49 AM
> Subject: Task Force Climate Change Strategic Outreach Plan
>
> Dear TFCC Colleagues,
>
> I'm attaching for your reference Task Force Climate Change's weekly
> Strategic Outreach Plan. These will be sent out on a monthly basis as
a
> way to inform action officers of the variety of activities in which
TFCC
> is engaging, some of which may overlap with your own activities. If
you
> have any questions or comments about a particular event, please do not
> hesitate to contact me.
>
> V/r,
> Courtney
>
>
> Courtney St. John.
> Climate Change Affairs Officer, Task Force Climate Change.
> Office of the Oceanographer of the Navy.
> 202.762.0576.
> courtney.st.john@navy.mil
> courtney.stjohn@navy.smil.mil
> <TFCC Strategic Outreach Plan - FY 11 Oct-Mar 101129.pdf>

TFCC Strategic Outreach Plan – FY 2011

Updated on:
28 Nov at 1400

Arctic

October

- Attend: NSC Arctic and National Security Update, 10/4
- Attend: Arctic Policy Group, 10/7
- Attend: US Arctic Marine Transportation IAT, 10/6
- Speak: Norwegian visit to OSD, 10/21
- Organize: Arctic IPT Meeting, 10/22
- SA: Arctic Practitioner's Workshop, 10/26-27
- Attend: N86 Mtg Surface Combatants in the High Latitudes, 10/27
- Attend: Antarctic Astronomy Event, 10/28
- Attend: Atlantic Council Event, 10/28
- Attend: Raytheon Arctic Demo Day, 10/28

November

- *Speak: Finnish Arctic Conference, 11/8, Helsinki
- Attend: NORTHCOM Arctic Planning Mtg, 11/1-4
- Attend: Arctic FAST, 11/02
- Mtg: Institute for Foreign Policy Analysis, 11/16
- Brief: Norwegian Midshipman, 11/10
- Attend: CMTS IAT, 11/18
- SA: SEARCH Fall Mtg, 11/17-18
- Speak: DHS "IC Support to the Arctic" conference, 11/16-17
- SA: C3F/DHS Arctic Symposium, 11/23-24
- Attend: Arctic Policy Group, 11/18
- O/C: Danish Naval Atache, 11/23

December

- Attend: EUCOM Arctic Zephyr, 12/1-3
- Attend: NWC Arctic Shipping Wargame, 12/8-10
- Attend: Arctic Policy Group, 12/16
- *CNO Arctic Roadmap Update, 12/23

Climate Change

October

- *O/C: Brian Detter, DASN ExW, 10/06
- Attend: GreenGov Symposium, 10/5-7
- Attend: Irregular WF Wargame Debrief, 10/19
- Attend: NRC Review GAO Geoengineering Report, 10/6-7
- Speak: NSF Brown-bag, 10/19
- Attend: Woodrow Wilson Ctr Geoengineering Event, 10/6
- Speak: Draper Laboratory GCM Symposium, 10/21-22
- Mtg: Nat Climate Assessment, 10/07
- *Attend: OSTP CENRS Mtg, 10/21
- Attend: Inter-agency Forum on Climate Change, 10/27
- *O/C: ASN (EI&E) Pfannenstiel, 10/12
- Speak: University of Maine Climate conference, 10/25
- *O/C: Ford Hart, CNO Foreign Policy, 10/28
- Attend: Woodrow Wilson Ctr Human Security, 10/19
- Attend: UNFCCC Interagency Briefing, 10/28

November

- Mtg: Bipartisan Policy Center, 11/01
- *O/C: DASD Dory & GEN Engel, 11/16
- *Testify: House E&E Subcommittee, 11/17
- Attend: AEPI Briefing, 11/23
- *Speak: ONR, 11/2
- Attend: Raytheon Demo Day, 11/4
- Speak: NCEP Geoengineering TF, 11/18
- Mtg: USAID, 11/23
- Attend: UK Royal Society Geoengineering Conf, 11/8-9, London
- O/C: World Ocean Council, 11/18
- Attend: Defense Science Board, 11/8-9
- *Speak: TEDx, 11/19
- Attend: IAIA Symposium, 11/15-17
- Attend: UNFCCC Interagency Briefing, 11/22
- Speak: USNA Global Climate Change Course, 11/15

December

- *Speak: Blue Planet Forum, 12/2
- Mtg: OSD AT&L Desk Officer Brief, 12/08
- Mtg: GAO, 12/02
- *Speak: DoD Panel at COP16, Cancun12/09
- Mtg: SERDP SLR Study, 12/02
- Attend: Inter-agency Forum on Climate Change, 12/03
- Attend: AEPI Water Security Workshop, 12/14
- Attend: Nat Climate Assessment Scenarios Workshop, 12/6-8
- Attend: Defense Science Board, 12/17
- *Speak: SERDP/ESTCP Annual Symposium, 11/30-12/01
- *Speak: AGU Annual Symposium, 12/13-17
- Mtg: USGCRP Climate Comm. WG, 12/20

Energy

October

- Mtg: NECO WG, 10/05
- Mtg: NECO WG, 10/19
- Attend: SECNAV Energy Awards, 10/06
- SA: Navy Energy Forum, 10/13-14

November

- Mtg: NECO WG, 11/02
- Mtg: NECO WG, 11/30
- Mtg: NECO WG, 11/16

December

- Mtg: NECO WG, 12/14
- Mtg: NECO WG, 12/28

Media

October

- Navy Environment/TFCC/TFE Website Launch
- Article: Bangor Daily News, 10/25

November

- Article: Surface Warfare Magazine, Fall Issue
- Interview: Foreign Policy Analysis, 11/16
- Interview: Medill News Service, 11/18

December

- Interview: Bob Reiss for "The Coming Storm", 12/01
- Interview: Reuters, 12/07

Key

Green text = C[illegible]ences/Large meetings
Red text = Of[illegible]ls
Blue text = AO level mtgs/work groups
Pink text = Congressional Engagement
Black [illegible]Articles
Orang[illegible] Interviews
Purple Text = TFCC Symposia
Starred items = RADM Titley attending
Highlighted tex[illegible]hange from last SOP

TFCC Strategic Outreach Plan – FY 2011

Updated on:
28 Nov at 1400

January	February	March
Arctic		
*Speak: Arctic Frontiers, Oslo, 1/24		
Climate Change		
*Speak: NRL, 1/06 *Attend: Swedish Navy Staff Talks, 1/13 *Attend: MEDEA, 1/19 *Attend/Speak: NCSE Our Changing Oceans , 1/19-21	*Speak: AAAS Annual Meeting, 2/17-21 Speak: USNA Sustainable Security Conference	Attend: GITEC Summit Attend: PACCOM Environmental Security Conference, 3/15-17
Energy		Sponsor: Navy Climate and Energy Symposium, 3/29-30
Media		
Article: Sea Technology Article: Live Better Magazine		

Key

Green text = C[illegible]ences/Large meetings
Red text = Off[illegible]s
Blue text = AO level mtgs/work groups
Pink text = Congressional Engagement
Black t[illegible]Articles
Orang[illegible] Interviews
Purple Text = TFCC Symposia
Starred items = RADM Titley attending
Highlighted text[illegible]hange from last SOP

Northern Waters Task Force minutes – December 2, 2010 Barrow, Alaska

Members:
Representative Reggie Joule – Chair
Senator Bert Stedman – Vice Chair
Senator Donny Olson
Representative Bob Herron
Representative Bryce Edgmon
Chris Hladick
Chuck Greene
Dave Kubiak
Mayor Edward Itta
Captain Adam Shaw, USCG (on behalf of RADM Colvin)
Larry Hartig, Commissioner, DEC
(Rep. Seaton on phone as interested legislator)

Speakers:

Jimmy Stotts	Inuit Circumpolar Conference- Alaska
Johny Aiken	Alaska Eskimo Whaling Commission
Todd Sformo	North Slope Borough (NSB) Dept of Wildlife Management
Jason Herremia	NSB Dept of Wildlife Management
Barrett Ristroph	NSB Law Department
George Olemaun	Inupiat Community of the Arctic Slope (ICAS)
Debby Edwardson	Ilisagvik College
George Edwardson	ICAS
Gordon Brower	NSB Planning Department
Ethel Patkotak	Self

Representative Joule convened the meeting at noon with introductory commenst regarding the Task Force and the importance of hearing from the people that depend on the northern waters. Members in attendance introduced themselves.

Jimmy Stotts, President of the Alaska chapter of the Inuit Circumpolar Conference (ICC) addressed the Task Force from prepared remarks that defined the ICC and its purpose in strengthening unity among Arctic Inuit, promoting Inuit rights and interests at the international level, developing and encouraging long term policies that protect the Arctic environment, and seeking full and active partnership in the political, economic, and social development of the Arctic. For 30 years, ICC has been pushing for Inuit influence over all activities affecting their people, homeland, and environment.
Expressed concerns with the State's pro-development attitude feeling that the state's approach is not evenly balanced and lacks involvement of local people and tribes. He also noted the importance of the Arctic Council and the ICC's permanent participant status, and encouraged the Task Force to stay informed of the work of the Arctic Council and particularly the human dimension. Jimmy offered 8 recommendations to the Task Force as follows:

1. Recommends a tribal presence on the task force
2. Put strong local influence back into Coastal Zone Management (CZM) and criticized the state for failing to move forward on this legislation for years

3. Realize Arctic offshore development is international in nature and is a process already in motion the State's interest is late
4. Science and traditional knowledge should help form the basis for decisions
5. Focus on offshore development must be holistic, not lopsided state's present approach lacks balance
6. Inupiat must benefit from development and not just through jobs
7. Seriously consider the NSB's offshore oil and gas policy (eight points)
8. Expand the task force mandate to review the environmental side of Arctic Ocean resource development

Jimmy concluded by noting that ICC will be holding an Inuit Leadership Summit on Resource Development February 23-24 in Ottawa Canada to discuss offshore oil and gas development, uranium mining, and the social and environmental impact assessment process.
In addition to his written testimony, a copy of the Inuit Arctic Policy will be forthcoming to Rep. Joule.

Senator Stedman commented that CZM was a broader, statewide issue and also is complicated by the President's Executive Order. He noted that the legislature will be working on this but a resolution may take more than one session. Current system creates too much tension.

Representative Herron questioned as to whether a multi-lateral treaty for the Arctic, similar to the Antarctic made sense thus keeping the governance close at hand. Jimmy noted that an international treaty on search and rescue is in the works and that there are several bilateral treaties in existence.

Mr. Johny Aiken, Executive Director, Alaska Eskimo Whaling Commission (AEWC), provided a power point presentation on the Alaska Whaling Commission, the distribution of bowhead whales and the challenges of whaling and working in heavy ice. The presentation was a repeat of the presentation made to BOEMRE in their July OCS Forum. His key points were:

- Migratory paths of the whales are known and well mapped, have been researching them through a tagging process with the Department of Fish and Game
- Noted possible oil drilling sites that are in the whale's migratory paths
- Noted that past conflict avoidance agreements with the oil industry have been effective in working together balancing oil exploration with subsistence hunting needs
- Know that the whale's migration path can be impacted up to 20 feet away from oil development/sound
- Depend on food in the sea for survival most important being the whale
- Heavy ice and pressure ridges make work very difficult in the Arctic waters
- Heavy ice requires the best technology and feeling is that the industry is not ready to respond to a spill in these conditions in remote Alaska
- Deepwater Horizon showed even with infrastructure, how difficult controlling and containing an oil discharge is, making the point that Alaska and industry are not ready for work away from Prudhoe Bay
- Concern for animals if a spill occurred and feels it would be very difficult to help large animals impacted by a spill like whales and polar bears

- Support Liberty directional and extended reach drilling as a way to avoid conflicts with whales and environmental risk
- Does not support off shore development without better technology does not believe ready for the challenge in the Arctic

Johny concluded his comments noting that the AEWC strongly supports coastal zone management and wants to insure there is a community voice in the development process.

Todd Sformo and Jason Herremia, NSB Department of Wildlife Management provided a power point presentation overview of the wildlife research and management.

Todd provided a historical framework of research on the North Slope noting the long standing practice of working with local people as scientists from the earliest days. He referred to "50 More Years Below Zero" section on "Science and Community: Inupiat Contributors to the Laboratory's Effectiveness" for "*Introduction to Alaska's Original Naturalist*" and "*Historical Perspectives on Inupiat Contributions to Arctic Science at NARL*" to point out the importance of collaborative research work. He quoted a passage from Kenneth Toovak, Sr. as he evaluated his career of collaboration with scientists: " *I was scared of White people…I stayed to myself. Pretty soon, those folks started coming around to talk to me, asking questions. I started to get to know these people I had been scared of. We started to share the different things we know. This sharing became a very important part of my life. It wasn't easy…But, we kept on sharing knowledge…Scientist wanted my help…they felt good when I helped them on the ice. So I made myself available to them, and we went on sharing" (Toovak, 1992: 19)).* The key point made by Todd was that the people of Barrow have been working to combine traditional knowledge and western science for over 50 years and both sides are committed to continuing this process. He also noted that the NSB scientific research has had both regional and international significance.

Jason discussed the different research work at the Arctic Science Center, with a focus on subsistence animals used by the community. The bowhead whale remains one of the primary research focus areas, with recognition of their extended age (180-200 yrs old). They are also working on the entire genome of the whale with university researchers. The Center has also expanded into collecting baseline disease assessment, tracking, population data, and other related research for ice seals (ring, spotted), caribou herds, beluga whales, and a variety of water fowl. A recent focus has been on assessing the health of subsistence users as diets and climate conditions change. The center also tracks ESA listing as they pertain to local populations and subsistence foods (eiders, polar bears and ice seals). He noted that much of the funding for the research comes from a variety of grants and the North Slope Borough.

Senator Olson asked about narwhal research in the eastern Beaufort Sea and Canada. It was noted that this was out of the area researched and little information existed at the NSB, although contacts with Canadian collaborators could help find information. Additionally, in the future it is possible that research will happen on the narwhal.

Barrett Ristoph, NSB Law Department spoke of her efforts to support policies of the NSB, including the Planning Department for the Alaska Coastal Management Program to improve the program and specific work on land use codes for the nearshore areas to streamline the permitting process for development.

She is currently working on updating an outdated land use code, it is 20 years old. Barrett talked about wildlife co-management, climate issues, and her work with different groups like AEWC, ICAs and many others. The NSB tries to work collaboratively with other departments and agencies to achieve their common goals through Memorandums of Understanding and joint comments for federal and state processes.

Representative Herron raised the success of the Migratory Bird Treaty as an analogy to CZM. He noted that CZM worked for decades and with the present issues facing Alaska and the Arctic it could serve to provide protection comparable to the Migratory Bird Treaty. Herron noted that we didn't have decades to work out CZM. Barrett commented that the Migratory Bird treaty has been successful and gives the state's rights over an area that they wouldn't otherwise have much control over. She believes that the NSB can work cooperatively with the federal government to achieve common goals and that they have done so in the past. Representative Herron commented on CZM and states right and noted the importance of using the time available to resolve local governance and states' rights issues sooner rather than later.

George Olemaun talked on behalf of the Inupiat Community of the Arctic Slope (ICAS) and provided written comments that highlighted the relationship between the long term survivability of the Inuit, and the natural resources found in the area. George talked about the importance of the ocean for survival both as a food source but also as an integral part of the spiritual culture, and noted the importance of subsistence for the future and the next generation of Inuit. He spoke about the marine mammals, fish and birds that all come north to the Arctic Ocean and of the Inuit's dependence in Alaska from Kaktovik to Unalakleeet, believing that no compromise should be made for their safety. George stressed keeping the "Human Factor" upfront when making decisions about development and taking the time to get to know the people up north and respecting the Inupiat for "who we are versus who we represent". By following guiding principles he believes people can adapt for natural environmental change and economic need. He concluded by recognizing the "persistent presence" of Inupiat people in the Arctic.

Debbie Edwardson, Special Projects Coordinator, Ilisagvik College, and NSB School Board President. Debbie e introduced the College mission as 2 fold; (1) addressing human resource needs for the North Slope workforce, and (2) perpetuating Inupiat language and culture. She recognized that encroaching development needed attention from policy makers and professionals to insure community involvement and felt that Prudhoe Bay missed the mark in local hire of workforce. Debbie talked about the Marine Mammal Observer Stewardship Program (background article, although not provided, can be found at http://www.thearcticsounder.com/article/1045ilisagvik_colleges_marine_mammal_observer) and requested support from the NWTF as the program brought traditional Inupiat science together with National Marine Fisheries Services in addressing the MMPA in the Arctic. Through the program, local observers work on boats sharing traditional knowledge about the animals in an effort to keep them safe. NMFS is presently working on guidelines for observing mammals but she wants to insure that these guidelines give the observers a real presence on the boats and that they do not end up with a mere token presence noting the observers must have true authority to act. Noted that there have been some reports that these observers have been treated as a "token presence" and that in some cases the observations were not respected and encouraged trust in the knowledge of people that have watched

the marine mammals for decades. Debbie continued with sharing information about other accredited programs including USCG licensing program, this program has been accredited by AFN. On the subject of forthcoming regulations and the ability to comment, she highlighted the importance of respecting the traditional knowledge of elders and their closeness to the sea. She concluded by noting that "the sea is our garden."

Representative Joule commented on the proactive programs of Ilisagvik College and the investment of capital for "People Involvement" as the programs move forward.

George Edwardson, President, ICAS, stressed the importance of keeping the local people and the authority at the table when looking at the animals and community dependence. With high unemployment rates people depended on subsistence to meet needs. George talked about jurisdiction of the tribe and how there was an analogy between UNCLOS and the Alaska constitution as the governance of the Inupiat people was linked to the animals and thus extended beyond state waters into federal waters and those waters agreed to by UNCLOS. He noted that after the three mile limit the state had few rights but the tribes did so the state should work with the local people.

Gordon Brower, NSB Planning Department, provided remarks reflecting on Johny Aiken's presentation that pictures tell the story. He encouraged the task force to address ocean concerns as the ocean feeds the community. CZM was of significant interest as a tool to reinforce local perspective, but cautioned that it was different across the state. He encouraged reauthorization of the ACMP to strengthen local involvement and facilitate co-management in the EEZ. Concerns were noted for the migratory paths of bowheads and oil development and issues associated with nearshore re-zoning of the NSB. NSB has worked on new near shore zoning rules to mitigate risk. Respect was given for the importance of economic development and the success of Liberty and others and noted a balanced approach of jobs and risk mitigation. Examples included North Star being stuck in moving ice and the interest in an ordinance for ice capable barge system on the North Slope. Gordon asked for improved learning tools for better managing offshore development. He suggested an offshore advisory panel that could study existing near shore development and look into advanced technology for near shore development and make recommendations/regulations regarding the development. Gordon concluded with advice to the committee on finding balanced development by looking at what the NSB has done over the last several years.

Representative Herron noted a press conference on CZM as the Governor and colleagues move forward and asked whether "local control" or "local input" was preferred. Gordon commented that "local input" was a priority outside state waters and that the goal was to protect the bowhead whale. Noted the frustration of not being able to comment beyond the 3 mile limit.

Ethel Patkotak spoke on behalf of herself as a resident of Wainwright after a 20 year absence from the NSB. Ethel noted her 2 law degrees and her work for indigenous people. In recognizing the value of the Task Force, she encouraged an understanding of the urban-rural to coastal-inland divide as community survival is no different between challenges with oil and gas fluctuations, salmon disasters, or the crash of the timber industry. Different locations have had to survive different economic troubles. In each

case, endurance of the people is key and finding ways for sustainable local economies. Must recognize the migratory nature of many of our communities and the mixed economy that exists which combines subsistence and cash economic activity in communities. Ethel continued with guidance on keeping sight of history, including the Exxon Valdez oil spill and the role of the RCAC's and OPA-90. The Gulf of Mexico needs to be looked at with fresh eyes to see who or what was overlooked and the voids or gaps in the scientific process. Look at what has worked and what hasn't worked with the advisory councils. Ethel continued in expressing concerns for the use of statistics, whether shown in federal and industry expenditures, science in not understanding the Arctic, and how studies often need to be redone as site or subject specific to validate the statistical findings. In concluding, Ethel encouraged the Task Force to look back and see what is driving activities and look forward with defensible values, noting that committee members must stay true to their values. Sees the task force as looking for a means to keep communities involved in development processes but notes that the train is already moving full speed ahead.

Closing Comments:

After taking public testimony, Representative Joule looked to the Task Force members for closing comments.

Commissioner Hartig as the Administration's member noted the value of field hearings in making risk decisions. He compared his use of market risk with the Permanent Fund Dividend in making decisions versus DEC in environmental risk decisions. Clearly, the DEC environmental risk remains the ones of his greatest concern.

Senator Olson commented on his concerns for oil and ice and his fear of an incident. He recognized the grave concerns logically presented at the hearing and he looks forward to discussions of policies in the session between legislators and state commissioners.

Captain Shaw, on behalf of RADM Colvin, appreciated the advocacy for balance between subsistence and development. The USCG maintains preparedness for oil spills and is working to insure input from local users. He introduced Joel Casto as the USCG Tribal Liaison for District 17 and encouraged working with him.

Representative Edgmon complimented those providing testimony for their passion and eloquence and how it mirrors the discussions he hears on Pebble. He recognizes the importance of a lifetime of resources behind these discussions. Representative Edgmon looks forward to making progress on CZM.

Representative Herron concurred with Representative Edgmon noting the Kuskokwim area maintains salmon integral to the Yupik culture. He concluded with a compliment to Mayor Itta for his hospitality.

Mayor Itta complimented Senator McGuire for taking time to hear from the people in a cross-border Arctic Caucus meeting as it was relevant and timely. He reflected on Jimmy Stotts words for a national debate on energy and climate change as exploration in the Arctic is allowed. He expressed concern over

President Obama's recent decision to allow drilling in the Arctic reversing his prior order. Message is exploration will be allowed in Arctic, substantial offshore activity and this will affect all of us. He concluded with a compliment of having the Task Force hearing in conjunction with PNWER.

Senator Stedman noted upcoming CZM discussions that will occur in January. Has not talked with his communities yet but anticipates that there will not be uniform agreement among his communities but believes everyone will say that they want more input. Process may look messy from the outside but will smooth out and get resolution. Wants hearings in a variety of communities regarding CZM across the state. He noted that Ketchikan had lost its local subsistence rights and that Sitka was at risk and looks forward to resolutions of the issues in his communities.

Dave Kubiak complimented Senator Stevens for his appointment and appreciated Barrow's hospitality. He was very impressed with the speakers and sees Barrow as allies with equal concerns on the issues expressed before the Task Force.

Chris Hladick noted his community's role in oil and gas versus shipping and expressed the importance to insure the USCG is ready for the Arctic. He noted the risk for ships in the Bering Sea and cognizance of the correct skills, crews and sea lanes in managing shipping issues. Major concern of his area will be shipping as his area is a hub.

Chuck Greene noted that the Task Force members didn't yet have an idea of what the final outcome will look like, and noted that the issues are not part of a perfect process. He commented on the common words people used when testifying such as, "holistic process", "balanced development" "local input" "sustainability." This hearing reflected a good cross section of the grass roots nature of public input and what it represents to the state. Believes in the end the decision will be representative of what they have heard and believes that the task force has a good balance of people that represent the people of the state and the northern region.

Representative Joule concluded the comments encouraging attendees to continue with written comments if they didn't have an opportunity to testify. He acknowledged the service of the Task Force members to the state and that service and reciprocity often went hand in hand. Expanded services like the Task Force often include layer upon layer of government, but he hoped that the process offered to be participatory. Pleased to hear from the community that they wanted to participate in whatever process evolved. Believes that when the community and people have input often mitigates the needs for courts. This Task Force process offers to keep the input public and time is available given the on-going CZM discussion in the Legislature and the National Ocean Council activities, although there is not a luxury of time. Representative Joule concluded by thanking the members and the attendees in the hearing.

The hearing adjourned

12/22/2010

Johny Ailken testimony from BOEMRE hearing in Anchorage, as he noted this is same presentation presented to the Northern Waters Task Force

http://www.boemre.gov/forums/documents/AnchorageTranscript26Aug10.pdf

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MR. AIKEN: Good morning, everyone. First of all, I would like to thank Director Bromwich and the Bureau of Ocean Energy Management, Regulation and Enforcement for holding this forum and to give us a chance to speak on how we feel about offshore activities in the Arctic.

My name is Johnny Aiken, and I am the executive director of the Alaska Eskimo Whaling Commission. I am from Barrow, Alaska and was born and raised there and have been whaling with my father for over 40 years. AWC has 11 whaling villages, and my presentation is focused on whaling and our environment. I do not want to take too much of your time, so I will make my presentation as brief as possible. I have a lot of pictures, and I think that looking at pictures tells a better story than words can say. So I just wanted to give you an idea of our environment and the culture we enjoy as a result of what our environment has to offer us as a people.

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This is a photograph of Harry Brower's whaling crew and a whale he harvested not very long ago. As most of you know, Harry Brower is the chairman of the Alaska Eskimo Whaling Commission and was not able to be here because of his busy schedule.

This is a slide that shows where the whales are in different times of the year. The yellow low is where the whales are in the wintertime. According to the tagged whales, we have learned that the yellow is the area where the whales winter every year. The green is showing you that during -- the green is during the spring when the whales start migrating north towards Canada, and that is when our spring whaling begins.

For Barrow, our whaling activities begin in mid to late April. I think the migration starts as early as January or February. The pink is where the whales summer in Canada. And the brown is where the whales start migrating south in the fall.

This slide shows the areas where seismic leasing and drilling are to occur in the Chukchi Sea and the Beaufort Sea should this program be opened.

Here is where Shell's Beaufort Sea campaign is -- here is where Shell's Beaufort Sea campaign is to drill the Sivulliq project in the near future if allowed.

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I lost it, sorry. This slide shows where a lot of whale sighting occurred during 1979 and 2005 -- between 1975 and 2005. All the dates are whale sightings -- all the dots are whale sightings, I'm sorry. The yellow is the Kaktovik's bowhead use area, and people in Nuiqsut use area. The red lines indicate Nuiqsut's whaling GPS tracking where they hunt, the red lines there inside all those dots.

This slide shows where Sivulliq is going to

be located in the brown circles. And the gray indicate where deflection -- whale deflection distances from the center. The center being the Sivulliq project. Each circle represents a distance, and the distances are 6, 9, 15 and 19 miles. Those lines depict the use areas for Nuiqsut. As you can see, Sivulliq is right in the path of the migrating whales in the fall.
On this slide our lines, which -- depict the tagged whales and the lease areas. This is in the fall. As you can see, many whales migrate through the lease area. Work in the Arctic will mean work in heavy ice, and we are concerned that there may not be technology to be working in the ice-infested waters. Ice is -- it can be a very strong -- it's something that you've got to be real careful with, and it's not going to be easy to work in the ice should a spill occur.

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This slide here shows typical ice structures in the winter. We have a lot of pressure ridges nearshore which tells us how powerful moving ice can be. As you can see, some of these pressure ridges can be pretty huge. For our whaling crews, a lot of work is involved in building trails to the open lead. Every year crews go out and build a trail to the open lead. Sometimes it can take weeks to get to the lead. We cannot use any heavy equipment. All the work is done by hand, labor, ice picks, and using heavy equipment may be too dangerous.
Our ocean, the Arctic Ocean, has many animals and fish, with the most important being the whale. The whales travel through any kind of ice conditions, whether it be closed or open. Many have calves either in the spring or the fall migration. We know whales can live under the ice when there is no water to be seen. We have seen air holes, such as this, even in three to four feet of thick ice. If oil is under the ice, the whales are sure to be there.
And this is a picture of a whale breathe through the ice. Should an oil spill occur, many animals will be impacted, probably much more than what happened in the Gulf. Since ice has receded in recent years because of global warming, hundreds of walrus have been found on beaches along the Arctic coast. I believe this photograph

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is located between Point Lay and Point Hope. Polar bears are a concern, too. I can't imagine a polar bear tarred with oil. I don't think it would ever survive if it had oil on its coat in the wintertime.
In the Arctic, we have our share of storms. Along with the storms comes erosion of our coastline. Here we see the same area before the storm. These are the same houses. In August of 2000 we had one of our biggest storms. The worst storms we had were in 1963 when we saw houses and fuel tanks floating along the coast. In October 2006, we had bad storms also. Some of these storms destroyed erosion control structures. This is in Wainwright. Almost straight offshore are the lease areas.
This is a slide on the Liberty Project, and the reason I wanted to show this is because we need to find better technology if we're going to develop offshore oil

and gas. Right now I believe that we are not ready to develop offshore oil and gas in the Arctic where it will be much harder to respond to an oil spill. The oil industry had a hard enough time in the -- in their response in the Gulf spill where there was no ice, where temperatures and weather were not an issue. It's extremely cold in the Arctic, and I can't imagine having to respond to a spill where there is ice and where it gets too cold for equipment. We need to wait until there is technology which is capable of responding to oil spills in the Arctic.

Thank you, Commissioner.

Northern Waters Task Force minutes – December 2, 2010

Members:
Representative Reggie Joule – Chair
Senator Bert Stedman – Vice Chair
Senator Donny Olson
Representative Bob Herron
Representative Bryce Edgmon
Chris Hladick
Chuck Greene
Dave Kubiak
Mayor Edward Itta
Captain Adam Shaw, USCG (on behalf of RADM Colvin)
Larry Hartig, Commissioner, DEC
(Rep. Seaton on phone as interested legislator)

Speakers:

Jimmy Stotts	Inuit Circumpolar Conference- Alaska
Johny Aiken	Alaska Eskimo Whaling Commission
Todd Sformo	North Slope Borough (NSB) Dept of Wildlife Management
Jason Herremia	NSB Dept of Wildlife Management
Barrett Ristroph	NSB Law Department
George Olemaun	Inupiat Community of the Arctic Slope (ICAS)
Debby Edwardson	Ilisagvik College
George Edwardson	ICAS
Gordon Brower	NSB Planning Department
Ethel Patkotak	Self

Representative Joule convened the meeting at 12:00 (check time) with introductory comment regarding the Task Force and the importance of hearing from the people that depend on the northern waters. Members in attendance introduced themselves.

Jimmy Stotts, President of the Alaska chapter of the Inuit Circumpolar Conference (ICC) addressed the Task Force from prepared remarks (attached) that defined the ICC and its purpose in strengthening unity among Inuit of the Arctic, promote Inuit rights and interest at the international level, develop and encourage long term policies that protect the Arctic environment, and seek full and active partnership in the political, economic, and social development of the Arctic. For 30 years, ICC has been pushing for Inuit influence over all activities affecting the people, homeland and environment.
After discussing concerns for a pro-development attitude of the State of Alaska and concerns for involving local people, he noted the importance of Arctic Council and the ICC's permanent participant status, encouraging the Task Force to stay informed of the work of the Arctic Council and particularly the human dimension. Jimmy offered 8 recommendations to the Task Force as follows:

1. Include a tribal presence on the task force
2. Put strong local influence back into Coastal Zone Management (CZM)
3. Realize Arctic offshore development is international in nature
4. Science and traditional knowledge should form the basis for decisions
5. Focus on offshore development must be holistic, not lopsided
6. Inupiat must benefit from development, beyond jobs

7. Seriously consider the NSB's offshore oil and gas policy (eight points)
8. Expand the task force mandate to review the environmental side of Arctic Ocean resource development

Jimmy concluded by noting that the ICC Inuit Leadership Summit on Resource Development on February 23-24 in Ottawa Canada to discuss offshore oil and gas development, uranium mining, and the social and environmental impact assessment process.
In addition to his written testimony, a copy of the Inuit Arctic Policy will be forthcoming to Rep. Joule.

Senator Stedman commented that CZM was a broader, statewide issue and also is complicated by the President Executive Order. He noted that the legislature will be working on this but may take more than one session.

Representative Herron questioned as to whether a multi-lateral treaty for the Arctic, similar to the Antarctic made sense thus keeping the governance close at hand.

Mr. Johny Aiken, Executive Director, Alaska Eskimo Whaling Commission (AEWC), provided a powerpoint presentation (to be posted) on the Alaska Whaling Commission, the distribution of bowhead whales and the challenges of whaling and working in heavy ice. The presentation was a repeat of the presentation made to BOEMRE in their July OCS Forum (transcript attached). His key points were:

- Migratory paths of the whales are known and well mapped
- Conflict avoidance agreements were effective for working together
- Heavy ice and pressure ridges make work very difficult
- Heavy ice requires the best technology and feeling is that the industry is not ready for those conditions in remote Alaska
- Deepwater Horizon showed even with infrastructure, how difficult controlling and containing an oil discharge is, making the point that Alaska and industry are not ready for work away from Prudhoe Bay
- Support Liberty directional and extended reach drilling as a way to avoid conflicts with whales and environmental risk

Johny concluded his comments noting that the AEWC strongly supported CZM and wanted to insure there was a community voice in development.

Todd Sformo and Jason Herremia, NSB Department of Wildlife Management provided an powerpoint presentation overview of the wildlife research and management. Todd provided a reference to "50 More Years Below Zero" section on "Science and Community: Inupiat Contributors to the Laboratory's Effectiveness" for "*Introduction to Alaska's Original Naturalist*" and "*Historical Perspectives on Inupiat Contributions to Arctic Science at NARL*" was made as to the importance of collaborative help. (I believe the quoted passage was from Kenneth Toovak, Sr. as he evaluated his career of collaboration with scientists: *I was scared of White people...I stayed to myself. Pretty soon, those folks started coming around to talk to me, asking questions. I started to get to know these people I had been scared of. We started to share the different things we know. This sharing became a very important part of my life. It wasn't easy...But, we kept on sharing knowledge...Scientist wanted my help...they felt good when I*

helped them on the ice. So I made myself available to them, and we went on sharing" (Toovak, 1992: 19)). The key point made by Todd was that the people of Barrow have been working to combine traditional knowledge and western science for over 50 years and are committed to many years more. Jason discussed the different research work of the Arctic Science Center, with a subsistence focus for the animals used by the community. The bowhead whale remains the primary research focus, with recognition of their extended age (180-200 yrs old). The Center has also expanded into collecting baseline disease assessments in ice seals and monitoring caribou populations. A recent focus has been on assessing the health of subsistence users as diets and climate conditions change. The center also tracks ESA listing as they pertain to local populations and subsistence (polar bears and ice seals). A plea was made for grant funding sources, as training is moving forward for the young people as they are the future of Barrow collaboration in science.

Senator Olson asked about narwhal research in the eastern Beaufort sea and Canada. It was noted that this was out of the area researched and little information existed at the NSB, although contacts with Canadian collaborators could help find information.

Barrett Ristoph, NSB Law Department spoke of her efforts to support policies of the NSB, including the Planning Department for the Alaska Coastal Management Program to improve the program and specific work on land use codes for the nearshore areas to streamline the permitting process. Barrett talked about wildlife co-management, climate issues, and her work with the AEWC, ICAs and others for Memorandums of Understanding and joint comments for federal and state actions.

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George Olemaun talked on behalf of the Inupiat Community of the Arctic Slope (ICAS) prov9ided written comments (attached) that highlighted the relationship between the Inuit/Inupiaq people survivability and the natural resources. George talked on the ocean for survival and the importance of subsistence for the future. He noted that the marine mammals, fish and birds were circum Arctic Ocean and of dependence in Alaska from Kaktovik to Unalakleeet, with no compromise to be made for their safety. George stressed to keep the "Human Factor" upfront as the Inupiat are "who we are versus who we represent". By following guiding principles people can adapt for natural change and economic need. He concluded by recognizing the "persistent presence" of Inupiat people in the Arctic.

Debbie Edwardson, Director Workforce Development (?), Ilisagvik College, introduced the College mission as 2 fold, addressing human resource needs for the North Slope and perpetuate Inupiat language and culture for the students. She recognized the encroaching development needed attention from policy makers and professionals to insure community involvement and felt that Prudhoe Bay missed the mark in local hire of workforce. Debbie talked about the Marine Mammal Observer

Stewardship Program (background article, although not provided, at http://www.thearcticsounder.com/article/1045ilisagvik_colleges_marine_mammal_observer) and requested support from the NWTF as the program brought traditional Inupiat science together with NMFS in addressing the MMPA in the Arctic. She expressed concerns that these "observers" were a "token presence" and that in cases the observations were not respected and encouraged trust in the knowledge of people that have watched the marine mammals for decades. Debbie continued with sharing the accredited programs including USCG licensing that were AFN respected. On the subject of forthcoming regulations and the ability to comment, she highlighted the respect of the traditional knowledge of elders and their closeness to the sea.

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These included understanding a migratory versus mixed economy that cross-cuts subsistence versus economic activity. Ethel continued with guidance on keeping sigh on history, including the Exxon Valdez oil spill and the role of the RCAC's and OPA-90. The Gulf of Mexico needs to be looked at with fresh eyes to see who or what was overlooked and the voids or gaps in the scientific process. Ethel continued in expressing concerns for the use of statistics, whether shown in federal and industry expenditures, science in not understanding the Arctic, and how studies often need to be redone as site or subject specific to validate the statistical findings. In concluding, Ethel encouraged the Task Force to look back and see what is driving activities and look forward with defensible values.

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Senator Stedman noted CZM discussions in January and the input focus. He noted that Ketchikan had lost its local subsistence rights and that Sitka was at risk and looks forward to resolutions of the issues in his communities.

Dave Kubiak complimented Senator Stevens for his appointment and appreciated the Barrow allies with equal concerns on the issues expressed before the Task Force.

Chris Hladick noted his community's role in oil and gas versus shipping and expressed the importance to insure the USCG is ready for the Arctic. He noted the risk for ships in the Bering Sea and cognizance of the correct skills, crews and sea lanes in managing shipping issues.

Chuck Greene encouraged the Task Force to understand what the final outcome will look like, as the issues are not part of a perfect process. He commented on the holistic process in balancing pro-development for input versus control and consideration of sustainability. This hearing reflected good cross section of the grass roots nature of public input and what it represents to the state.

Representative Joule concluded the comments encouraging attendees to continue with written comments. He respected the service of the Task Force members to the state and that sevice and reciprocity went hand in hand. Expanded services often include layer upon layer of government, but he hoped that the process offered to be participatory. The community ability to input often mitigates the needs for courts. This Task Force process offers to keep the input public and time is available given the CZM discussion in the Legislature and the National Ocean Council activities, although there is not a luxury of time. Representative Joule concluded by thanking the members and the attendees in the hearing.

The hearing adjourned at 2:15 (check time).

Johny Ailken testimony from BOEMRE hearing in Anchorage, as he noted this is same presentation presented to the Northern Waters Task Force

http://www.boemre.gov/forums/documents/AnchorageTranscript26Aug10.pdf

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MR. AIKEN: Good morning, everyone. First
of all, I would like to thank Director Bromwich and the
Bureau of Ocean Energy Management, Regulation and
Enforcement for holding this forum and to give us a chance
to speak on how we feel about offshore activities in the
Arctic.
My name is Johnny Aiken, and I am the
executive director of the Alaska Eskimo Whaling Commission.
I am from Barrow, Alaska and was born and raised there and
have been whaling with my father for over 40 years.
AWC has 11 whaling villages, and my
presentation is focused on whaling and our environment. I
do not want to take too much of your time, so I will make
my presentation as brief as possible. I have a lot of
pictures, and I think that looking at pictures tells a
better story than words can say. So I just wanted to give
you an idea of our environment and the culture we enjoy as
a result of what our environment has to offer us as a people.
Page 90
This is a photograph of Harry Brower's
whaling crew and a whale he harvested not very long ago.
As most of you know, Harry Brower is the chairman of the
Alaska Eskimo Whaling Commission and was not able to be
here because of his busy schedule.
This is a slide that shows where the whales
are in different times of the year. The yellow low is
where the whales are in the wintertime. According to the
tagged whales, we have learned that the yellow is the area
where the whales winter every year. The green is showing
you that during -- the green is during the spring when the
whales start migrating north towards Canada, and that is
when our spring whaling begins.
For Barrow, our whaling activities begin in
mid to late April. I think the migration starts as early
as January or February. The pink is where the whales
summer in Canada. And the brown is where the whales start
migrating south in the fall.
This slide shows the areas where seismic
leasing and drilling are to occur in the Chukchi Sea and
the Beaufort Sea should this program be opened.
Here is where Shell's Beaufort Sea campaign
is -- here is where Shell's Beaufort Sea campaign is to
drill the Sivulliq project in the near future if allowed.
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I lost it, sorry. This slide shows where a lot of whale
sighting occurred during 1979 and 2005 -- between 1975 and
2005. All the dates are whale sightings -- all the dots
are whale sightings, I'm sorry. The yellow is the
Kaktovik's bowhead use area, and people in Nuiqsut use
area. The red lines indicate Nuiqsut's whaling GPS

tracking where they hunt, the red lines there inside all those dots.
This slide shows where Sivulliq is going to be located in the brown circles. And the gray indicate where deflection -- whale deflection distances from the center. The center being the Sivulliq project. Each circle represents a distance, and the distances are 6, 9, 15 and 19 miles. Those lines depict the use areas for Nuiqsut. As you can see, Sivulliq is right in the path of the migrating whales in the fall.
On this slide our lines, which -- depict the tagged whales and the lease areas. This is in the fall. As you can see, many whales migrate through the lease area. Work in the Arctic will mean work in heavy ice, and we are concerned that there may not be technology to be working in the ice-infested waters. Ice is -- it can be a very strong -- it's something that you've got to be real careful with, and it's not going to be easy to work in the ice should a spill occur.

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This slide here shows typical ice structures in the winter. We have a lot of pressure ridges nearshore which tells us how powerful moving ice can be. As you can see, some of these pressure ridges can be pretty huge. For our whaling crews, a lot of work is involved in building trails to the open lead. Every year crews go out and build a trail to the open lead. Sometimes it can take weeks to get to the lead. We cannot use any heavy equipment. All the work is done by hand, labor, ice picks, and using heavy equipment may be too dangerous.
Our ocean, the Arctic Ocean, has many animals and fish, with the most important being the whale. The whales travel through any kind of ice conditions, whether it be closed or open. Many have calves either in the spring or the fall migration. We know whales can live under the ice when there is no water to be seen. We have seen air holes, such as this, even in three to four feet of thick ice. If oil is under the ice, the whales are sure to be there.
And this is a picture of a whale breathe through the ice. Should an oil spill occur, many animals will be impacted, probably much more than what happened in the Gulf. Since ice has receded in recent years because of global warming, hundreds of walrus have been found on beaches along the Arctic coast. I believe this photograph

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is located between Point Lay and Point Hope. Polar bears are a concern, too. I can't imagine a polar bear tarred with oil. I don't think it would ever survive if it had oil on its coat in the wintertime.
In the Arctic, we have our share of storms. Along with the storms comes erosion of our coastline. Here we see the same area before the storm. These are the same houses. In August of 2000 we had one of our biggest storms. The worst storms we had were in 1963 when we saw houses and fuel tanks floating along the coast. In October

2006, we had bad storms also. Some of these storms destroyed erosion control structures. This is in Wainwright. Almost straight offshore are the lease areas. This is a slide on the Liberty Project, and the reason I wanted to show this is because we need to find better technology if we're going to develop offshore oil and gas. Right now I believe that we are not ready to develop offshore oil and gas in the Arctic where it will be much harder to respond to an oil spill. The oil industry had a hard enough time in the -- in their response in the Gulf spill where there was no ice, where temperatures and weather were not an issue. It's extremely cold in the Arctic, and I can't imagine having to respond to a spill where there is ice and where it gets too cold for equipment. We need to wait until there is technology which is capable of responding to oil spills in the Arctic.

Thank you, Commissioner.

Christine Hess

From: Rep. Reggie Joule
Sent: Tuesday, December 07, 2010 4:14 PM
To: Christine Hess
Subject: FW: Better Schools on Lower Budgets? Policy Brief Tells How

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From: centennial@ccu.edu [mailto:centennial@ccu.edu]
Sent: Saturday, December 04, 2010 8:07 AM
To: Rep. Reggie Joule
Subject: Better Schools on Lower Budgets? Policy Brief Tells How

CENTENNIAL INSTITUTE

Lakewood, Colorado
www.Centennialccu.org

For Immediate Release
December 3, 2010

Contact:
John Andrews
andrewsjk@aol.com

William Moloney
Moloneyvision@aol.com

Policy Brief Envisions Better Schools on Lower Budgets

Colorado's second straight year of inevitable cuts in state aid to education can become an opportunity to improve learning performance while shedding needless costs, according to a policy brief from the Centennial Institute, Colorado Christian University's think tank. The paper is online here.

"Much Better Schools on Much Lower Budgets: A Primer for Colorado Policymakers" draws on proven models for achieving more with less, from schools across the country and around the world. "Our state has massive cost inefficiencies and educational deficiencies within the structure of K-12 education, built up over decades and crying out for correction," says the author. Over $1 billion must be cut from projected spending in order to balance the 2011-2012 budget.

Students in neighboring Utah, the paper points out, significantly outperform Colorado students on the respected NAEP test, even though Utah's spending per pupil is only 61 cents on the dollar compared to Colorado's. Denver parochial schools succeed better with minority youngsters than nearby public schools, at just 55 cents on the dollar. Looking abroad, we see education systems from Canada to Korea to Germany far exceeding the United States in academic achievement at 30% lower cost.

The paper is organized in Q&A format around 20 concise topics, starting with "Admit: The US trails woefully in global rankings," running through "See why the teaching profession has faltered" and "Realize school funding is bloated, not starved," and concluding with recommendations to "Legislate boldly in 2011."

William J. Moloney, former Colorado Education Commissioner with a lifetime of school experience in a half-dozen other states and countries, authored the policy brief in consultation with a panel of educators, legislators, and budget experts. "It is in our power to fix what is broken; all that's needed is the political will," Moloney writes in the introduction. "There will never be a more opportune moment to break out of the old paradigm."

He calls on the General Assembly to reinterpret Amendment 23's factor formulas in line with budget realities; offer local school districts a timeout from costly mandates, accreditation, and testing; allow schools to outsource many functions; encourage charters, vouchers, and tax credits; and defuse PERA's "pension time bomb."

John Andrews, director of the Centennial Institute, says in an editor's note that when Moloney warned some weeks ago about Colorado public education becoming one of several "metastasizing entitlements that have reached a point of absolute unsustainability," defenders of the education status quo replied in print with emotion, not logic. They deemed the former commissioner's analysis "offensive to educators" -- without attempting to refute it factually. (Denver Post, Oct. 3 and Oct. 14, 2010.)

In releasing the policy brief today, Andrews commented: "Centennial Institute and Bill Moloney will be working actively with legislators of both parties to help translate this new paradigm into budgetary solutions. With or without cooperation from teacher unions and the education lobby, the state's dire fiscal condition is forcing policymakers to think way outside the box -- and that's good news for ill-served Colorado schoolchildren." Read the Policy Brief

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North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Summary

Baseline Science

Provide funding for scientific research to gather adequate baseline data prior to new offshore activity. Support a collaborative approach to research and data sharing, such as the North Slope Science Initiative (NSSI). Tie specific research requirements to industrial activity.

Stricter Regulation

Require OCS production to use pipelines to shore-based facilities rather than tanker transportation. Require MMS to apply regulations and stipulations more vigorously. Improve standards in the leasing process. Require negotiation of CAAs with NSB for other marine mammals species.

Cumulative Impacts

Require detailed discussion of area-wide cumulative impacts in EIS/EA documents, including socio-cultural impacts. Stipulate limits on the number of projects allowed in an area at one time.

Revenue Sharing

Revenue sharing to offset impacts should be included in all phases of development, including pre-lease seismic and sampling work. Use the NPR-A model for early funding. Broaden acceptable uses for CIAP funds.

Discharge/Emissions

Require zero-volume discharge standards in arctic waters. Require reinjection of all cuttings, muds, produced waters and other byproducts of exploration and development. Write subsistence considerations into the Clean Water Act. Do not allow "disaggregation" as a strategy to avoid obtaining a Clean Air Act PSD permit.

Oil Spill Prevention and Response

Spill prevention and response are twin concerns in the OCS. Spill prevention efforts should be viewed as an investment that pays dividends in avoiding the costs of a spill. Best available technology related to undersea pipelines is an example of a worthy spill prevention investment. Spill response should be anchored in provable cleanup technologies, and real-world demonstrations of cleanup capabilities should be required before activity begins.

Coast Guard Presence

Offshore development and increasing vessel traffic point to the need for an effective U.S. Coast Guard presence. Congress should fund a year-round Coast Guard station with oceangoing and airborne response capabilities.

Compulsory Marine Pilotage

Add a provision in federal law that requires state-licensed Alaska marine pilots on qualified vessels in the Beaufort or Chukchi Seas.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Baseline Science

Provide funding for scientific research to gather adequate baseline data prior to new offshore activity. Support a collaborative approach to research and data sharing, such as the North Slope Science Initiative (NSSI). Tie specific research requirements to industrial activity.

Evaluation of impacts from oil and gas development has to start with an understanding of conditions prior to new activity. This understanding comes from a robust data set that should be gathered in anticipation of development. Baseline science is crucial to any assessment of change over time from natural and industrial causes. Mitigation measures are evaluated against this baseline data and best practices are established over time with its confirmation.

The federal government should enable baseline science before activity commences and should commit to collaborative research, data sharing and analysis through an organization such as NSSI, which brings together scientists from federal, state and local agencies, as well as industry and other organizations for just this type of collaboration.

Pre-leasing activities should mirror the approach that BLM has taken in NPR-A with its pre-activity study program. The needs are even greater offshore because the risks are greater. NEPA requires that MMS determine what effect any development scenario will have on the environment. Without adequate baseline science, such a determination is suspect and can be easily challenged.

Areas of incomplete baseline data include:

1. Air quality
2. Water quality
3. Marine mammal migration and habitat
4. Subsistence impacts
5. Health impacts.

The Borough is by no means alone in recognizing large data gaps in Arctic Ocean science. In its most recent multi-sale Draft EIS for the Beaufort and Chukchi Seas, MMS identified numerous areas in which data is insufficient. We look forward to working with the federal government in pursuit of increased research and better understanding of offshore areas.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Stricter Regulation of OCS Operations

Require MMS to apply regulations and stipulations more vigorously. Require OCS production to use pipelines to shore-based facilities rather than tanker transportation. Improve standards in the leasing process. Require negotiation of CAAs with NSB for other marine mammals species.

Alaskans and NSB residents have a lot to gain from new oil and gas development – especially the infrastructure associated with long-term jobs, maximized use of TAPS, and a healthy tax base. OCS development could add substantially to the North Slope's infrastructure, or it could bypass it entirely. It all depends on how the resources are transported to market. If they are piped to shore-based facilities and fed into existing or planned pipelines, then Alaskans can reap their fair share of economic stimulus from development in adjacent waters – even without federal revenue sharing.

However, there is no inherent barrier to producing oil from self-contained rigs and transporting the product by tanker to distant markets. Nor does any law or lease sale stipulation prevent oil companies from choosing that approach if it is in their economic interest. This must be resolved prior to development.

In the past decade, MMS has been increasingly lax in its interpretation of laws and enforcement of regulations as the nation's overseer of planning and operations for offshore development. Environmental concerns have been routinely ignored and impact assessments conducted with little vigor. In fact, the litigation that halted Shell's exploration plan was rooted in MMS' decision to substitute an EA for a full EIS, which requires little or no public input. Another example is the elimination of "Stipulation 5" from the pending draft EIS for arctic lease sales. This stipulation establishes a consultation process aimed at avoiding conflict between industry operations and subsistence activities.

The Conflict Avoidance Agreement (CAA) process has played a valuable role in bringing together developers and subsistence bowhead whaling communities to ensure that company operations do not compromise traditional subsistence whaling activities. This model should be extended to include other marine mammal species on which the Inupiat depend for nutritional and cultural survival. NSB should represent local concerns in CAA negotiations regarding these other species.

MMS planning, review and oversight of leasing processes need a thorough overhaul so as to honor the intent of existing laws and regulations. A guiding principle in this effort should be that MMS lease agreements must, at a minimum, meet or exceed standards set forth in the MMPA.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Cumulative Impacts

Require detailed discussion of area-wide cumulative impacts in EIS/EA documents, including socio-cultural impacts. Stipulate limits on the number of projects allowed in an area at one time.

Each discreet development activity has specific effects on air and water quality, marine life, habitat, and nearby communities. In combination with other projects or activities, an individual project can have unanticipated additional impacts. Cumulative effects can be significant, not only in areas of intensive development, but also where there is gradual expansion or infill.

Dramatically increasing impacts from climate change add a new dimension to any discussion of cumulative impacts and should be factored into the cumulative impacts review process. No single entity has the responsibility for comprehensive planning for oil and gas development in arctic waters and coastal areas.

The process for cumulative effects analysis and management is hampered by the absence of a coordinated review of planned industrial activities by all permitting agencies. A global, coordinated analysis should be required in the EIS/EA process. This analysis should consider limiting the number of projects in the region.

Cumulative impacts studies should include an overall analysis of the arctic region as a whole, including analysis of the Beaufort and Chukchi Seas.

Because of the sudden and significant level of impacts due to climate change in the Arctic, development should be phased gradually to allow for adequate study of the combined environmental effects.

Impacts to the health, social structure and culture of communities should also be subjected to substantial analysis.

North Slope Borough
Arctic Offshore Oil and Gas Development Policies

OCS Revenue Sharing

Revenue sharing to offset impacts should be included in all phases of development, including pre-lease seismic and sampling work. Use the NPR-A model for early funding. Broaden acceptable uses for CIAP funds.

Beyond three miles, the OCS is controlled by the federal government. State and local governments have very little input in decisions. Local communities bear all the direct risks of offshore development – environmental, social, cultural and economic – yet they receive very little in exchange. This is deeply disconcerting to us, because it suggests that the federal government either doesn't place much value on our ancestral connection to the ocean, or it doesn't recognize the risks to our most important subsistence food supply. The ocean is the cradle of our culture. It is where we most need to have a voice, yet we have almost none.

The Federal Government has a long established policy of sharing revenues from mineral leases with state and local governments. Any new revenue sharing program should be based on existing programs that acknowledge impacts and risks to local communities. A federal OCS program could provide direct payments to municipalities, as in the Gulf of Mexico Energy Security Act of 2006. If funds are not distributed directly to local governments, the NPR-A Impact Aid program offers another model, although it has been susceptible to state legislative interference in the disbursement of funds. The program could be improved if proof of impact by coastal communities were established in federal law and not required as a component of funding in the state appropriation process.

The authorized uses of revenue sharing funds should be as broad as those defined in the NPR-A Impact Aid program, but not restricted to particular issues like the Coastal Impact Aid Program (CIAP).

Any revenue sharing program should acknowledge that impacts begin before lease sales occur and extend beyond completion of the development project.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Discharge and Emissions

Require zero-volume discharge standards in arctic waters. Require reinjection of all cuttings, muds, produced waters and other byproducts of exploration and development. Write subsistence considerations into the Clean Water Act. Do not allow "disaggregation" as a strategy to avoid obtaining a Clean Air Act PSD (Prevention of Significant Deterioration) permit.

Discharge

The use of world-class technologies in arctic waters should be accompanied by world-class environmental standards. Zero-volume discharge is required in the northern region of the Barents Sea and in state waters of the Beaufort Sea, where it has proved to be both technically feasible and cost effective. Technological options that could satisfy the zero volume discharge requirement include use of a separate injection well, backside injection of an exploration well, or barging to shore, as is done in state waters.

The zero volume discharge requirement should also apply to sanitary waste, gray water and ballast water, as these will pollute the sea where our residents hunt for food. Traditional knowledge among subsistence whalers indicates that no amount of sanitary waste should be dumped in the ocean, as any type of human scent causes deflection of the whale migration. The Clean Water Act should be amended to protect subsistence activities by requiring zero volume discharge in all exploration and production activities.

The Borough is actively engaged in analysis of discharge options through a panel of its Scientific Advisory Committee, which is working with agencies and industry to identify preferred discharge policies.

Emissions

OCS operators are currently able to avoid the use of best available air pollution control technology in many cases. This is accomplished through a strategy of "disaggregation," in which companies artificially divide their operations into "separate" pollution sources so as to stay below the threshold that triggers a technical review aimed at determining the best pollution control technology. Disaggregation should not be allowed. All emissions associated with a company operation should be considered under a single Clean Air Act permit. This is the best way to assure that the best available technology is required under appropriate circumstances.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Oil Spill Prevention and Response

Spill prevention and response are twin concerns in the OCS. Spill prevention efforts should be viewed as an investment that pays dividends in avoiding the costs of a spill. Best available technology related to undersea pipelines is an example of a worthy spill prevention investment. Spill response should be anchored in provable cleanup technologies, and real-world demonstrations of cleanup capabilities should be required before activity begins.

Spill *prevention* must have the greatest emphasis in arctic waters. It can save industry from having to deal with spill response, which is likely to achieve only partial success in remote, icebound waters of the Arctic Ocean. Spill prevention includes three actions covered in the following pages: stricter regulation of OCS operations, compulsory marine pilotage with independent reporting duties, and a significant Coast Guard presence in the Arctic Ocean.

Spill prevention measures must also be built into undersea pipelines, including corrosion prevention systems, corrosion monitoring systems and leak detection systems. Recent experience in the Prudhoe Bay field demonstrates the need for these measures.

Adequate spill *response* should include a demonstration of industry's ability to retrieve spilled oil in broken or refreezing ice conditions during the transitional periods of spring and autumn. Purposely spilling a small amount of oil in representative conditions is worth the risk of minor contamination in order to prove the true extent of industry's spill response readiness. Allowing OCS development without such a demonstration means we are accepting substantial risk on the basis of a wish and a promise. As national policy, this is fundamentally irresponsible. A phased approach to a real-world demonstration could start with a laboratory prototype as a first step.

Spill response equipment should conform to "best available technology" standards.

The Borough's Scientific Advisory Committee is completing its final report on spill prevention and response.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Coast Guard Presence

Offshore development and increasing vessel traffic point to the need for an effective U.S. Coast Guard presence. Congress should fund a year-round Coast Guard station with oceangoing and airborne response capabilities.

Effective oil spill prevention and response in the Arctic Ocean are predicated on active monitoring of vessel traffic and swift emergency response capability in times of crisis. The U.S. Coast Guard plays a primary role in these activities in other coastal oil provinces, and extreme arctic conditions justify an important role for the Coast Guard in the Beaufort and Chukchi Seas.

Increased needs for navigation aid placement, vessel traffic management, ship compliance inspections, security considerations and emergency response capability clearly suggest that enhanced federal safety infrastructure and maritime resources need to be committed to this region. These needs include an expansion of the Marine Exchange with real-time data sharing that includes the NSB, the Barrow Arctic Science Consortium (BASC) and AEWC.

As sea ice continues to recede and make way for greater vessel access, international maritime shipping, tourism and commercial fishing may also add to marine traffic and increase the need for an expanded U.S. presence in arctic waters.

North Slope Borough
Arctic Offshore Oil and Gas Development Policy Positions

Compulsory Marine Pilotage

Add a provision in federal law that requires state-licensed Alaska marine pilots on qualified vessels in the Beaufort or Chukchi Seas.

Vessel traffic is increasing in the highly sensitive marine environment of the Chukchi and Beaufort Seas as oil companies show unprecedented interest in offshore prospects and shippers eye the rapidly receding ice pack with visions of an arctic shipping route. This intensifying interest in commercial uses of the Arctic Ocean causes North Slope residents grave concerns about the risk of oil spills and other industrial accidents. Among the most promising ways to minimize shipping accidents in the Beaufort or Chukchi Seas is to require the use of state-licensed marine pilots on all "qualified vessels" entering these waters. Federal regulations already allow the state to declare compulsory marine pilotage in federal waters. The Borough would like to see this state primacy codified in federal law.

Currently, the Arctic has state-licensed pilotage only in the nearshore state waters. Beyond the three-mile limit, there is only a voluntary system for ships that may be associated with oil and gas exploration, seismic testing, maritime shipping, tourism or any other commercial interest. This gives little comfort to North Slope residents, since almost all the industrial activity proposed for arctic waters would occur outside the current compulsory pilotage areas. Expanded compulsory pilotage is an important first step toward policies that will protect Alaska's arctic waters and preserve the traditional way of life for the whaling culture of the North Slope.

The State of Alaska recently issued a notice of a proposed regulatory change to extend compulsory state pilotage beyond three miles in the Chukchi and Beaufort Seas. This proposal faces strong resistance from industry. The NSB believes that licensed marine pilots with Alaskan experience will increase safety through their extensive knowledge of local conditions. They are clearly best suited to the task of navigating Beaufort and Chukchi waters. This precautionary approach will help to reduce the risk of accidents, and the use of marine pilots who independently report to the state will help to decrease residents' anxiety over increased offshore activity.

Compulsory marine pilotage is required in all other Alaskan waters. Surely the waters of the Arctic are just as precious.

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Shell Offshore Inc., Kulluk Drilling Unit, Permit No. R10OCS-AK-07-01, Petition for Review

Oil Spill Prevention and Response

The Arctic Coastal Zone Management Newsletter, May 1978, "The lessons of Brest – NSB Planners prepare for the impossible." http://www.ebenhopson.com/czm/1978cz/May78.pdf

Svalbard 2006 Experimental Oil Spill Under Ice: Remote sensing, Oil weathering under arctic conditions and assessment of oil removal by in-situ burning, DF Dickins, SINTEF, April 2006
http://www.mms.gov/tarprojects/569/SummaryFieldReport.pdf
http://www.mms.gov/tarprojects/569/Memo_in-situ_burning.pdf

Joint industry program on oil spill contingency for Arctic and ice covered waters. Full Scale Offshore field experiment 2009, FEX 2009 Handbook. April 3, 2009 JIP Oil in Ice:
http://www.sintef.no/Projectweb/JIP-Oil-In-Ice/

Oil and Gas Assessment – Pre-publication edition – AMAP– An Arctic Council Working Group, March 2009 Final version of Chapter 7 – Scientific Findings and Recommendations, Findings 6-10 http://www.amap.no/oga/

Attached is a report from 2004 by David Dickins of DF Dickins Associates, LLC. The report was prepared for The Prince William Sound Oil Spill Recovery Institute (OSRI) and the United States Arctic Research Commission (USARC). http://www.arctic.gov/files/OilInIceReport.pdf

Coast Guard Presence

Operation Salliq 2008: The Coast Guard Arctic Initiative
A Summer Remembered, By: Rear Admiral Gene Brooks
http://www.piersystem.com/go/page/780/27987/

Healy Mapping Mission - Arctic Land-grab- *National Geographic. Apr 15, 2009*
http://ngm.nationalgeographic.com/2009/05/healy/funk-text

UNITED STATESARCTIC RESEARCH COMMISSION ANNUAL REPORT FISCAL YEAR 2006:
http://www.arctic.gov/files/annualreport-01-30-08.pdf

Compulsory Marine Pilotage

A Career as a Marine Pilot, Paul Kirschner, US Coast Guard Proceedings, Fall 2008
http://homeport.uscg.mil/mycg/portal/ep/contentView.do?channelId=-18262&contentId=142367&programId=12870&programPage=%2Fep%2Fprogram%2Feditorial.jsp&pageTypeId=11328&contentType=EDITORIAL&BV_SessionID=@@@@1605449122.1242240365@@@@&BV_EngineID=ccccadehehgkelmcfigcfgfdffhdghi.0

North Slope Borough Resolution Serial No. 5-2009 – A Resolution supporting the expansion of compulsory Marine Pilotage in areas offshore northern Alaska., 'nsb marine pilots resolution.pdf'

Pilotage in the United States, American Pilot's Association, Washington DC, 2006,
http://www.americanpilots.org/PilotageInUS.aspx

Alaska Statutes are passed by the legislature. Regulations (also called the Alaska Administrative Code) are rules adopted by the board to implement, interpret, and make specific the statutes. Both statutes and regulations have the force of law. AS 08.62 and regulations 12 AAC 56 specifically govern marine pilotage. AS 08.01 - 08.03 and regulations 12 AAC 02 apply to all professions regulated by the division. http://www.dced.state.ak.us/occ/pub/MarineStatutes.pdf

Arctic Deep Water Sea Port Act of 2009 (Introduced in Senate)

S 2849 IS

111th CONGRESS

1st Session

S. 2849

To require a study and report on the feasibility and potential of establishing a deep water sea port in the Arctic to protect and advance strategic United States interests within the evolving and ever more important region.

IN THE SENATE OF THE UNITED STATES

December 8, 2009

Ms. MURKOWSKI introduced the following bill; which was read twice and referred to the Committee on Armed Services

A BILL

To require a study and report on the feasibility and potential of establishing a deep water sea port in the Arctic to protect and advance strategic United States interests within the evolving and ever more important region.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Arctic Deep Water Sea Port Act of 2009'.

SEC. 2. REPORT ON ESTABLISHMENT OF ARCTIC DEEP WATER PORT.

(a) Study-

(1) IN GENERAL- The Secretary of Defense, in consultation with the Secretary of Homeland Security, shall conduct a study on the feasibility and potential of establishing a deep water sea port in the Arctic to protect and advance strategic United States interests within the evolving and ever more important Arctic region.

(2) SCOPE- The study required under paragraph (1) shall address the following issues:

(A) The capability that such a port would provide.

(B) Potential and optimum locations for such a port.

(C) Resources needed to establish such a port.

(D) The time frame needed to establish such a port.

(E) The infrastructure required to support such a port, including Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) facilities, health care facilities, barracks and housing, airfield and pier support, and operations facilities.

(F) Any other issues the Secretary determines necessary to complete the study.

(b) Report- Not later than two years after the date of the enactment of this Act, the Secretary of Defense shall submit to the Committees on Armed Services and Appropriations of the Senate and the House of Representatives a report on the findings of the study conducted under subsection (a).

News

Melting ice could mean new riches

Jill Burke
Mar 1, 2010

"It's not a question of if but when."

That's what Mead Treadwell, chairman of the U.S. Arctic Research Commission, told a New York City crowd Monday about the prospect of a booming northwest passage.

Treadwell made the remarks during a moderated panel discussion, "Will the Bering Strait become the Panama Canal of the North?" hosted by the Council on Foreign Relations at Alaska House New York. (Alaska House is a nonprofit organization founded by Alaska Dispatch publisher Alice Rogoff to promote education about Alaska and its Native culture and foster economic development within the state.)

The day's discussion, which pulled together Alaska's congressional delegates, regional leaders and industry representatives, centered on the sense of urgency seemingly missing both in the state and nationwide for developing the infrastructure -- like deep water ports and international rules -- that will be needed to tap into a new hustling, bustling Bering Strait.

Two of the world's largest mining operations are above the Arctic Circle, including the Red Dog zinc mine in Alaska off the coast of Kivalina, according to Treadwell -- and the Arctic is poised to deliver even more resources. Minerals, fishing, oil and gas, exploration and science, and tourism all have northern footholds. Capturing opportunities related to those activities with the prospect of shorter shipping routes as ice recedes is something Americans need to be thinking about now, Treadwell said.

The challenge is building the infrastructure. Deep water ports are needed to accommodate large container ships and provide an anchor for the military presence that will need to increase to keep pace with a rise in offshore activity near the United States' northern coast.

Participants, including Rogoff, suggested that developing port infrastructure for Alaska's western coast, from Adak to Barrow, could be an economic boom as important to the state as the trans-Alaska oil pipeline, particularly when even a handful of new port jobs has the potential to pull villages teetering on the brink of economic failure into sustainability.

Alaska Sens. Lisa Murkowski, a Republican, and Mark Begich, a Democrat, attended the event and told participants they are aware of the critical role Alaska is poised to play in a changing Arctic environment. Murkowski is pushing for a Department of Defense and Homeland Security feasibility study for a deep water port off Alaska's shores.

"This study will determine whether it is in the strategic interest of the United States, as I believe it is, to build a port and where it might be located. A deep water port would not only serve our military and Coast Guard needs, but as we develop our offshore oil and gas reserves and see more shipping, tourism and vessel traffic in the Arctic, a deep water port could provide valuable support," Murkowski said.

A full transcript of the day's discussion will be posted online at the Council on Foreign Relations' Web site.

Contact Jill Burke at jill(at)alaskadispatch.com .

Related Articles

- Alaska's energy 'civil war'
- Correction - Denali pipeline plans
- An anniversary worth learning from
- Caribou crime: The hunt for the hunters
- Terms of Use

Astrid Lievano

From: Alan Austerman [aausterman@gci.net]
Sent: Saturday, January 02, 2010 12:03 PM
To: Rep. Alan Austerman
Subject: FW: Northern Waters Commission

From: mead@ventureadastra.com [mailto:mead@ventureadastra.com]
Sent: Thursday, December 31, 2009 2:41 PM
To: Alice Rogoff; Mead Treadwell; Bill Noll; mike.nizich@alaska.gov
Cc: bob_walsh@murkowski.senate.gov; aausterman@gci.net; Alice Rogoff Rubenstein
Subject: Re: Northern Waters Commission

We should discuss with MARAD. They are pioneering joint port work here in Anchorage, Hawaii, Guam.

MT

Mead Treadwell
New Office Address as of 6/2009:
509 West Third Ave., Ste. 128
Anchorage, AK 99501
(907) 278-4801 office
(907) 278-4807 fax
(907) 223-8128 mobile
(907) 258-7764 home
meadwell@alaska.net
Sent from my BlackBerry®

Reggie –
Please Review –
We should Discuss
this!
very interesting
CLH Alan

From: "Alice Rogoff" <alice@anaf.us>
Date: Thu, 31 Dec 2009 15:15:39 -0800
To: Mead Treadwell<meadwell@alaska.net>; Skymajor<skymajor@aol.com>; <mike.nizich@alaska.gov>
Cc: <bob_walsh@murkowski.senate.gov>; <aausterman@gci.net>; <anrr@aol.com>
Subject: RE: Northern Waters Commission

Interesting thought about a Western Alaska Port Authority: would that be a federal/state partnership? If so, it might be a great way to interest
private investment, too.

a

Alice N Rogoff

alice@anaf.us

907-350-6109

From: Mead Treadwell [meadwell@alaska.net]
Sent: Thursday, December 31, 2009 4:34 PM
To: 'Skymajor'; mike.nizich@alaska.gov

Cc: bob_walsh@murkowski.senate.gov; aausterman@gci.net; anrr@aol.com
Subject: RE: Northern Waters Commission

Bill, et al -- I think the fed/state collaboration process Bill lays out is great, but I'd watch the current legislation in DC that will set u a process we could try to work with in a slightly different form. A Western Alaska/Arctic port authority might be another approac too. MT

Mead Treadwell
Office Address:
1007 West Third Ave., Ste. 200
Anchorage, AK 99501
(907) 278-4801 office
(907) 278-4807 fax
(907) 223-8128 mobile
(907) 258-7764 home
meadwell@alaska.net<mailto:meadwell@alaska.net> or mead@ventureadastra.com<mailto:mead@ventureadastra.com>
From: Skymajor [mailto:skymajor@aol.com]
Sent: Wednesday, December 30, 2009 10:18 PM
To: mike.nizich@alaska.gov
Cc: meadwell@alaska.net; bob_walsh@murkowski.senate.gov; aausterman@gci.net; Alice Rogoff
Subject: Northern Waters Commission

Mike,

Here's an outline of what I suggested re Northern Waters.

The waters north and northwest of Alaska have strategic importance for at least these reasons:

1. Protection of routes of ocean transit.
2. Mineral and other resource rights, sub-surface and on-shore.
3. Territorial rights and claims by foreign governments.
4. Rights and welfare of local inhabitants.

I was very happy to hear that the Governor and you are already paying attention to the subject. I have also discussed this subject with Alan Austerman, Alice Rogoff, Mead Treadwell and Bob Walsh, whom I am copying.

The interests listed above are shared by the Federal government and the State of Alaska. As of now, there is no organized Federal-State mechanism for handling these matters. It is logical that there should be, and here is a suggestion on how to do it.

Suggestion.

1. Use the very successful Fishery Management Council model, on which Federal and State appointees sit.
2. Feds and State agree to form a Northern Waters Commission (working title).
3. Suggested Federal membership:
   a. State Department
   b. Homeland Security, specifically the US Coast Guard
   c. Defense Department, specifically the US Navy and Alaska Command
   d. Department of Energy
   e. US Arctic Research Commission
4. Suggested State membership:
   a. Two at-large members appointed by the Governor
   b. One local government appointee, rotating, appointed by the Governor
   c. DMVA
   d. DCCED
   e. DNR

As we concluded last night, more discussion on this concept is warranted. You suggested sometime the week of January 11 (??), when you would be in Anchorage. You name it. Let's coordinate a day/time and include others who have an interest in the subject and who could be helpful at this early stage.

Happy New Year to all,
Bill Noll

ALASKA STATE LEGISLATURE

SENATOR DONALD C. OLSON

ALASKA
STATE CAPITOL
ROOM 514
JUNEAU, ALASKA 99801-1182

(907) 465-3707
FAX (907) 465-4821

February 8, 2010

Dear Honorable Governor Parnell,

Given the great potential for finding and developing new energy resources in Alaska's offshore waters of the Arctic Ocean, we believe it would be prudent for this state to implement compulsory marine pilotage (CMP) within these areas. Please allow us to explain.

Having worked with the members of Alaska Marine Pilots over the years we have learned about the importance of state pilotage and the level of protection and independent oversight it brings to commercial shipping operations throughout the state. In our collective opinion, having marine pilots serving aboard commercial vessels that will operate in the Arctic will greatly reduce the risks associated with offshore oil and gas exploration and development. With this in mind we support the current proposed regulation by the Board of Marine Pilots that seeks to expand the State of Alaska's compulsory pilotage waters.

Compulsory marine pilotage is currently limited, by administrative rule, to waters within three-miles of the coast of Alaska. In general a state has considerable authority to regulate the waters off its coast, even beyond this traditional three-mile boundary. In fact, courts in other jurisdictions have allowed states to assert their pilotage regulations as far as 50 miles offshore, and beyond. The main consideration in these cases has been the courts' consideration of local needs and conditions. As Alaska addresses the development in the arctic that is on the horizon, we feel that it must keep in mind the intimate connection that many of the state's residents have with the Beaufort and Chukchi Seas. While the extension of CMP to cover the vast area that will see economic development is admittedly unprecedented, so is the development of this fragile and important marine environment.

Protection of life, property and the marine environment must go hand in hand with any future development in our offshore waters. To that end we respectfully ask that your administration give its full support to the expansion of CMP in the Arctic.

Thank you,

Senators;

Donald Olsen

Lyman Hoffman

Representatives;

Reggie Joule

Neal Foster

Bryce Edgmon

Bob Herron

Astrid Lievano

From: Skymajor [skymajor@aol.com]
Sent: Thursday, February 04, 2010 7:44 AM
To: Rep. Alan Austerman
Cc: Alice Rogoff; bob_walsh@murkowski.senate.gov
Subject: Fwd: Northern Waters Commission
Attachments: Northern Waters Commission

Below should be the original email I sent to Mike Nizich and others. There is just the concept and an initial outline of possible members.

I sent an email to Alice Rogoff, her staff and the folks at Center on Foreign Relations asking if teleconferencing is available for the March 1st event in New York. No response yet, but I'm sure we'll get an answer.

Thanks for your interest. I'd like to stay in contact with you on this subject. There is plenty of activity from the Federal side, including interest from Senator Murkowski and Congressman Young.

I mentioned this "commission" concept to Dave Benton (Marine Conservation Alliance) while in Juneau. He got the concept right away, especially the parallels with the establishment of the Fishery Management Councils to cope with policy and management issues of such magnitude. He wants to help/be involved as this idea moves ahead.

It was good to see you and Ginny in Juneau.

Best regards,
Bill
PS: Didn't know that Cliff Stone was a Vietnam vet. US Navy in Danang. We're going to compare notes next time I'm there. Bob Walsh was also US Navy in Vietnam.

Astrid Lievano

From: Skymajor [skymajor@aol.com]
Sent: Wednesday, December 30, 2009 10:18 PM
To: mike.nizich@alaska.gov
Cc: meadwell@alaska.net; bob_walsh@murkowski.senate.gov; aausterman@gci.net; Alice Rogoff
Subject: Northern Waters Commission

Mike,

Here's an outline of what I suggested re Northern Waters.

The waters north and northwest of Alaska have strategic importance for at least these reasons:

1. Protection of routes of ocean transit.
2. Mineral and other resource rights, sub-surface and on-shore.
3. Territorial rights and claims by foreign governments.
4. Rights and welfare of local inhabitants.

I was very happy to hear that the Governor and you are already paying attention to the subject. I have also discussed this subject with Alan Austerman, Alice Rogoff, Mead Treadwell and Bob Walsh, whom I am copying.

The interests listed above are shared by the Federal government and the State of Alaska. As of now, there is no organized Federal-State mechanism for handling these matters. It is logical that there should be, and here is a suggestion on how to do it.

Suggestion.

1. Use the very successful Fishery Management Council model, on which Federal and State appointees sit.
2. Feds and State agree to form a Northern Waters Commission (working title).
3. Suggested Federal membership:
   a. State Department
   b. Homeland Security, specifically the US Coast Guard
   c. Defense Department, specifically the US Navy and Alaska Command
   d. Department of Energy
   e. US Arctic Research Commission
4. Suggested State membership:
   a. Two at-large members appointed by the Governor
   b. One local government appointee, rotating, appointed by the Governor
   c. DMVA
   d. DCCED
   e. DNR

As we concluded last night, more discussion on this concept is warranted. You suggested sometime the week of January 11 (??), when you would be in Anchorage. You name it. Let's coordinate a day/time and include others who have an interest in the subject and who could be helpful at this early stage.

Happy New Year to all,
Bill Noll

Astrid Lievano

From: Skymajor [skymajor@aol.com]
Sent: Sunday, February 21, 2010 3:47 PM
To: Alan Austerman; Rep. Alan Austerman
Subject: Fwd: Northern Waters Commission
Attachments: Northern Waters commission

Follow Up Flag: Follow up
Flag Status: Completed

Hello Alan,

This is to convey the email I sent to Chad Padgett for Congressman Young on the subject of the Northern Waters Commission. It is only a little expanded from the version I sent you before. Do you have interest in drafting anything for consideration for the Legislature? If so, would you like any assistance?

And lastly, would you have any interest in having me do a report for the Legislature on the current status of things at the Federal and local level? I am attending the March 1st sessions in NY, and I hear that you will be listening in. I hear that Rep. Gatto will attend. My report could summarize all actions up to date, provide current Federal reports, and report the presentations and comments from the two March 1st meetings.

My interest is high, and my rates are reasonable.

Best regards,
Bill Noll
27-7015

Astrid Lievano

From: Skymajor [skymajor@aol.com]
Sent: Friday, February 19, 2010 1:18 AM
To: chad.padgett@mail.house.gov
Subject: Northern Waters commission

Chad,

Here's an outline of what I have recently sent to a few people regarding a commission that I have dubbed the "Northern Waters Commission." I realize that Congressman Young and Senator Murkowski have done work on this subject, submitting bills at the Federal level, but the State has not done much yet.

I view the situation in Northern Waters as follows.

The waters north and northwest of Alaska have strategic importance for at least these reasons:

1. Protection of routes of ocean transit.
2. Mineral and other resource rights, sub-surface and on-shore.
3. Territorial rights and claims by foreign governments.
4. Rights and welfare of local inhabitants.

The interests listed above are shared by the Federal government and the State of Alaska. Yet, as of now, there is no organized Federal-State mechanism for handling or even discussing these matters. I am apprehensive that a local ad hoc oversight group might spring up in Alaska, which is not what is needed right now, and, in fact, might be disruptive. (Is this perhaps the gist of what Sen. Begich is suggesting?)

There is another approach that is time-proven and very successful. Here is a suggestion on how to do it.

Suggestion.

1. Use the very successful Fishery Management Council model, on which Federal and State appointees sit.
2. Feds and State agree to form a Northern Waters Commission (working title).
3. Suggested Federal membership:
   a. State Department
   b. Homeland Security, specifically the US Coast Guard
   c. Defense Department, specifically the US Navy and Alaska Command
   d. Department of Energy
   e. US Arctic Research Commission
   f. USDOT.
4. Suggested State membership:
   a. Two at-large members appointed by the Governor
   b. One local government appointee, rotating, appointed by the Governor
   c. DMVA
   d. DCCED
   e. DNR

The Northern Waters Commission would be the forum in which to discuss policy issues, such as those listed above. Procedures for action would be established in its by-laws. Regular meetings would be held, just as with the Fishery Management Council, in a balanced atmosphere, with solid advice and input from a variety of sources.....again, like we have done so successfully on the North Pacific Fishery Management Council.

I have discussed this subject with Mike Nizich, Rep. Alan Austerman, Alice Rogoff, Mead Treadwell, Dave Benton and Bob Walsh. No actions have been undertaken as yet, but all have shown great interest. I am going to attend a March 1st meeting in New York where Senators Murkowski and Begich will address the Council on Foreign Relations. Karen Knudsen has committed an appointment for me at that time to brief Senator Murkowski on the Northern Waters Commission concept.

I also request the opportunity to talk with you about this concept, as well as Congressman Young, hopefully while he is here. I am available at your convenience.

Best regards,
Bill Noll
227-7015

Arctic Marine Shipping Assessment Implementation Act of 2009 (Introduced in Senate)

S 1561 IS

111th CONGRESS

1st Session

S. 1561

To ensure safe, secure, and reliable marine shipping in the Arctic, including the availability of aids to navigation, vessel escorts, oil spill response capability, and maritime search and rescue in the Arctic, and for other purposes.

IN THE SENATE OF THE UNITED STATES

August 3, 2009

Mr. BEGICH introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

A BILL

To ensure safe, secure, and reliable marine shipping in the Arctic, including the availability of aids to navigation, vessel escorts, oil spill response capability, and maritime search and rescue in the Arctic, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Arctic Marine Shipping Assessment Implementation Act of 2009'.

SEC. 2. FINDINGS.

Congress finds the following:

(1) The United States is an Arctic nation with--

(A) an approximately 700-mile border with the Arctic Ocean;

(B) more than 100,000,000 acres of land above the Arctic Circle; and

(C) an even broader area defined as Arctic by temperature, which includes the Bering Sea and Aleutian Islands.

(2) The Arctic region of the United States--

(A) is home to an indigenous population which has subsisted for millennia on the abundance in marine mammals, fish, and wildlife, many of which are unique to the region;

(B) is known to the indigenous population as Inuvikput or the `place where we live'; and

(C) has produced more than 16,000,000,000 barrels of oil and, according to the United States Geological Survey, may hold an additional 30,000,000,000 barrels of oil and 220,000,000,000,000 cubic feet of natural gas, making the region of fundamental importance to the national interest of the United States.

(3) Temperatures in the United States Arctic region have warmed by 3 to 4 degrees Celsius over the past half-century, a rate of increase that is twice the global average.

(4) The Arctic ice pack is rapidly diminishing and thinning, and the National Oceanic and Atmospheric Administration estimates the Arctic Ocean may be ice free during summer months in as few as 30 years.

(5) Such changes to the Arctic region are having a significant impact on the indigenous people of the Arctic, their communities and ecosystems, as well as the marine mammals, fish, and wildlife upon which they depend.

(6) Such changes are opening new portions of the United States Arctic continental shelf to possible development for offshore oil and gas, commercial fishing, marine shipping, and tourism.

(7) It is in the interests of the United States to work with the State of Alaska and the United States neighbors in the Arctic region to ensure that shipping in the Arctic Ocean and adjacent seas is safe for mariners, protective of the natural environment, including the air, land, water, and wildlife of the Arctic, and mindful of the needs of longstanding subsistence users of Arctic resources.

(8) It is in the interests of the United States to ensure that shipping in the Arctic Ocean and adjacent seas is secure, that United States sovereign and security interests, including the freedom of navigation rights of United States and foreign vessels to transit international straits, are respected and protected, consistent with international and customary law, that access is provided throughout the Arctic Ocean for legitimate research vessels of all nations, and that peaceful relations are maintained in the Arctic region.

(9) It is in the interests of the United States to cooperate to establish a system of international cooperation to support reliable shipping, with methods for joint investment in providing mariners aids to navigation, ports of refuge, vessel-to-shore communication, weather and ice forecasting, ship tracking and reporting, hydrographic mapping, and search and rescue capability.

(10) The United States has continuing research, security, environmental, and commercial interests in the Arctic region that rely on the availability of polar class icebreakers of the Coast Guard that were commissioned in the 1970s and are in need of replacement.

(11) Sovereign interests of the United States in the Arctic Ocean and Bering Sea regions may grow with submission of a United States claim for an extended continental shelf, pending the United States becoming a party to the United Nations Convention on the Law of the Sea, done at Montego Bay December 10, 1982.

(12) Building new icebreakers, forward operating bases, aids to navigation, and other facilities, and establishing coordinated shipping regulations and oil spill prevention and response capability through international cooperation requires long lead times.

(13) Beginning such efforts, with the completion of an Arctic Marine Shipping Assessment by the 8-nation Arctic Council, is essential to protect United States interests given the extensive current use of the Arctic Ocean and adjacent seas by vessels of many nations.

SEC. 3. PURPOSE.

The purpose of this Act is to ensure safe, secure, and reliable maritime shipping in the Arctic, including the availability of aids to navigation, vessel escorts, spill response capability, and maritime search and rescue in the Arctic.

SEC. 4. DEFINITIONS.

In this Act, the term `Arctic' has the meaning given that term in section 112 of the Arctic Research and Policy Act of 1984 (15 U.S.C. 4111).

SEC. 5. SENSE OF CONGRESS ON INTERNATIONAL AGREEMENTS.

It is the sense of Congress that, to carry out the purpose of this Act, the Secretary of State, in consultation with the Secretary of Homeland Security, acting through the Commandant of the Coast Guard, should work to establish agreements to promote coordinated action among the United States, Russia, Canada, Iceland, Norway, and Denmark and other seafaring and Arctic nations with respect to--

(1) placement and maintenance of aids to navigation in waters of the Arctic;

(2) improved navigational charts;

(3) the monitoring of ocean conditions including wind, waves, and currents and the timely reporting of information about ice and weather conditions;

(4) appropriate icebreaking escort, tug, and salvage capabilities;

(5) oil spill prevention and response capability;

(6) maritime domain awareness, including long-range vessel tracking and communications facilities;

(7) search and rescue; and

(8) facilities for ship generated waste.

SEC. 6. COAST GUARD ARCTIC MISSION ANALYSIS.

(a) Submission of Report Analysis to Congress-

(1) REQUIREMENT FOR SUBMISSION- Not later than 90 days following the completion of the High Latitude Polar Ice-Breaking Mission Analysis Report, the Commandant of the Coast Guard shall submit to the appropriate committees of Congress--

(A) such report; and

(B) consistent with section 93(a)(24) of title 14, United States Code, any recommendations of the Commandant related to such report.

(2) APPROPRIATE COMMITTEES OF CONGRESS DEFINED- In this subsection, the term `appropriate committees of Congress' means the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives.

(b) Mission Requirements Analysis-

(1) MISSION REQUIREMENTS ANALYSIS- Not later than 90 days after the date of the enactment of this Act, the Commandant of the Coast Guard shall, subject to the availability of appropriations, execute a contract with an independent entity to--

(A) conduct an analysis of future mission requirements of the Coast Guard in the Arctic and Antarctic; and

(B) estimate the necessary resources to provide for such requirements.

(2) SUBMISSION OF ANALYSIS AND ESTIMATE- Not later than 120 days after the date that the contract described in paragraph (1) is executed, the analysis and estimate described in subparagraph (A) and (B) of that paragraph shall be submitted to--

(A) the appropriate committees of Congress;

(B) the Commandant of the Coast Guard; and

(C) the Comptroller General of the United States.

(3) ADDITIONAL RECOMMENDATIONS- Not later than 90 days after the submission of the analysis and estimate described in paragraph (2)--

(A) the Commandant of the Coast Guard shall submit to the appropriate committees of Congress, consistent with section 93(a)(24) of title 14, United States Code, any recommendations of the Commandant related to such analysis and estimate; and

(B) the Comptroller General shall submit to the appropriate committees of Congress any recommendations of the Comptroller General related to such analysis and estimate.

(4) APPROPRIATE COMMITTEES OF CONGRESS DEFINED- In this subsection, the term `appropriate committees of Congress' means--

(A) the Committee on Commerce, Science, and Transportation and the Committee on Homeland Security and Governmental Affairs of the Senate; and

(B) the Committee on Homeland Security and the Committee on Transportation and Infrastructure of the House of Representatives.

SEC. 7. ARCTIC VESSEL TRAFFIC RISK ASSESSMENTS.

(a) In General- Pursuant to sections 4 and 5 of the Ports and Waterways Safety Act of 1972 (33 U.S.C. 1223 and 1224), the Commandant of the Coast Guard, in consultation with the appropriate Area Committee established under section 311(j)(4) of the Federal Water Pollution Control Act (33 U.S.C. 1321(j)(4)), shall prepare--

(1) not later than 2 years after the date of the enactment of this Act, a vessel traffic risk assessment for the Bering Strait, Alaska; and

(2) not later than 3 years after the date of the enactment of this Act, a vessel traffic risk assessment for the Arctic Ocean waters adjacent to Alaska's North Slope.

(b) Contents- A vessel traffic risk assessment, prepared pursuant to subsection (a), shall describe for the Bering Strait or the Arctic Ocean, as appropriate--

(1) the amount and character of present and estimated future shipping traffic in the region; and

(2) the current and projected use and effectiveness in reducing risk of--

(A) traffic separation schemes and routing measures;

(B) long-range vessel tracking systems developed under section 70115 of title 46, United States Code;

(C) towing, response, or escort tugs;

(D) vessel traffic services;

(E) emergency towing packages on vessels;

(F) increased spill response equipment including equipment appropriate for severe weather and sea conditions;

(G) the automatic identification system developed under section 70114 of title 46, United States Code;

(H) particularly sensitive sea areas, important ecological areas, areas to be avoided, and other traffic exclusion zones;

(I) aids to navigation;

(J) vessel response plans, facility response plans, any other response plans that the Secretary deems necessary; and

(K) area contingency plans and the effectiveness of the several response plans to support an area contingency plans.

(c) Recommendations-

(1) IN GENERAL- An assessment, prepared pursuant to this section, may include any appropriate recommendations to enhance the safety and security, or lessen potential adverse environmental impacts, of marine shipping.

(2) CONSULTATION- Prior to making any recommendation described in paragraph (1), the Commandant of the Coast Guard, acting through the appropriate Area Committee established under section 311(j)(4) of the Federal Water Pollution Control Act (33 U.S.C. 1321(j)(4)), shall consult with affected Federal, State, and local government agencies, representatives of the fishing industry, Alaska Natives from the region, the conservation community, and the merchant shipping and oil transportation industries.

SEC. 8. CENTRAL BERING SEA HARBOR OF REFUGE.

(a) Consultation and Determination- Not later than 1 year after the date of the enactment of this Act, the Commandant of the Coast Guard shall consult with the Secretary of the Army to determine the viability of and the improvements necessary to make the harbor at St. George Island, Alaska, a fully functional harbor of refuge throughout the year to enhance safety of life at sea and protection from oil pollution in the Central Bering Sea.

(b) Completion of Harbor- Not later than 3 years after the date of the enactment of this Act, the Secretary of the Army shall complete the harbor at St. George Island, Alaska, including the improvements determined under subsection (a) and any engineering design needed for safe navigation.

SEC. 9. REPORT ON ESTABLISHMENT OF ARCTIC DEEP WATER PORT.

(a) Study-

(1) IN GENERAL- The Commandant of the Coast Guard shall conduct a study on the feasibility and potential of establishing a deep water sea port in the Arctic to protect and advance strategic United States interests within the evolving and ever more important Arctic region.

(2) SCOPE- The study required under paragraph (1) shall address the following issues:

(A) The capability that such a port would provide.

(B) Potential and optimum locations for such a port.

(C) Resources needed to establish such a port.

(D) The time frame needed to establish such a port.

(E) The infrastructure required to support such a port.

(F) Any other issues the Secretary determines necessary to complete the study.

(b) Report- Not later than 1 year after the date of the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on the findings of the study conducted under subsection (a).

SEC. 10. TRANSFER OF FUNDS FOR ICEBREAKING SERVICES.

Notwithstanding any other provision of law, the Director of the National Science Foundation shall transfer all amounts provided pursuant to any Act for the procurement of polar icebreaking services to the United States Coast Guard Appropriation Accounts, and such amounts shall remain available until expended for operating expenses, renovation, and improvement.

SEC. 11. AUTHORIZATION OF APPROPRIATIONS.

(a) In General- There are authorized to be appropriated to the Secretary of Homeland Security--

(1) $40,000,000 in fiscal year 2011 for the design of a new polar class icebreaker;

(2) $800,000,000 for each of fiscal years 2011 and 2012 for the construction of 2 polar capable icebreakers;

(3) $5,000,000 for each of fiscal years 2011 through 2015 for seasonal operations in the Arctic;

(4) $10,000,000 for each of fiscal years 2012 through 2015 to carry out any agreements referred to in section 5;

(5) $4,000,000, to remain available until expended, for a vessel traffic risk assessments to be conducted pursuant to section 7; and

(6) $100,000,000 in each of the fiscal years 2011 through 2013 for the construction of forward operating bases, including aircraft hangar, bunk and mess facilities in Barrow, Nome, and Saint Paul Island, Alaska.

(b) Hydrographic Services- Section 306 of the Hydrographic Services Improvement Act of 1998 (33 U.S.C. 892d) is amended by adding at the end the following new paragraphs:

`(7) To acquire hydrographic data, provide hydrographic services, and conduct coastal change analyses necessary to ensure safe navigation, and to improve the management of coastal change in the Arctic, $10,000,000 for each of fiscal years 2011 and 2012.

`(8) To acquire hydrographic data and provide hydrographic services in the Arctic necessary to delineate the United States extended continental shelf, $5,000,000 for each of fiscal years 2011 and 2012.'.

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National Ocean Council

Overview

June is National Oceans Month. America's oceans, coastal, and Great Lakes regions support tens of millions of jobs and contribute trillions of dollars a year to our national economy. Our oceans, coasts, and Great Lakes are also a part of the American way of life; they are places of history and wonder and are places where our families go for fun, rest and restoration.

Last July, President Obama signed an Executive Order to ensure the continued health of these critical resources and established our Nation's first comprehensive *National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes* (National Ocean Policy). The National Ocean Policy sets priorities for Federal actions and strengthens our efforts to conserve, protect and sustainably manage our oceans by providing a structure that brings together State, local and tribal governments and the public and prioritizes efforts and resources to address the most critical issues facing our oceans. The Executive Order also established guiding principles for ocean management, and adopted a flexible framework for regionally based, collaborative spatial planning to address conservation, economic activity, competing uses, and sustainable use of the ocean, our coasts and the Great Lakes.

The Obama Administration remains committed to the conservation, protection and sustainable management of America's ocean and coastal resources so that they can continue to provide the many benefits to the nation. The Administration is working with stakeholders and the general public to find practical and effective solutions essential to ensuring the health of our oceans and addressing the needs and concerns of the American people. To this end, the National Ocean Council has released nine strategic action plan content outlines focused on key priorities to further the National Ocean Policy and address some of the most pressing challenges facing our ocean, coasts, and Great Lakes. The outlines are now available for a 30-day public comment period at www.whitehouse.gov/oceans.

Throughout June, the National Ocean Council will host 12 public listening sessions around the country. There are three main objectives for these listening sessions: 1) to hear about and discuss the actions and issues most important to Americans, 2) to use this knowledge to inform development of each of the nine strategic action plans, and 3) to offer a forum for the public to learn about the National Ocean Policy.

The National Ocean Policy

The National Ocean Policy provides a comprehensive approach, based on science and technology, to uphold our stewardship responsibilities and ensure accountability for management of our oceans and coasts to present and future generations. The National Ocean Policy significantly advances our capacity to maintain our ocean and coastal resources in the face of growing and often competing uses, including national security, shipping, energy production, and commercial fishing, as well as increasing pressure from pollution, resource extraction, and a changing climate. The National Ocean Policy will foster greater certainty and predictability for economic investments through sharing of environmental and ocean use data, improved management of cumulative impacts, and enhanced sustainability of the many uses in our oceans, coasts, and the Great Lakes.

Implementation of the National Ocean Policy is focused around nine priority objectives. The first four objectives, which together frame *How We Do Business*, are ways the Federal Government must operate to improve stewardship of the ocean, coasts, and Great Lakes. These four priority objectives are (1) ecosystem-based management, (2) coastal and marine spatial planning, (3) inform decisions and improve

understanding, and (4) coordinate and support. The remaining objectives identify five areas of special emphasis, each of which also represents a substantive area of importance to achieving the National Ocean Policy. These objectives are (1) resiliency and adaptation to climate change and ocean acidification, (2) regional ecosystem protection and restoration, (3) water quality and sustainable practices on land, (4) changing conditions in the Arctic, and (5) ocean, coastal, and Great Lakes observation, mapping, and infrastructure.

Strategic Action Plan Content Outlines

As part of President Obama's charge for Federal agencies to implement the National Ocean Policy, the National Ocean Council is responsible for developing strategic action plans for the nine priority objectives. Strategic action plans will identify specific and measurable near-term, mid-term, and long-term actions, with milestones, performance measures, and outcomes, to meet each of the nine priorities. Each plan will explicitly identify lead and participating agencies; gaps and needs in science and technology; potential resource requirements and efficiencies; and steps for integrating or coordinating current and out-year budgets. The plans will be adaptive to allow for modification and addition of new actions based on new information or changing conditions.

Under the direction of the National Ocean Council, experts from the Council's 27 Federal agencies and offices have drafted strategic action plans outlines with critical input from national, regional, and local stakeholders and the public. These outlines are an interim step toward developing the comprehensive strategic action plans called for by the President for each priority objective. They represent a starting point, leaving ample room for interested parties to help shape the targeted actions, outcomes, and milestones in the final plans.

Regional Public Listening Sessions

The National Ocean Council is hosting a series of 12 public Listening Sessions across the country to solicit input on the draft strategic action plan outlines. Representatives from some of the 27 Federal Agencies that comprise the National Ocean Council will be present at each listening session to describe the National Ocean Policy, take questions and hear the comments. The schedule of regional listening sessions is:

- **June 9,** 6:00-8:30 pm, Washington, DC, Women's Memorial at Arlington National Cemetery
- **June 9,** 4:00-9:00 pm, Barrow, AK, North Slope Borough Offices
- **June 10,** 4:00-9:00 pm, Anchorage, AK, Wilda Marston Theatre, Z. J. Loussac Library
- **June 13,** 1:00-5:00 pm, Chicago, IL, U.S. EPA Regional Headquarters
- **June 15,** 5:00-9:00 pm, Jacksonville, FL, University of North Florida
- **June 16,** 1:00-4:00 pm, Honolulu, HI, The Neal Blaisdell Center
- **June 27,** 11:30am-3:00 pm, Exeter, NH, Exeter High School
- **June 27,** 5:00-8:30 pm, Galveston, TX, Galveston Convention Center
- **June 27**, 8:30am-5:00 pm, Ocean Shores, WA, Quinault Beach Resort and Casino
- **June 30,** 1:00-5:00 pm, San Francisco Bay Area, CA, TBD
- **June 30,** 10:00am-5:00 pm, West Long Branch, NJ, Monmouth University
- **July 1,** Time TBD, Portland, OR, Portland State University

National Workshop on Coastal and Marine Spatial Planning

The National Ocean Council also will hold a National Coastal and Marine Spatial Planning (CMSP) Workshop in Washington, DC, on June 21-23. The Workshop will bring together Federal, state, tribal, and regional representatives to develop an understanding of the CMSP process, begin to build a community of future CMSP practitioners, and consider next steps for regional implementation. The first day of the Workshop will include a dedicated public and stakeholder session.

Collaborative, regionally based comprehensive planning is meant to improve communication between stakeholders, the public, and Federal, State, and tribal authorities and improve opportunities for community and citizen participation in the planning process. It is also meant to reduce significant upfront industry and agency costs. Comprehensive planning is not a new concept. The Federal Government has been working with the public, industry, and State and tribal partners for decades to collaboratively plan on many of our public lands. For National Forests and parklands, for example, comprehensive planning helps us achieve multiple goals, whether they are recreation, timber, energy, or protecting our ecological treasures. CMSP applies this concept to our oceans.

EXECUTIVE OFFICE OF THE PRESIDENT
NATIONAL OCEAN COUNCIL
WASHINGTON, D.C. 20503

FOR IMMEDIATE RELEASE:
June 2, 2011

Contact: Sahar Wali (CEQ)
(202) 395-5428
Rick Weiss (OSTP)
(202) 456-6037

Obama Administration Marks Next Steps in Implementing Nation's First Ocean Stewardship Policy with Series of National Ocean Month Public Events

WASHINGTON – Today, the Obama Administration took another important step to implement the nation's first comprehensive ocean policy by launching a series of events aimed at gathering public input from the communities and economies that depend on and care for our ocean, coasts, and Great Lakes. Feedback and comments gathered through this public engagement will assist the National Ocean Council as it implements a new National Policy for the Stewardship of the Ocean, Our coasts, and the Great Lakes.

Under the Executive Order issued by President Obama last July that established the National Ocean Policy, the National Ocean Council is charged with implementing that policy. The National Ocean Council will host a series of public listening sessions across the country starting next week. Listening sessions will be held throughout the month of June in Washington, DC, Barrow, AK, Anchorage, AK, Chicago, IL, Jacksonville, FL, Honolulu, HI, Exeter, NH, Galveston, TX, Ocean Shores, WA, San Francisco Bay Area, CA, West Long Branch, NJ, and Portland, OR.

These listening sessions mark the latest milestone in implementing a robust ocean policy that will address the most critical issues facing our ocean, coasts, and Great Lakes and ensure that Federal resources in these domains are used wisely. The National Ocean Council's efforts will bring together State, local, and tribal governments and all of the ocean's users—including recreational and commercial fishermen, boaters, industry, environmental groups, scientists, and the public—to better plan for, manage, harmonize, and sustain the uses that healthy oceans, coasts, and the Great Lakes support.

In addition, the National Ocean Council has launched a month-long online public review period for nine draft strategic action plan outlines. These strategic action plans will propose attainable goals and specific, measureable actions the Federal government can take to address key challenges facing our ocean, coasts, and Great Lakes. Today, nine draft outlines were released for public comment, including: incorporating ecosystem-based management; implementing coastal and marine spatial planning; informing decisions and improving understanding to respond to changes and challenges facing our resources; improving coordination and support for Federal, state, tribal, local and regional management of our resources; addressing changing conditions in the Arctic; enhancing water quality; implementing a regional ecosystem restoration and protection strategy; strengthening and integrating ocean, coastal and great lakes observations, mapping and infrastructure, and strengthening the resiliency of coastal communities and their abilities to adapt to climate change impacts. These outlines were drafted with input from a wide range of stakeholders. To participate in providing feedback for the strategic action plans or to get more information on listening sessions please visit www.whitehouse.gov/oceans.

Later in June, the National Ocean Council will host State, regional, tribal, and local representatives, experts, and stakeholders from around the country at a national workshop focused on regional collaboration and soliciting public input in planning for the conservation and sustainable use of our ocean resources.

In a joint statement, National Ocean Council Co-Chairs Nancy Sutley and John P. Holdren said: "Our oceans, coasts and, Great Lakes support tens of millions of jobs and generate trillions of dollars each year for our economy through tourism, development, commercial and recreational fishing, energy, and waterborne commerce. The public's input will help us target limited Federal resources to where they are needed most to help our oceans and coastal economies and communities thrive."

To obtain a copy of these strategic action plan outlines and provide your comments on them, please visit www.whitehouse.gov/oceans

To find a National Ocean Council regional listening session near you, please visit http://www.whitehouse.gov/blog/2011/05/26/share-your-ideas-national-ocean-council-listening-session-near-you

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THE WHITE HOUSE

WASHINGTON

March 30, 2011

PRESIDENTIAL POLICY DIRECTIVE/PPD-8

SUBJECT: National Preparedness

This directive is aimed at strengthening the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the Nation, including acts of terrorism, cyber attacks, pandemics, and catastrophic natural disasters. Our national preparedness is the shared responsibility of all levels of government, the private and nonprofit sectors, and individual citizens. Everyone can contribute to safeguarding the Nation from harm. As such, while this directive is intended to galvanize action by the Federal Government, it is also aimed at facilitating an integrated, all-of-Nation, capabilities-based approach to preparedness.

Therefore, I hereby direct the development of a national preparedness goal that identifies the core capabilities necessary for preparedness and a national preparedness system to guide activities that will enable the Nation to achieve the goal. The system will allow the Nation to track the progress of our ability to build and improve the capabilities necessary to prevent, protect against, mitigate the effects of, respond to, and recover from those threats that pose the greatest risk to the security of the Nation.

The Assistant to the President for Homeland Security and Counterterrorism shall coordinate the interagency development of an implementation plan for completing the national preparedness goal and national preparedness system. The implementation plan shall be submitted to me within 60 days from the date of this directive, and shall assign departmental responsibilities and delivery timelines for the development of the national planning frameworks and associated interagency operational plans described below.

National Preparedness Goal

Within 180 days from the date of this directive, the Secretary of Homeland Security shall develop and submit the national preparedness goal to me, through the Assistant to the President

for Homeland Security and Counterterrorism. The Secretary shall coordinate this effort with other executive departments and agencies, and consult with State, local, tribal, and territorial governments, the private and nonprofit sectors, and the public.

The national preparedness goal shall be informed by the risk of specific threats and vulnerabilities - taking into account regional variations - and include concrete, measurable, and prioritized objectives to mitigate that risk. The national preparedness goal shall define the core capabilities necessary to prepare for the specific types of incidents that pose the greatest risk to the security of the Nation, and shall emphasize actions aimed at achieving an integrated, layered, and all-of-Nation preparedness approach that optimizes the use of available resources.

The national preparedness goal shall reflect the policy direction outlined in the National Security Strategy (May 2010), applicable Presidential Policy Directives, Homeland Security Presidential Directives, National Security Presidential Directives, and national strategies, as well as guidance from the Interagency Policy Committee process. The goal shall be reviewed regularly to evaluate consistency with these policies, evolving conditions, and the National Incident Management System.

National Preparedness System

The national preparedness system shall be an integrated set of guidance, programs, and processes that will enable the Nation to meet the national preparedness goal. Within 240 days from the date of this directive, the Secretary of Homeland Security shall develop and submit a description of the national preparedness system to me, through the Assistant to the President for Homeland Security and Counterterrorism. The Secretary shall coordinate this effort with other executive departments and agencies, and consult with State, local, tribal, and territorial governments, the private and nonprofit sectors, and the public.

The national preparedness system shall be designed to help guide the domestic efforts of all levels of government, the private and nonprofit sectors, and the public to build and sustain the capabilities outlined in the national preparedness goal. The national preparedness system shall include guidance for planning, organization, equipment, training, and exercises to build and maintain domestic capabilities. It shall provide an all-of-Nation approach for building and sustaining a cycle of preparedness activities over time.

The national preparedness system shall include a series of integrated national planning frameworks, covering prevention, protection, mitigation, response, and recovery. The frameworks shall be built upon scalable, flexible, and adaptable coordinating structures to align key roles and responsibilities to deliver the necessary capabilities. The frameworks shall be coordinated under a unified system with a common terminology and approach, built around basic plans that support the all-hazards approach to preparedness and functional or incident annexes to describe any unique requirements for particular threats or scenarios, as needed. Each framework shall describe how actions taken in the framework are coordinated with relevant actions described in the other frameworks across the preparedness spectrum.

The national preparedness system shall include an interagency operational plan to support each national planning framework. Each interagency operational plan shall include a more detailed concept of operations; description of critical tasks and responsibilities; detailed resource, personnel, and sourcing requirements; and specific provisions for the rapid integration of resources and personnel.

All executive departments and agencies with roles in the national planning frameworks shall develop department-level operational plans to support the interagency operational plans, as needed. Each national planning framework shall include guidance to support corresponding planning for State, local, tribal, and territorial governments.

The national preparedness system shall include resource guidance, such as arrangements enabling the ability to share personnel. It shall provide equipment guidance aimed at nationwide interoperability; and shall provide guidance for national training and exercise programs, to facilitate our ability to build and sustain the capabilities defined in the national preparedness goal and evaluate progress toward meeting the goal.

The national preparedness system shall include recommendations and guidance to support preparedness planning for businesses, communities, families, and individuals.

The national preparedness system shall include a comprehensive approach to assess national preparedness that uses consistent methodology to measure the operational readiness of national

capabilities at the time of assessment, with clear, objective and quantifiable performance measures, against the target capability levels identified in the national preparedness goal.

Building and Sustaining Preparedness

The Secretary of Homeland Security shall coordinate a comprehensive campaign to build and sustain national preparedness, including public outreach and community-based and private-sector programs to enhance national resilience, the provision of Federal financial assistance, preparedness efforts by the Federal Government, and national research and development efforts.

National Preparedness Report

Within 1 year from the date of this directive, the Secretary of Homeland Security shall submit the first national preparedness report based on the national preparedness goal to me, through the Assistant to the President for Homeland Security and Counterterrorism. The Secretary shall coordinate this effort with other executive departments and agencies and consult with State, local, tribal, and territorial governments, the private and nonprofit sectors, and the public. The Secretary shall submit the report annually in sufficient time to allow it to inform the preparation of my Administration's budget.

Roles and Responsibilities

The Assistant to the President for Homeland Security and Counterterrorism shall periodically review progress toward achieving the national preparedness goal.

The Secretary of Homeland Security is responsible for coordinating the domestic all-hazards preparedness efforts of all executive departments and agencies, in consultation with State, local, tribal, and territorial governments, nongovernmental organizations, private-sector partners, and the general public; and for developing the national preparedness goal.

The heads of all executive departments and agencies with roles in prevention, protection, mitigation, response, and recovery are responsible for national preparedness efforts, including department-specific operational plans, as needed, consistent with their statutory roles and responsibilities.

Nothing in this directive is intended to alter or impede the ability to carry out the authorities of executive departments and agencies to perform their responsibilities under law and consistent with applicable legal authorities and other Presidential guidance. This directive shall be implemented consistent with relevant authorities, including the Post-Katrina Emergency Management Reform Act of 2006 and its assignment of responsibilities with respect to the Administrator of the Federal Emergency Management Agency.

Nothing in this directive is intended to interfere with the authority of the Attorney General or Director of the Federal Bureau of Investigation with regard to the direction, conduct, control, planning, organization, equipment, training, exercises, or other activities concerning domestic counterterrorism, intelligence, and law enforcement activities.

Nothing in this directive shall limit the authority of the Secretary of Defense with regard to the command and control, planning, organization, equipment, training, exercises, employment, or other activities of Department of Defense forces, or the allocation of Department of Defense resources.

If resolution on a particular matter called for in this directive cannot be reached between or among executive departments and agencies, the matter shall be referred to me through the Assistant to the President for Homeland Security and Counterterrorism.

This directive replaces Homeland Security Presidential Directive (HSPD)-8 (National Preparedness), issued December 17, 2003, and HSPD-8 Annex I (National Planning), issued December 4, 2007, which are hereby rescinded, except for paragraph 44 of HSPD-8 Annex I. Individual plans developed under HSPD-8 and Annex I remain in effect until rescinded or otherwise replaced.

Definitions

For the purposes of this directive:

(a) The term "national preparedness" refers to the actions taken to plan, organize, equip, train, and exercise to build and sustain the capabilities necessary to prevent, protect against, mitigate the effects of, respond to, and recover from those threats that pose the greatest risk to the security of the Nation.

(b) The term "security" refers to the protection of the Nation and its people, vital interests, and way of life.

(c) The term "resilience" refers to the ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies.

(d) The term "prevention" refers to those capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism. Prevention capabilities include, but are not limited to, information sharing and warning; domestic counterterrorism; and preventing the acquisition or use of weapons of mass destruction (WMD). For purposes of the prevention framework called for in this directive, the term "prevention" refers to preventing imminent threats.

(e) The term "protection" refers to those capabilities necessary to secure the homeland against acts of terrorism and manmade or natural disasters. Protection capabilities include, but are not limited to, defense against WMD threats; defense of agriculture and food; critical infrastructure protection; protection of key leadership and events; border security; maritime security; transportation security; immigration security; and cybersecurity.

(f) The term "mitigation" refers to those capabilities necessary to reduce loss of life and property by lessening the impact of disasters. Mitigation capabilities include, but are not limited to, community-wide risk reduction projects; efforts to improve the resilience of critical infrastructure and key resource lifelines; risk reduction for specific vulnerabilities from natural hazards or acts of terrorism; and initiatives to reduce future risks after a disaster has occurred.

(g) The term "response" refers to those capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.

(h) The term "recovery" refers to those capabilities necessary to assist communities affected by an incident to recover effectively, including, but not limited to, rebuilding infrastructure systems; providing adequate interim and long-term housing for survivors; restoring health, social, and community services; promoting economic development; and restoring natural and cultural resources.

BARACK OBAMA

the White House
President George W. Bush

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For Immediate Release
Office of the Press Secretary
December 17, 2003

December 17, 2003 Homeland Security Presidential Directive/Hspd-8

Subject: National Preparedness

Purpose

(1) This directive establishes policies to strengthen the preparedness of the United States to prevent and respond to threatened or actual domestic terrorist attacks, major disasters, and other emergencies by requiring a national domestic all-hazards preparedness goal, establishing mechanisms for improved delivery of Federal preparedness assistance to State and local governments, and outlining actions to strengthen preparedness capabilities of Federal, State, and local entities.

Definitions

(2) For the purposes of this directive:

(a) The term "all-hazards preparedness" refers to preparedness for domestic terrorist attacks, major disasters, and other emergencies.

(b) The term "Federal departments and agencies" means those executive depart-ments enumerated in 5 U.S.C. 101, and the Department of Homeland Security; independent establishments as defined by 5 U.S.C. 104(1); Government corporations as defined by 5 U.S.C. 103(1); and the United States Postal Service.

(c) The term "Federal preparedness assistance" means Federal department and agency grants, cooperative agreements, loans,

an guarantees, training, and/or technical assistance provided to State and local governments and the private sector to prevent, prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies. Unless noted otherwise, the term "assistance" will refer to Federal assistance programs.

(d) The term "first responder" refers to those individuals who in the early stages of an incident are responsible for the protection and preservation of life, property, evidence, and the environment, including emergency response providers as defined in section 2 of the Homeland Security Act of 2002 (6 U.S.C. 101), as well as emergency management, public health, clinical care, public works, and other skilled support personnel (such as equipment operators) that provide immediate support services during prevention, response, and recovery operations.

(e) The terms "major disaster" and "emergency" have the meanings given in section 102 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5122).

(f) The term "major events" refers to domestic terrorist attacks, major disasters, and other emergencies.

(g) The term "national homeland security preparedness-related exercises" refers to homeland security-related exercises that train and test national decision makers and utilize resources of multiple Federal departments and agencies. Such exercises may involve State and local first responders when appropriate. Such exercises do not include those exercises conducted solely within a single Federal department or agency.

(h) The term "preparedness" refers to the existence of plans, procedures, policies, training, and equipment necessary at the Federal, State, and local level to maximize the ability to prevent, respond to, and recover from major events. The term "readiness" is used interchangeably with preparedness.

(i) The term "prevention" refers to activities undertaken by the first responder community during the early stages of an incident to reduce the likelihood or consequences of threatened or actual terrorist attacks. More general and broader efforts to deter, disrupt, or thwart terrorism are not addressed in this directive.

(j) The term "Secretary" means the Secretary of Homeland Security.

(k) The terms "State," and "local government," when used in a geographical sense, have the same meanings given to those terms

in section 2 of the Homeland Security Act of 2002 (6 U.S.C.

)1).

Relationship to HSPD-5

(3) This directive is a companion to HSPD-5, which identifies steps for improved coordination in response to incidents. This directive describes the way Federal departments and agencies will prepare for such a response, including prevention activities during the early stages of a terrorism incident.

Development of a National Preparedness Goal

(4) The Secretary is the principal Federal official for coordinating the implementation of all-hazards preparedness in the United States. In cooperation with other Federal departments and agencies, the Secretary coordinates the preparedness of Federal response assets, and the support for, and assessment of, the preparedness of State and local first responders.

(5) To help ensure the preparedness of the Nation to prevent, respond to, and recover from threatened and actual domestic terrorist attacks, major disasters, and other emergencies, the Secretary, in coordination with the heads of other appropriate Federal departments and agencies and in consultation with State and local governments, shall develop a national domestic all-hazards preparedness goal. Federal departments and agencies will work to achieve this goal by:

(a) providing for effective, efficient, and timely delivery of

Federal preparedness assistance to State and local governments;

and

(b) supporting efforts to ensure first responders are prepared to

respond to major events, especially prevention of and response

to threatened terrorist attacks.

(6) The national preparedness goal will establish measurable readiness priorities and targets that appropriately balance the potential threat and magnitude of terrorist attacks, major disasters, and other emergencies with the resources required to prevent, respond to, and recover from them. It will also include readiness metrics and elements that support the national preparedness goal including standards for preparedness assessments and strategies, and a system for assessing the Nation's overall preparedness to respond to major events, especially those involving acts of terrorism.

(7) The Secretary will submit the national preparedness goal to me through the Homeland Security

Council (HSC) for review and approval prior to, or concurrently with, the Department of Homeland Security's Fiscal Year 2006 budget submission to the Office of Management and Budget.

Federal Preparedness Assistance

(8) The Secretary, in coordination with the Attorney General, the Secretary of Health and Human Services (HHS), and the heads of other Federal departments and agencies that provide assistance for first responder preparedness, will establish a single point of access to Federal preparedness assistance program information within 60 days of the issuance of this directive. The Secretary will submit to me through the HSC recommendations of specific Federal department and agency programs to be part of the coordinated approach. All Federal departments and agencies will cooperate with this effort. Agencies will continue to issue financial assistance awards consistent with applicable laws and regulations and will ensure that program announcements, solicitations, application instructions, and other guidance documents are consistent with other Federal preparedness programs to the extent possible. Full implementation of a closely coordinated interagency grant process will be completed by September 30, 2005.

(9) To the extent permitted by law, the primary mechanism for delivery of Federal preparedness assistance will be awards to the States. Awards will be delivered in a form that allows the recipients to apply the assistance to the highest priority preparedness requirements at the appro-priate level of government. To the extent permitted by law, Federal preparedness assistance will be predicated on adoption of Statewide comprehensive all-hazards preparedness strategies. The strategies should be consistent with the national preparedness goal, should assess the most effective ways to enhance preparedness, should address areas facing higher risk, especially to terrorism, and should also address local government concerns and Citizen Corps efforts. The Secretary, in coordination with the heads of other appropriate Federal departments and agencies, will review and approve strategies submitted by the States. To the extent permitted by law, adoption of approved Statewide strategies will be a requirement for receiving Federal preparedness assistance at all levels of government by September 30, 2005.

(10) In making allocations of Federal preparedness assistance to the States, the Secretary, the Attorney General, the Secretary of HHS, the Secretary of Transportation, the Secretary of Energy, the Secretary of Veterans Affairs, the Administrator of the Environmental Protection Agency, and the heads of other Federal departments and agencies that provide assistance for first responder preparedness will base those allocations on assessments of population concentrations, critical infrastructures, and other significant risk factors, particularly terrorism threats, to the extent permitted by law.

(11) Federal preparedness assistance will support State and local entities' efforts including planning, training, exercises, interoperability, and equipment acquisition for major events as well as capacity building for prevention activities such as information gathering, detection, deterrence, and collaboration related to terrorist attacks. Such assistance is not primarily intended to support existing capacity to address normal local first responder operations, but to build capacity to address major events, especially terrorism.

(12) The Attorney General, the Secretary of HHS, the Secretary of Transportation, the Secretary of Energy, the Secretary of Veterans Affairs, the Administrator of the Environmental Protection Agency, and the heads of other Federal departments and agencies that provide assistance for first responder preparedness shall coordinate with the Secretary to ensure that such assistance supports and is consistent with the national preparedness goal.

(13) Federal departments and agencies will develop appropriate mechanisms to ensure rapid obligation and disbursement of funds from their programs to the States, from States to the local community level, and from local entities to the end users to derive maximum benefit from the assistance provided. Federal departments and agencies will report annually to the Secretary on the obligation, expenditure status, and the use of funds associated with Federal preparedness assistance programs.

Equipment

(14) The Secretary, in coordination with State and local officials, first responder organizations, the private sector and other Federal civilian departments and agencies, shall establish and implement streamlined procedures for the ongoing development and adoption of appropriate first responder equipment standards that support nationwide interoperability and other capabilities consistent with the national preparedness goal, including the safety and health of first responders.

(15) To the extent permitted by law, equipment purchased through Federal preparedness assistance for first responders shall conform to equipment standards in place at time of purchase. Other Federal departments and agencies that support the purchase of first responder equipment will coordinate their programs with the Department of Homeland Security and conform to the same standards.

(16) The Secretary, in coordination with other appropriate Federal departments and agencies and in consultation with State and local governments, will develop plans to identify and address national first responder equipment research and development needs based upon assessments of current and future threats. Other Federal departments and agencies that support preparedness research and development activities shall coordinate their efforts with the Department of Homeland Security and ensure they support the national preparedness goal.

Training and Exercises

(17) The Secretary, in coordination with the Secretary of HHS, the Attorney General, and other appropriate Federal departments and agencies and in consultation with State and local governments, shall establish and maintain a comprehensive training program to meet the national preparedness goal. The program will identify standards and maximize the effectiveness of existing Federal programs and financial assistance and include training for the Nation's first responders, officials, and others with major event preparedness, prevention, response, and recovery roles. Federal departments and agencies shall include private organizations in the accreditation and delivery of preparedness training as appropriate and to the extent permitted by law.

(18) The Secretary, in coordination with other appropriate Federal departments and agencies, shall

establish a national program and a multi-year planning system to conduct homeland security preparedness-related exercises that reinforces identified training standards, provides for evaluation of readiness, and supports the national preparedness goal. The establishment and maintenance of the program will be conducted in maximum collaboration with State and local governments and appropriate private sector entities. All Federal departments and agencies that conduct national homeland security preparedness-related exercises shall participate in a collaborative, interagency process to designate such exercises on a consensus basis and create a master exercise calendar. The Secretary will ensure that exercises included in the calendar support the national preparedness goal. At the time of designation, Federal departments and agencies will identify their level of participation in national homeland security preparedness- related exercises. The Secretary will develop a multi-year national homeland security preparedness-related exercise plan and submit the plan to me through the HSC for review and approval.

(19) The Secretary shall develop and maintain a system to collect, analyze, and disseminate lessons learned, best practices, and information from exercises, training events, research, and other sources, including actual incidents, and establish procedures to improve national preparedness to prevent, respond to, and recover from major events. The Secretary, in coordination with other Federal departments and agencies and State and local governments, will identify relevant classes of homeland-security related information and appropriate means of transmission for the information to be included in the system. Federal departments and agencies are directed, and State and local governments are requested, to provide this information to the Secretary to the extent permitted by law.

Federal Department and Agency Preparedness

(20) The head of each Federal department or agency shall undertake actions to support the national preparedness goal, including adoption of quantifiable performance measurements in the areas of training, planning, equipment, and exercises for Federal incident management and asset preparedness, to the extent permitted by law. Specialized Federal assets such as teams, stockpiles, and caches shall be maintained at levels consistent with the national preparedness goal and be available for response activities as set forth in the National Response Plan, other appropriate operational documents, and applicable authorities or guidance. Relevant Federal regulatory requirements should be consistent with the national preparedness goal. Nothing in this directive shall limit the authority of the Secretary of Defense with regard to the command and control, training, planning, equipment, exercises, or employment of Department of Defense forces, or the allocation of Department of Defense resources.

(21) The Secretary, in coordination with other appropriate Federal civilian departments and agencies, shall develop and maintain a Federal response capability inventory that includes the performance parameters of the capability, the timeframe within which the capability can be brought to bear on an incident, and the readiness of such capability to respond to domestic incidents. The Department of Defense will provide to the Secretary information describing the organizations and functions within the Department of Defense that may be utilized to provide support to civil authorities during a domestic crisis.

Citizen Participation

(22) The Secretary shall work with other appropriate Federal departments and agencies as well as State and local governments and the private sector to encourage active citizen participation and involvement in preparedness efforts. The Secretary shall periodically review and identify the best community practices for integrating private citizen capabilities into local preparedness efforts.

Public Communication

(23) The Secretary, in consultation with other Federal departments and agencies, State and local governments, and non-governmental organizations, shall develop a comprehensive plan to provide accurate and timely preparedness information to public citizens, first responders, units of government, the private sector, and other interested parties and mechanisms for coordination at all levels of government.

Assessment and Evaluation

(24) The Secretary shall provide to me through the Assistant to the President for Homeland Security an annual status report of the Nation's level of preparedness, including State capabilities, the readiness of Federal civil response assets, the utilization of mutual aid, and an assessment of how the Federal first responder preparedness assistance programs support the national preparedness goal. The first report will be provided within 1 year of establishment of the national preparedness goal.

(25) Nothing in this directive alters, or impedes the ability to carry out, the authorities of the Federal departments and agencies to perform their responsibilities under law and consistent with applicable legal authorities and presidential guidance.

(26) Actions pertaining to the funding and administration of financial assistance and all other activities, efforts, and policies in this directive shall be executed in accordance with law. To the extent permitted by law, these policies will be established and carried out in consultation with State and local governments.

(27) This directive is intended only to improve the internal management of the executive branch of the Federal Government, and it is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity, against the United States, its departments, agencies, or other entities, its officers or employees, or any other person.

GEORGE W. BUSH

# # #

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Ecosystem-Based Management
Strategic Action Plan
Full Content Outline

Objective: Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes.

Definition: Ecosystem-Based Management (EBM) is an integrated approach to resource management that considers the entire ecosystem, including humans, and the elements that are integral to ecosystem functions. EBM is informed by science to conserve and protect our cultural and natural heritage by sustaining diverse, productive, resilient ecosystems and the services they provide, thereby promoting the long-term health, security, and well-being of our Nation.

I. Overview of Priority Objective: Ecosystem Based Management

- The National Ocean Policy recommended EBM as a foundational principle to promote more effective and sustainable stewardship of our Nation's oceans, coasts, and Great Lakes.
- The Strategic Action Plan (SAP) for EBM will enhance our Nation's efforts to understand, use, manage, and conserve our valuable coastal and marine ecosystems. This SAP will provide a conceptual framework for integrating the management of diverse human activities that are linked to or depend on coastal and marine resources (e.g., shipping, fishing, energy production, military operations, coastal development).
- EBM differs from current approaches that focus on single-sector management (i.e., a single species or type of activity) by considering the whole ecosystem, including humans. The foundation for sustaining the long-term capacity of these systems to deliver a range of ecosystem services depends on ensuring the health and function of ecosystems.
- EBM plans and strategies must incorporate the cumulative effects of multiple human activities and varying levels of those activities on entire ecosystems, and address explicitly approaches for assessing trade-offs among these activities with the goal of maintaining ecosystem health and services.

II. Context and Continuity

- The EBM SAP outlined below is founded on four themes:
  - EBM Leadership and Collaboration - Establishes a framework across Federal and non-Federal agencies and organizations at multiple levels to guide the implementation of EBM at multiple scales; defines the criteria for selecting the initial geographic areas where EBM will be implemented; and identifies a plan to phase EBM implementation into additional areas. This theme will complement the Coordinate and Support SAP.
  - Interagency EBM Science Framework - Develops and implements a hypothesis-driven, nation-wide framework of integrated observations, monitoring, and research to provide a sound scientific basis for understanding ecosystems and informing management decisions.

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

- Inform Decision-making - Promotes the sharing of knowledge regarding EBM by communicating the principles, best practices, and decision-support tools among the partners involved in the decision-making process. This theme will be integrated with the Inform Decisions and Improve Understanding SAP.
- Policy and Governance - Identifies legislative and regulatory impediments to implementing EBM, and identifies actions to incorporate EBM cohesively into the environmental statutory and regulatory regime, project planning, and management strategies at the Federal, regional, state, territorial, tribal, and local levels. This theme will be integrated with the Inform Decisions and Improve Understanding SAP.

III. Body of the Plan

A. Action 1- EBM Leadership and Collaboration.

A Federal interagency working group will: (1) develop and propose an explicit framework for working with regional, state, territorial, tribal, and local management entities; (2) ensure that Federal agencies integrate EBM approaches into their decision-making processes; (3) identify strategies to increase understanding of EBM within the federal workforce; and (4) serve as a forum that monitors the integration of ecosystem-based activities within Federal agencies.

1. Why Do This
   - This action will lay the foundation for more efficient and effective management of the oceans, coasts, and Great Lakes by promoting a common understanding of and competence in leading implementation of the EBM approach to: (a) eliminate duplication of effort across agencies; (b) inform management decision-making with the best available science and data about the diverse interests of partners and stakeholders; and (c) build capacity and promote cooperation and leveraging of data, resources, and tools across all levels of government (Federal, regional, state, tribal, territorial, and local) and between governments and diverse stakeholders, including industry, NGOs, and the general public.
   - This action will ensure the assimilation of EBM and its principles as the improved way of doing business and promote stewardship of our Nation's coastal and ocean resources. It will incorporate lessons from and promote the exchange of information derived from Federal and non-Federal EBM models that successfully use collaborative, stakeholder-driven, place-based tools and approaches to address coastal and ocean management issues. Examples of those efforts include, but are not limited to, regional fisheries management (e.g., State of Alaska, NOAA), the National Estuary Program (EPA), Landscape Conservation Cooperatives (DOI, NOAA, and NGOs), and regional Governors' agreements. This action will build on those regional, state, tribal, territorial, and local models that apply EBM principles and build leadership and collaborative decision-making competence in additional places/regions.

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2. Timeframe –Mid-term

3. Outcomes

- Increased application of EBM by Federal and non-Federal agencies and organizations at multiple levels to support collaborative strategic planning and priority-setting in selected geographic areas. Federal and non-Federal parties will: a) develop and align place-based goals and plans; b) involve multiple stakeholder interests; c) improve the coordination of activities; and d) increase leveraging of each others' resources in support of outcome-oriented EBM. They will begin to better integrate and consider regional and local economic activity and human uses as well as the cumulative impacts on ecosystems. They will utilize scenario building, coastal and marine spatial planning (CMSP) tools, and other available decision-support tools.
- Enhanced integration of capabilities and resources among Federal and non-Federal parties. All partners will participate in the information sharing and promotion of holistic EBM and adaptive management approaches. Implementation of this action will promote the development and exchange of sound, accessible, and best-available scientific and socio-economic data regarding the condition and health of ecosystems and will highlight the results of efforts to apply EBM concepts at the regional, state, tribal, territorial, and local level.
- Criteria for identifying priority areas for EBM implementation will be selected. Representation on the working group will include consideration of unique marine environments, natural resources and cultural sensitivities as well as tribes' cultures, traditions, economic livelihoods, and public health.
- Place-based pilot projects will utilize best practices and promote understanding of and information about how to effectively implement EBM principles and concepts.
- A process is established to implement collaborative approaches to resource management, using EBM to set strategic goals and objectives and more effectively manage ecosystems. These processes will build upon the existing frameworks in those regions where Governors' agreements are in place.
- Educating and training a cadre of decision-makers and managers at all levels in EBM principles and practices will begin. The training and education will include transferring lessons learned from those entities already engaged in ecosystem-based management of coastal and ocean resources. These decision-makers and managers will be competent in leading the adoption of EBM approaches and of adaptive management principles and concepts.
- Regional, tribal, territorial, state and local stakeholders and decision-makers will begin collaborating to identify shared goals as well as common and divergent interests in each geographic region. They will develop and adopt strategies for addressing priority needs.

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- As the EBM SAP is implemented, gaps in the coordination processes among state, tribal, territorial, and local authorities and regional governance structures will be identified and efforts undertaken to begin addressing those gaps.
- Efforts will be undertaken to align agency-specific and cross-agency EBM goals and objectives with existing regulatory and statutory management requirements.

4. Milestones
   - Establish a joint interagency-regional EBM Working Group.
   - Develop a course catalog of a recommended curriculum for developing competencies in leading the adoption of EBM and adaptive management approaches.
   - Identify geographic priority areas for EBM implementation based on a clearly defined set of criteria determined through an interagency process.
   - Establish criteria for identifying priority geographic areas to implement EBM in cooperation and consultation with Regional bodies and utilizing CMSP and other available tools.
   - Compile and disseminate information depicting examples of EBM capacity, as well as resources and tools to further EBM implementation at all levels. Utilize local community partnerships and build on existing EBM networks to facilitate implementation.
   - Complete agency-specific guidance that provides direction for using EBM to achieve management requirements with existing regulatory and legislative authorities.
   - Decision-makers and managers complete the recommended EBM curriculum and share a common knowledge base of EBM concepts, principles, and practices. Key decision-makers and managers include individuals working in Federal coastal, ocean, and Great Lakes programs and their counterparts at the state, regional, tribal, territorial, and local level.
   - Decision-makers and managers develop the skills to integrate technical and scientific knowledge into ecosystem-based approaches to management at a regional scale. This knowledge includes information and tools such as adequate scientific and socio-economic data and information, ecosystem modeling expertise, engagement of diverse stakeholders in collaborative processes designed to identify management priorities, and incorporating external, time-sensitive drivers of EBM (e.g., loss of critical Northeast groundfish, expansion of offshore energy development).
   - Develop and implement model agreements (e.g., Memoranda of Agreement) to coordinate intergovernmental EBM implementation processes.

5. Gaps and Needs in Science and Technology

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

- Report on the status of marine and coastal ecosystems at a relevant scale through ecosystem research, monitoring, and observations, including key indicators of stresses on those ecosystems.
- Leadership and governance capacity: lack of knowledge about EBM and adaptive management on the part of policymakers, decision-makers, and managers could be an obstacle to agencies' support for the development of leadership competencies in EBM and adaptive management.

B. Action 2 - EBM Science Framework.

Establish an interagency EBM Science Framework of integrated research, observation, and monitoring capacity to improve understanding of ecosystem functions and the degree to which interactions among and within human and natural systems effects ecosystem health and services. This action will incorporate many of the actions of the Inform Decisions and Improve Understanding SAP into the EBM science framework.

EBM needs a science framework that will:

- Identify and facilitate the fundamental research needed to inform, implement, support, and advance EBM across the country.
- Emphasize the need to understand the basic physical, biological, ecological, and socio-economic aspects of marine and coastal ecosystems, to assess the more complex interactions, cumulative effects, and trade-offs required to maintain ecosystem health and services.
- Identify ecosystem services, describe hidden costs associated with human use of those services, assess trade-offs in benefits versus costs, avoid or reduce user and management conflicts, improve management outcomes, and promote sustainable use of ecosystems.
- Identify spatial extent of ecosystems, or boundaries, in terms of both management needs and the natural environment. Identify potential connections at multiple scales for ecosystems that connect across multiple jurisdictional boundaries, including international.
- Provide the scientific basis for managing people and their actions in a manner that sustains healthy, resilient ecosystems and ecosystem services. Among other things, this will require more effective alignment of the spatial characteristics of human activities with the environmental characteristics of marine ecosystems through marine spatial planning.
- Include all forms of scientific investigation, including short- and long-term observations, hypothesis testing, adaptive experimentation, and predictive modeling.
- Provide a range of science information tools and their appropriate application to the decision-making process. These tools can be broadly classified as modeling tools, decision analysis tools, and indicators of ecosystem status.

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- Promote interdisciplinary research to understand the structure and function of marine ecosystems, including the complex interactions that shape them, rather than simply assessing their various components without regard to their role in ecosystems.
- Emphasize and enable applied research to address existing and anticipated management challenges, but also support basic research to promote scientific creativity and ingenuity.
- Utilize innovative technology (e.g., remote sensors) and field research programs, and build upon and complement existing Federal and non-Federal scientific programs.
- Leverage existing resources and capabilities from Federal and non-Federal agencies and organizations to provide stable and sustainable long-term financial support for EBM science framework.

1. Why Do This

An EBM approach depends on a strong scientific foundation that:

- Provides the physical, chemical, biological, ecological, and socio-economic data required to assess the linkages, interactions, interdependencies, and cumulative effects that are the metrics of ecosystem health, resilience, and productivity;
- Capitalizes on and complements the research capacity of Federal and non-Federal agencies and organizations at multiple levels;
- Elucidates benefits and costs associated with human activities within marine ecosystems;
- Centralizes research information to ensure that results are transparent, accessible, organized, and archived for future use;
- Promotes research targeted to specific regional ecosystems and sharing of information relevant to all regions and ecosystems;
- Utilizes targeted regional ecosystem projects to address specific knowledge gaps and inform place-based management needs;
- Develops new technology to enhance scientific and management efforts;
- Promotes a research-to-practice path for new technology; and
- Evaluates indicators of ecosystem health to provide the necessary assurance that our use of ecosystems is, in fact, sustainable.

2. Timeframe – Mid-term

3. Outcomes

- Establishment of a defined framework for guiding science, monitoring, and observations to inform and support EBM.
- Improved understanding of natural and human-related changes in ecosystems over time, as well as the implications of these changes for ecosystem and human health and for socio-economic well-being.
- Improved ability to forecast future conditions and outcomes.

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- Establishment of a comprehensive repository of governmental, non-governmental and private sector data and resources (e.g., Marine Protected areas, NOAA stock assessments, Navy monitoring efforts).

4. Milestones
   - Establish interagency EBM Science Work Group; develop charters setting forth goals and objectives.
   - Coordinate with Federal and non-Federal agencies and organizations at multiple levels to initiate development of the EBM science framework.
   - Catalog and inventory existing governmental, non-governmental and private sector research, programs, and assets aimed at or related to EBM (e.g., Ocean Observing Systems), and identify (1) areas of unnecessary redundancy or overlap and (2) gaps in science related to EBM.
   - Establish a comprehensive repository of governmental, non-governmental, and private sector data and resources management (e.g., Marine Protected areas, resource stock assessments, monitoring efforts).
   - Identify, develop, and implement tools for the effective execution of EBM (e.g., Integrated Ecosystem Assessment (IEA) approach). The results will provide a basis for balancing those uses through spatially and temporally explicit marine spatial planning.
   - Set up an adaptive management process for the next-generation of EBM, based on lessons learned in the first two years of implementation of data architectures and IEA processes.
   - Conduct regular reviews of the initial EBM scientific framework, examining its strengths, shortcomings, and key research topics needed to promote more effective EBM. These review and recommendation processes would be coordinated with the Observations, Mapping, and Infrastructure SAP.

5. Gaps and Needs in Science and Technology
   - Identification of key indicators of ecosystem health and spatial areas of high or unique value.
   - Identification of existing and emerging technology that enables scientists, decision-makers, and the public to more easily input, archive, access, share, analyze, visualize, and explain data and information, such as mapping and geospatial analysis tools. This will be done in coordination with CMSP and Inform Decisions and Improve Understanding SAPs.
   - Continued development of ocean observing systems (e.g., the Integrated Ocean Observing System, the Ocean Observatories Initiative) to collect physical, chemical, biological, and ocean use data in (near) real-time.
   - Facilitation of data access by developing formal metadata standards and specific guidance for data input, integration, and preservation.

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- Requirements for "open access" and "open science" for data and research methods.
- Development and adoption of protocols or standards for ecosystem service accounting and the valuation of EBM-relevant nonmarket goods and services that are not represented in the current economic literature.

C. Action 3 - Inform Decision-Making to Support EBM.

Develop and provide products and services to assist entities responsible for implementing EBM. Examples of products and services may include an interactive data portal, a synthesis and analysis of lessons learned from existing EBM initiatives, and an inventory of adaptive management approaches and tools. These products and services will enable Federal, state, territorial, tribal, regional, and local entities to share and discuss ecological, economic, social, physical, and other types of data and information that are needed to facilitate EBM and adaptive management approaches. This action will complement the actions of the Inform Decisions and Improve Understanding SAP.

1. Why Do This

Science-based products and services to support EBM are needed to:

- Ensure that decision-makers have access to the best available science, tools, and data;
- Ensure that the decision-making process reflects the interests of multiple stakeholders at Federal, state, territorial, tribal, regional, and local levels;
- Enable managers and stakeholders to consider all types of ecosystem services and the impacts to these services that may arise under alternative scenarios;
- Enable managers and stakeholders to assess the trade-offs associated with alternative policies and to minimize the conflicts that arise over multiple ecosystem uses;
- Promote collaboration and innovation among agencies responsible for managing our oceans, coasts, and Great Lakes; and
- Promote better informed and improved decision-making that will enhance our capacity to understand, respond, and adapt to a changing environment.

2. Timeframe – Mid-term

3. Outcomes

- Improved ability to balance the competing demands on ecosystems via improved understanding of ecosystem services, function, and resilience, and the interactions and feedbacks between human and natural systems.
- Enhanced management of resources due to the ability to evaluate trade-offs inherent in different management scenarios.
- An enhanced outreach and education program is available to inform stakeholders of EBM goals and underlying management and science principles.

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- Promote sharing of data among all EBM constituencies (i.e., at the Federal, state, regional, local, tribal, and territorial levels).
- Improved ability to minimize environmental risk with the use adoption of adaptive management approaches.
- Improved understanding of data and information required to fully adopt an ecosystem approach to management.
- Enhanced societal resiliency in response to environmental changes via understanding of environmental trends, and the causes and consequences of change.
- Improved public partnership and increased environmental awareness through an understanding of the role of humans in ecosystems, including feedbacks that affect livelihood, human health and well being, and quality of life.

4. Milestones
   - Complete inventory, analysis, and synthesis of "lessons learned," EBM pilot projects, and adaptive management approaches and tools pertaining to oceans, coasts, and Great Lakes.
   - Assess agency data and information holdings related to management of oceans, coasts, and Great Lakes, and the development of data listings.
   - Develop and initiate the implementation of an outreach and education program to inform stakeholders of EBM goals and underlying management and science principles.
   - Implement and complete two to three pilot studies using adaptive management decision-making tools in selected geographic areas.
   - Prepare case studies and document results of the pilot studies.

5. Gaps and Needs in Science and Technology
   - Reasonable approximations (including a range) of uncertainty and/or the scientific confidence associated with management actions that are not currently available must be developed.
   - Mechanisms to provide comprehensive information from science and research to better inform EBM decisions.

D. Action 4: Incorporate EBM Principles into Policy and Governance.

Incorporate EBM principles into Federal, regional, state, territorial, tribal, and local project planning and environmental review processes to support rapid and effective implementation of EBM throughout our Nation's marine and coastal ecosystems. This will be coordinated with the Coastal and Marine Spatial Planning (CMSP) SAP.

1. Why Do This
   - EBM needs to be incorporated cohesively into the environmental statutory and regulatory regime and project planning and review processes (e.g., National Environmental Policy Act, Endangered Species Act, Coastal Zone Management Act,

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Magnuson-Stevens Fishery Conservation and Management Act) to ensure a more holistic ecosystem-based approach.

- Management that is based on and more fully integrates physical, biological, ecological, and socio-economic information is more likely to meet human-related objectives while promoting healthier, more resilient, and productive ocean, coastal, and Great Lakes environments.
- Maintaining the health, resilience, and productivity of marine ecosystems is essential if our Nation's use of those ecosystems is to be sustainable for future generations.
- Opportunity exists to incorporate EBM principles into the regulatory regime under the Executive priority to improve regulation and regulatory review, which directs agencies to conduct a retrospective analysis of existing significant regulations (see Executive Order 13563, January 18, 2011).

2. Timeframe – Mid-Term

3. Outcomes

- Federal, state, tribal, territorial, and local project planning and review processes will incorporate EBM principles.
- An EBM approach will promote better stewardship because it takes into account the interactions among all the components of an ecosystem, including human activities.
- An EBM approach will provide a framework for managing multiple types of human activities in ways that do not diminish substantially the essential characteristics of marine ecosystems or undermine their ability to provide vital ecosystem services.
- Impacts to ecosystem services and functions will be addressed explicitly through environmental risk analyses, permits, and authorizations under the National Environmental Policy Act and other relevant Federal environmental legislation.
- Federal agencies will work collaboratively with regional, state, territorial, tribal, and local agencies and organizations through the regional CMSP process and other means to promote efforts such as the national system of Marine Protected Areas, Migratory Bird Joint Ventures, Landscape Conservation Cooperatives, the Marine Intertidal Network, and other ecosystem-based activities to conserve habitats.
- Targeted statutory and regulatory changes may be made to address relevant deficiencies in law and policy when deemed necessary in order to advance EBM.

4. Milestones

- Fully incorporate EBM into Federal agency environmental planning and review processes.
- Incorporate EBM principles into efforts responsive to legislative and regulatory environmental mandates.
- Review environmental statutory and regulatory regimes to determine areas of conflict and opportunities for integrating multiple agency management objectives towards achieving EBM goals.

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- Prepare risk analyses and monitoring and mitigation plans that enable EBM to promote regulatory efficiency, consistency, and transparency across multiple management objectives.
- Issue model legislation and/or regulations.

5. Gaps and Needs in Science and Technology
   - Mechanisms for increasing awareness and understanding regarding EBM.
   - Getting near-term buy-in/agreement from Federal agencies that EBM is an integral approach towards integrating a science framework into current management.

INTERIM

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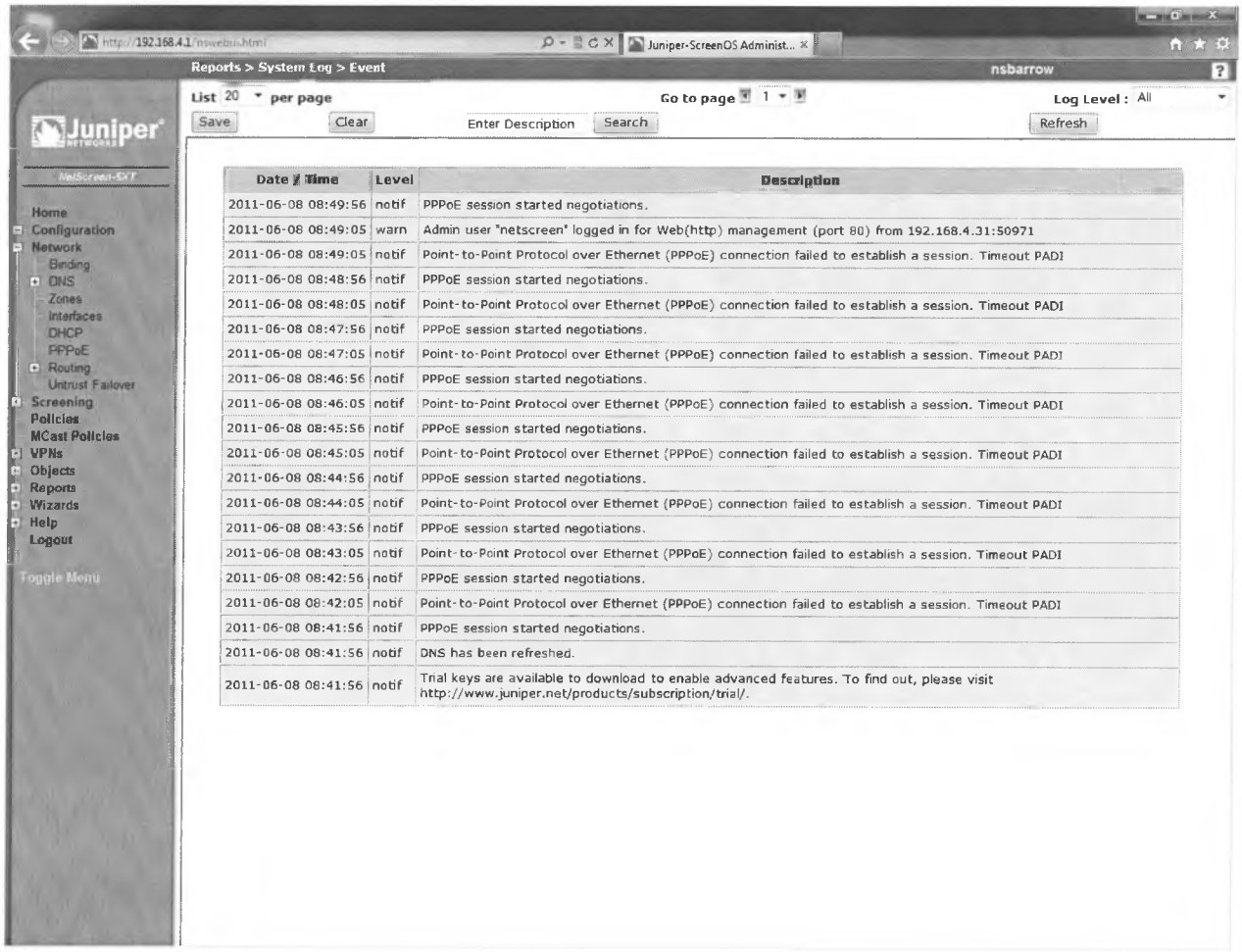

Date / Time	Level	Description
2011-06-08 08:49:56	notif	PPPoE session started negotiations.
2011-06-08 08:49:05	warn	Admin user "netscreen" logged in for Web(http) management (port 80) from 192.168.4.31:50971
2011-06-08 08:49:05	notif	Point-to-Point Protocol over Ethernet (PPPoE) connection failed to establish a session. Timeout PADI
2011-06-08 08:48:56	notif	PPPoE session started negotiations.
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2011-06-08 08:41:56	notif	DNS has been refreshed.
2011-06-08 08:41:56	notif	Trial keys are available to download to enable advanced features. To find out, please visit http://www.juniper.net/products/subscription/trial/.

Coastal and Marine Spatial Planning
Strategic Action Plan
Full Content Outline

Objective: Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning (CMSP) and management in the United States.

I. Overview of the Priority Objective

- This strategic action plan (SAP) addresses the National Ocean Policy priority objective to implement and expand the framework for effective CMSP as described in the Final Recommendations of the Interagency Ocean Policy Task Force (Final Recommendations), as adopted by Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes* (Executive Order).

- The Strategic Action Plan (SAP) for CMSP takes a different approach and has a significantly different structure than the other eight SAPs the other writing teams are developing.

    - This is appropriate, since much of the discussion in the Final Recommendations focuses on elements of the framework for implementing an effective CMSP process.

    - The National Ocean Policy calls upon the CMSP SAP Writing Team to reflect that approach and further develop those steps.

    - Moreover, the Executive Order and the framework for effective CMSP include specific expectations for additional guidance from the National Ocean Council (Council). The full content outline below provides a structure and some text in an effort to fulfill these expectations.

- As defined in the Executive Order, CMSP is a "comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas. It identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security, and social objectives. In practical terms, CMSP provides a public policy process for society to better determine how the ocean, coasts, and Great Lakes are sustainably used and protected -- now and for future generations."

- The Executive Order adopts a clear set of objectives that our Nation should pursue to further the National Ocean Policy. CMSP is one of the nine priority objectives under this implementation strategy. In his June 2009 memorandum establishing the Interagency Ocean Policy Task Force, President Obama specifically called upon the Task Force "to develop a recommended framework for effective coastal and marine spatial planning." As a result, the Task Force spent considerable time and effort to develop such a framework, largely based on valuable input from

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a wide spectrum of stakeholders, scientists, academics, and policy experts, as well as the general public.

- The Task Force members concluded that CMSP was a crucial element in a comprehensive national policy for the stewardship of ocean and coastal resources. The Task Force then outlined a comprehensive vision for CMSP in the ocean, coastal, and Great Lakes waters of the United States that is included in its Final Recommendations.

- The CMSP process that the Task Force identified aspires to significantly improve how we manage and protect our priceless coastal, marine, and Great Lakes waters and resources. At its core, CMSP begins with assembling all relevant stakeholders in each of nine coastal regions and gathering together all of the critical data elements. This includes mapping and assessing the ecological, economic, cultural, and societal resources as well as transportation, recreation, other off-shore uses, and security information within the context of an ecosystem model. Each of the nine regional planning bodies (RPBs) which will be established pursuant to the Executive Order, working with all interested stakeholders and the general public, will consider this assessment and associated maps and data, together with the current and projected uses of the entire planning area, to comprehensively and proactively identify those areas best suited for certain uses based on all relevant factors.

- The entire process is designed to be transparent, with close coordination between all State (defined to include the Territories), Federal, and tribal bodies, as well as a wide variety of domestic and foreign stakeholders. CMSP is intended to create a common shared vision for what all parties see as the best uses for these regional planning areas.

- This SAP will further explain the process of implementing the framework for effective CMSP. To help guide these regional CMSP efforts leading to the eventual development of coastal and marine spatial plans (CMS plans), this SAP will provide national CMSP objectives and performance measures. While the objectives and corresponding performance measures are national in scope, the CMSP process and CMS plans will be developed regionally, with regional objectives and performance measures which are informed by the national objectives. CMSP and CMS plans will be developed cooperatively among the Federal, State, and tribal partners on the RPBs—in consultation with indigenous community representatives, Regional Fishery Management Councils, and scientific, technical, and other experts—with substantial stakeholder and public input. The goal will be to provide specific, actionable, measurable, and cost-effective guidance to best achieve the many economic, environmental, security, and social benefits of CMSP throughout the ocean, coastal, and Great Lakes waters of the United States.

II. Context and Continuity.

- As the concept is implemented, CMSP will yield substantial economic, ecological, and social benefits. To do so, it must incorporate the principles of sound science for ecosystem-based and adaptive management, be transparent, and be informed by all stakeholders and the general

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public. Rather than adding layers of review and delays, CMSP will significantly improve and build upon existing Federal, State, tribal, local, and regional decision-making and planning processes. CMSP is intended to facilitate sustainable economic growth in coastal communities by increasing transparency and predictability for economic investments in coastal, marine, and Great Lakes industries, transportation, telecommunications, public infrastructure, and related businesses. CMSP should promote national objectives such as enhanced national energy security and trade and provide economic incentives, such as more predictable and faster project implementation, for a wide range of commercial users. CMSP is intended to improve ecosystem health and services by planning human uses in concert with the conservation of important ecological areas, such as areas of high productivity and biological diversity, areas critical to ecosystem function and resiliency, areas if spawning, breeding, and feeding; and migratory corridors. CMSP can promote enhanced ecosystem services and benefits because they are incorporated into the CMS plans as desired outcomes of the process and not just evaluated in the context of individual Federal or State agency action. CMSP allows for a comprehensive look at multiple sector demands which will provide a more complete evaluation of cumulative effects.

- Working in concert with the other eight SAPs, CMSP is intended to promote society goals, including greater opportunities for community and citizen participation in open planning processes that would determine the future of the ocean, our coasts, and the Great Lakes. For example, the CMSP process would recognize the social, economic, public health, and conservation benefits of sustainable recreational use of ocean, coastal, and Great Lakes resources, such as fishing, boating, swimming, and diving, by providing improved coordination with recreational users to ensure continued access and opportunities to experience and enjoy these activities consistent with economic, safety, and conservation goals. Integrated engagement and coordination will result in stronger and more diverse ocean, coastal, and Great Lakes stewardship, economies, and communities. Moreover, CMSP can assist Federal, State, tribal, and local managers in planning activities to sustain economic, cultural, and recreational uses, human health and safety, and the continued security of the United States. Through empowering the RPBs, CMSP can overcome the obstacles and take advantage of the many opportunities present in our ocean, coastal, and Great Lakes waters.

III. National Objectives and Performance Measures [This section begins the main body of the SAP. It will list the key national strategic objectives of CMSP and describe specific performance measures for each.]

- **Introduction to the Concept**
    - As directed by the Executive Order, this SAP enumerates national objectives and associated performance measures to promote national and regional consistency in the development and implementation of regional CMS Plans. The following four national objectives are based on the national goals and guiding principles for effective CMSP under the Executive Order. Explicitly designed to tier off these goals and guiding principles, these national objectives and their performance measures should be

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interpreted as a complement to them and not a stand-alone list of objectives. An appendix to this SAP will define key terms relevant to the CMSP process.

- While providing specific and measurable guidance, these national objectives as listed below are designed to permit flexibility for each RPB to craft regional objectives that address specific regional and local needs while helping to achieve the national goals. Due to the comprehensive nature of CMSP and the degree of external variables that could influence outcomes relative to national objectives, the approach taken here includes both outcome-based and output-based performance measures. Each national CMSP objective is accompanied by either performance measures that assess outcomes and/or milestones used to track specific outputs such as the establishment of RPBs. Index measures are used to help determine relative performance before plans are in place and after they are implemented in an effort to monitor changes attributable to CMSP according to individual agency specific mandates, authorities, and other requirements.

- The CMSP National Objectives and Performance Milestones and Measures will be designed to be as specific, measurable, achievable, realistic, and timely as possible given the nature of the planning process. They will also be designed to complement each other and guide CMSP development and implementation as well as monitoring and evaluating progress toward achieving the objectives and benefits of CMS plans.

- Under the Government Performance and Results Modernization Act of 2010, the Federal government will establish Federal performance goals deemed critically important to the Nation. Having national objectives and performance measures to track their achievement will be a benchmark for tracking interagency contributions as a whole and individually. This SAP identifies CMSP characteristics that should be reflected in its national objectives and measures such as regional scope; transparency; developed cooperatively among Federal, State, tribal, and local authorities, with stakeholders and the public working toward a shared vision; and incorporating ecosystem-based management for a more effective and cost-efficient means to guide and balance allocation of multi-sector activities. CMSP should reduce adverse cumulative impacts from human uses on marine ecosystems and provide more certainty in planning new investments. Further, it should reduce conflicts between how best to use and preserve the environment for sustainability and environmental stewardship.

- **Four Key National Objectives and Related Performance Measures**

  - **Objective 1 – Establish nine RPBs to undertake CMSP and develop by 2020 initial CMS plans for sustainable use and long-term protection of the ocean, coasts, and Great Lakes.** Per the Executive Order, CMSP is to be developed and implemented using a regional approach to allow for the variability of economic, environmental, and social aspects among the different areas of the United States. Each region is unique in geographic scope, cultural expectations and sensitivities, economic development, and

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existing structures and planning for marine spatial planning, environmental protection, and resource management. Organizing, establishing, and beginning the work of the nine fully functional RPBs are critically important steps in carrying out CMSP and the overall National Ocean Policy. The members of each RPB will prepare and execute a CMSP Development Agreement early in the process, and then begin the planning process.

- **Objective 2 – By 2015, applicable non-confidential and other non-classified Federal data identified for inclusion will be incorporated into the National Information Management System and Data Portal.** The underpinning of the National Ocean Policy and CMSP framework is science-based decision making. While it is true that much additional research is needed, a significant amount of data and information already exists. However, not all of it is accessible or in a useable format for CMSP purposes. This second national objective calls for an innovative approach to data integration across the Federal government, as well as extending this approach to State, local, and tribal governments, industry, academia, and non-governmental organizations (NGOs). The National Information Management System (NIMS) as called for in the National Ocean Policy will not only target integration of diverse data sets, but it will also make this data readily available to decision makers, ocean users, stakeholders, and the public and support the development of new and/or improved decision support tools critical to the CMSP process. This section will include concrete action items to identify how Federal agencies will make data available and how the NIMS will support regional and local efforts. It will also describe how to best integrate data products available at State, regional, and local levels.

- **Objective 3 – Preserve and enhance opportunities for sustainable and beneficial ocean use through the promotion of regulatory efficiency, consistency, and transparency as well as improved coordination across Federal agencies.** Efficient regulatory processes are essential to preserve and enhance the sustainable use of the oceans. Improving efficiency and coordination across Federal agencies, with States, tribes, local governments, indigenous community representatives, and international partners, where appropriate, will minimize the burdens of regulatory delays on all levels of government and the regulated community. Most laws include strict time frames within which review and analysis of permitted activities must be completed. However, currently it is difficult to meet these time frames, which often leads to increased scrutiny, legal filings, and even financial constraints for both those industries that are seeking the permits, as well as the responsible Federal agencies. Using a well-designed and data-supported CMSP process can reduce these delays and costs by pre-assessing areas where certain activities may be better suited; providing frameworks for compiling all the relevant environmental, economic, and social data and information; and identifying in advance those activities that might have synergistic relationships. Coordinated efforts for integration of data as outlined in Objective 2 will also provide efficiencies and consistencies and will aid in the reduction of effort and time (by both Federal and private entities) required to support comprehensive National Environmental Policy Act

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(NEPA) analyses. This objective will help meet the Administration's goal of reducing redundancy in Federal processes where appropriate, lead to more efficient regulatory review, and better support coastal economies into the future.

- **Objective 4 – Reduce cumulative negative impacts on environmentally sensitive resources and habitats.** Conducting an environmental impact assessment with a cumulative impact assessment is a mandatory step for any federally-regulated activity, yet assessing cumulative impacts quantitatively is challenging. Cumulative negative impacts on sensitive resources and habitats are those which result from adverse incremental impacts of human uses from the past, present, and foreseeable future. As stewards of the marine environment, Federal agencies are tasked with ensuring that beneficial environmental goods and services are not compromised by permitted activities. Similarly, a regional CMSP process involves defining and analyzing existing conditions and future conditions spatially—*before* any particular permitted activity is considered. As comprehensive, integrated assessment tools and analytical methods are developed and strengthened, so too will be the outputs of these efforts. Thus, this objective strives to avoid those impacts considered unacceptable, will lead to desirable activities being planned for those areas where resulting impacts are minimized or avoided, and will maximize existing sustainable and beneficial of the marine environment.

IV. Regional Implementation, Actions and Milestones, and Work Products. [This section will discuss regional implementation of CMSP consistent with the Executive Order and the framework for effective CMSP. Each of its elements should be clear and succinct; actionable; based on measurable and realistic outcomes within the stipulated milestones, timeframes, and limited resources; and adaptive, to allow for modification and addition of new actions based on new information or changing conditions. This section will also help identify the national and regional obstacles that must be overcome, including lack of adequate funding and other resources, better management data, and improved communications between all levels of government. An appendix will provide the timeline for the first five years of implementing CMSP at the national and regional levels.]

- **Organization of Federal, State, and Tribal Representatives by Region.** [This section will concisely describe the process that Federal agencies are using to identify, train, and authorize their regional representatives to participate effectively in the work of the RPBs. It will make brief reference to the lessons learned from the Council's National CMSP Workshop and Simulation Exercise. And, it will provide Council-approved guidance as to how State and tribal government representatives on the RPBs might be identified and selected by the States and tribes to represent their jurisdictional authorities as regional CMSP gets underway.]

- **Preparation of Regional CMSP Development Agreements.** [This section will include guidance on the collaborative process whereby the RPBs would prepare CMSP development agreements. The process for CMSP provides that once the Federal composition of RPBs is determined, the Council would coordinate with the appropriate State authorities and all Federally-recognized tribal representatives in the regions to establish RPBs, and enter into a development agreement.

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The development agreement would constitute a commitment from the partners to participate in a cooperative, open, and transparent CMSP process leading to the eventual development of a CMS Plan, acknowledging that each partner may have different authorities and non-discretionary mission objectives that must be fully addressed. Each RPB will have the flexibility to tailor the agreements as necessary and appropriate to reflect regional considerations and priorities, including relevant State and tribal interests which are essential to the success of CMSP.

  - The agreement would not commit any Federal, State, or tribal partner to its approval of a regional CMS Plan. To this end, the Council, in consultation with the Governance Coordinating Committee, is preparing a model agreement to assist RPBs in developing their own such agreements, and to foster efficiency and consistency in forming the RPBs. The model will identify the minimum elements for inclusion in the regional development agreements to be executed by the RPBs to ensure consistency with the national framework for CMSP. The Council's Model CMSP Development Agreement will be included as an appendix.]

- **Regional Capacity Assessment.** [This subsection will include guidance in assessing regional capacity consistent with the Executive Order and the framework for effective CMSP. Among other things, it will note that some regions and regional bodies are well ahead of others in their governing structure, resources, experience, and progress toward implementing CMSP.]

- **Examples of Initial Regional Steps.** [Although the determination of the initial regional steps will be left to each RPB, this subsection will provide helpful examples and lessons learned in developing regional CMS plans. Among other things, it will provide examples in the process of identifying and organizing each RPB under the leadership of the Federal, State, and tribal RPB Co-Leads, the value in holding a regional CMSP workshop and simulation exercise early in the process, and the other initial necessary steps to get the RPBs organized, up-and-running, and ready to produce beneficial results. To the extent practicable and appropriate, it will detail relevant lessons learned from other nation's marine spatial planning experiences.]

- **Stakeholder and Public Engagement and Participation.** [This subsection will include how the CMSP process will engage and involve environmental and trade groups, commercial and recreational fishing interests, other stakeholders, and the general public, including traditionally underserved, low-income, indigenous, isolated, and minority populations. It will include a proposed timeline, with specific dates, during which the initial engagement with stakeholders in the process should be completed, and how it will continue as the CMS plans are reevaluated and updated over time.]

- **Consultation with Scientists and Technical and Other Experts.** [This subsection will describe how the RPB might best consult with scientists, technical experts, and those with traditional knowledge of or expertise in coastal and marine sciences and other relevant disciplines to ensure that the development of regional CMS plans is based on sound science and the best available information. To this end, the RPB should establish regional scientific, technical, and

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other expert participation and consultation mechanisms to ensure that it obtains relevant information as required by the Executive Order and the framework for effective CMSP.]

- **Regional Advisory Committees (RACs).** [Consistent with the guidance in section 8 of the Executive Order, this subsection will describe how the Federal RPB Co-Lead, in consultation with the State and tribal Co-Leads and RPB members, could establish such advisory committees under the Federal Advisory Committee Act (FACA) as they may deem necessary to provide information and advice to the RPB on the development of regional CMS plans to better promote the purposes of the National Ocean Policy. In the end, each RPB would make the decision whether or not to establish any such FACA advisory body.]

- **Regional Work Plan Development.** [Although the development of a regional work plan will be left to the RPBs, this subsection will describe the process of how these bodies might choose to develop a regional work plan consistent with the Executive Order and the framework for effective CMSP. It will also outline how these bodies might plan to conduct their work in a wise and cost-effective manner, to enable them to produce a comprehensive, coherent, valuable, and consensus-based regional CMS plans as quickly and efficiently as possible.]

- **Council Certification of Regional CMS Plans.** [This subsection will describe the process of submitting the regional work plans and, eventually, the CMS plans to the Council to review, add value to, and then certify these plans in a timely and helpful manner. It will also explain what steps the RPB is to follow if the Council fails to certify all or part of a regional work plan or CMS plan. Finally, this subsection will provide details as to how the Council will review each regional CMS plan for national consistency after 30-days of public comment.]

- **Development of Regional CMS Plans.** [Although the development of the regional CMS plans will be left to the RPBs, this subsection will outline a recommended process for consideration. It will explain how the RPBs might choose to conduct their work in a wise and cost-effective manner, to enable them to produce a comprehensive, coherent, valuable, and consensus-based regional CMS plans as quickly and efficiently as possible. It will recognize that there will be different approaches, timetables, and expectations for developing these plans depending on regional conditions. It will also include possible target dates for the development of a preliminary draft, final draft, and final CMS plan. Finally, it will remind the regions of the need to include stakeholder engagement, scientific input, and public comment to ensure transparency and access the best possible ideas.]

- **Implementation of CMS Plans.** [Although the implementation of the CMS plans will be overseen by regional Federal, State, and tribal authorities with the necessary jurisdiction and authority, this subsection will provide appropriate guidance, along with the development of any monitoring and assessment mechanisms and any process for adaptive management. It will also recognize how CMS plans will be incorporated into the existing decision-making processes consistent with existing statutory authority, and describe opportunities for integration with existing and future State, tribal, regional, and local efforts.]

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V. Council Guidance Regarding the Development of a National Information Management System and CMSP Portal. [This section will discuss CMSP-related data and informational requirements. It will be entirely informed, if not completely written, by the Council's interagency Data Management Working Group, which is now developing such information and data-related guidance under the auspices of the Council. The approved data standards and other information concerning the information system may be included as an appendix.]

VI. Legal Analysis and Guidance. [This section will set forth the Council's analysis of how various statutory authorities of particular agencies can be harmonized in order to support comprehensive, integrated regional CMSP. The analysis will include an effort to identify gaps and conflicts in existing Federal authorities and recommend potential steps to reconcile them. The Council will also consider how legal authorities of Federal, State, tribal, and local entities might collectively be used to support implementation of regional efforts. In this regard, the Council will coordinate with the Governance Coordinating Committee as appropriate to ensure full consideration of relevant State and tribal legal authorities. This section will also include guidance to assist RPBs in complying with various laws relevant to their operation, such as FACA and the Freedom of Information Act (FOIA).]

VII. Regional CMSP Dispute Resolution Mechanism. [This section will set forth the regional CMSP dispute resolution mechanism currently under development by the Council in cooperation with the Governance Coordinating Committee. As provided in the Executive Order, the Council will design the mechanism in a way to ensure that most disputes would be resolved at the regional level, while ensuring consistency between the RPBs. The mechanism will ensure that all State and tribal partners will exercise a vital role in resolution of disputes involving State or tribal interests in a particular region. The mechanism will account for decision-making by the RPB by consensus. The mechanism will require that the Council coordinate with the Governance Coordinating Committee on matters involving State or tribal interests in the event a dispute is elevated to the Council for resolution. The mechanism will also be included in Council's Model CMSP Development Agreement.]

VIII. On-the-Horizon Strategic Planning Guidance. [This section is designed to provide additional strategic, long-term guidance from the Council on implementing CMSP. It may describe the benefits and products that will flow from successful CMSP, including promoting the national and regional objectives and streamlining the process of sustainable economic development in the coastal regions. However, specific elements of this guidance will be included in this SAP only as the ORM-IPC (and OST-IPC) may deem necessary and appropriate. An appendix will provide technical and scientific information and resources likely to prove useful to regional CMS planners at the appropriate level of detail. The CMSP SAP Writing Team may consider the need for such guidance and draft appropriate language for coordination with other bodies and approval by higher authority, eventually including the Council.]

IX. Conclusion

- This SAP to implement the priority objective of CMSP is intended to help chart a new course for improved stewardship of the ocean, our coasts, and the Great Lakes. Specifically, this SAP is a way forward for implementing a comprehensive, science-based, integrated, transparent, and

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ecosystem-based planning process to achieve the sustainable stewardship and optimum uses of these vitally important areas.

- The Council and the writing team preparing this SAP are aware that the Executive Order and National Ocean Policy—and this plan under development—may create a level of anxiety among those who rely on these resources and that it may generate questions about how this plan will align with existing processes, authorities, and budget challenges. Meaningful and frequent opportunities for stakeholder and public engagement throughout the implementation of CMSP will be an essential component of addressing these concerns.

- The Council and the writing team are confident that the investments and improvements described in this SAP will significantly advance the economic interests of the United States through sustainable and productive ocean uses; improve our capacity to address the long-term challenges and impacts of climate and environmental changes; and provide a lasting foundation for improving the stewardship of and further enhancing the many vital benefits our Nation can derive from these resources. With a clear, achievable, regionally-empowered approach to CMSP, we can achieve an America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured so as to promote the well-being, prosperity, and security of present and future generations.

INTERIM

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Inform Decisions and Improve Understanding
Strategic Action Plan
Full Content Outline

Objective: Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.

I. Overview of the Priority Objective

This strategic action plan (SAP) addresses the National Ocean Policy priority objective to:

- Ensure the availability of cross-cutting scientific research and technological innovation for developing management and policy decisions for ocean, coastal, and Great Lakes ecosystems and processes;
- Engage in ocean exploration to expand knowledge that has the potential to lead to new discoveries for energy resources and improved human health and well-being;
- Develop a comprehensive awareness and understanding of current and emerging human activities, including traditional, cultural, and historical, that affect our coastal watersheds and the ocean; and
- Increase the understanding of the importance and benefits that the ocean, coasts, and Great Lakes provide to our Nation's people.

II. Context and Continuity

Meeting this priority objective requires:

- Supporting basic and applied disciplinary and interdisciplinary scientific research, mapping, monitoring, observation, and assessment, coupled with development of forecasts, models, interactive maps, and other decision-support tools to address priority issues in ocean, coastal, and Great Lakes environments, including climate change, risks, and vulnerabilities;
- Increasing understanding of existing, emerging, and future uses of coastal, marine, and Great Lakes resources, effects of such uses on the ecosystems, tradeoffs among uses, and ways to increase sustainability of uses;
- Increasing scientific knowledge and detailed understanding of current and emerging human activities taking place in and around our Nation's waters;
- Improving management of resources and uses through data integration, increased scientific knowledge supporting management, development and improvement of spatially-explicit decision-support tools, and transition of research results into information products and tools for management;
- Increasing human capacity, developing a knowledgeable workforce, and improving education in ocean-related fields, including a focus on disadvantaged and underrepresented communities;
- Increasing ocean literacy through formal and informal education and public outreach;
- Supporting fundamental research for ocean exploration and discovery; and

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- Improving integration of social and natural sciences in developing policy and management actions for the ocean, coastal, and Great Lakes ecosystems.

III. Body of the Plan

A. Action 1 - Prioritize research activities based on "Science for an Ocean Nation: An Update of the Ocean Research Priorities Plan."

Federal agencies and partners will use the new "Science for an Ocean Nation: An Update of the Ocean Research Priorities Plan" ("Science for an Ocean Nation") as the primary basis for prioritizing research activities within their agencies. They will coordinate such activities across agencies to achieve maximum efficiencies in advancing the ocean sciences. Linkages between the research priorities in "Science for an Ocean Nation" and the National Ocean Policy priority objectives are explicitly identified in the new report, thereby allowing agencies to easily identify the connections between them. This action has connections to the data gaps and research needs identified in all eight of the other SAPs. (Note: While "Science for an Ocean Nation" has not yet been officially released, a preliminary draft was available to the SAP writing team and the full report will be available to the public within the next few months. Meanwhile, we urge readers to refer to the 2007 predecessor of "Science for an Ocean Nation" entitled "Charting the Course for Ocean Science in the United States for the next Decade." The new report differs from its predecessor by more strongly emphasizing the issues of ocean acidification and changing conditions in the Arctic, and by specifically linking the research priorities to the needs of the National Ocean Policy.)

1. Why Do This
   - The National Ocean Policy calls for use of "the best available science and knowledge to inform decisions affecting the ocean, our coasts, and the Great Lakes, and enhance humanity's capacity to understand, respond, and adapt to a changing global environment." It also calls on us to "improve our understanding and awareness of changing environmental conditions, trends, and their causes, and of human activities taking place in ocean, coastal, and Great Lakes waters."
   - The new "Science for an Ocean Nation" lays out research needs to inform policy decisions across six broad societal themes that directly connect with the objectives of the National Ocean Policy.
   - It therefore serves as a valuable framework to advance knowledge in a manner that will improve understanding and provide for informed decisions using the best available science.

2. Timeframe - Near-term

3. Outcomes
   - The recommendations in "Science for an Ocean Nation" significantly influence agency decisions about resource allocations and priorities within their science or education budgets.

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- Increased knowledge leads to enhanced sustainable uses of and benefits from ocean, coastal, and Great Lakes resources.
- Better stewardship of resources is enabled by increased understanding of ecosystem processes, impacts of human uses, and vulnerabilities.
- Knowledge allows the creation of comprehensive and generic multi-hazard risk assessments and warning system tools to support policy and management, as well as models, policies, and strategies for mitigation of and/or finding adaptive solutions to coastal and ocean hazards, ecosystem variability, and climate change.

4. Milestones
   - Agencies reference "Science for an Ocean Nation" in budget documents used to justify and defend budget decisions and include priorities from the report in annual budget requests.

5. Gaps and Needs in Science and Technology
   - "Science for an Ocean Nation" identifies a number of gaps and needs.

B. Action 2 – Provide science to support emerging sustainable uses of resources.
Federal agencies and partners will provide science and services to support the development and production of emerging sustainable uses of ocean, coastal, and Great Lakes resources.

1. Why Do This
   - Fundamental and applied scientific information and technology are needed to characterize resources, their uses, and potential environmental impacts.
   - Providing scientific information and services will ensure that emerging and future uses of ocean, coastal, and Great Lakes resources are economically and ecologically sustainable.
   - This will also better inform the process of coastal and marine spatial planning (CMSP) regarding potential economic and environmental impacts of compatible uses, and inform ecosystem-based management (EBM) (see the CMSP and EBM SAP outlines).

2. Timeframe - Long-Term

3. Outcomes
   - Private industry, government agencies, and partners make better informed decisions about the feasibility and operations of sustainable uses of ocean, coastal, and Great Lakes resources based on environmental, social, and economic data and predictive modeling.
   - Increased opportunities for sustainable and emerging uses of ocean, coastal, and Great Lakes resources, resulting in increased opportunities for economic growth, creation of new jobs, and increased sustainability of traditional ocean uses.

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4. Milestones
   - Develop joint agency aquaculture initiatives through the Joint Subcommittee on Aquaculture and other partnerships.
   - Design new renewable energy technologies using the integrated oceanic and atmospheric observation system and modeling programs.
   - Inventory the compiled nation-wide renewable energy potential and complete the national offshore wind energy resource map.
   - Develop test beds to provide enhanced wind energy forecasts via the High Resolution Rapid Refresh modeling system.

5. Gaps and Needs in Science and Technology
   - Research and technology development to support vibrant, profitable, and sustainable ocean, coastal, and Great Lakes resource and emerging technologies industries.
   - Information necessary for existing and emerging resource uses to make informed decisions through the CMSP framework.

C. Action 3 - Provide science support for managers and policy makers.

To enable and inform science-based decisions, Federal agencies and partners will regularly assess needs of resource managers and policy makers for research, data, and information, directly respond to those needs by providing data and information, developing and improving spatially-explicit decision-support tools (e.g., integrated ecosystem assessments), and expanding training and technical assistance. This action will connect with related training activities with the EBM SAP.

1. Why Do This
   - Robust decision-support tools and processes support rapid, effective, and publicly-supported management of growing uses of ocean, coastal, and Great Lakes resources.
   - Providing needed research, data, information, and traditional knowledge will help ensure sustainability of natural resources, biodiversity, and critical ecosystem services.
   - Assessing management and policy needs will also minimize the negative environmental and human health impacts (particularly due to climate change and sea-level rise) on vulnerable communities.

2. Timeframe - Mid-Term

3. Outcomes

   Ocean, coastal, and Great Lakes decision-makers use technically robust decision-support tools, processes, and services that:
   - Integrate scientific, environmental, and socio-economic information to support EBM and CMSP;

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- Provide meaningful indicators of ecosystem health and societal goals; and
- Support prediction and scenario evaluation to make informed decisions, with particular focus on CMSP.

4. Milestones
   - Create an interagency (Federal, State, Tribal, regional, and local) team that will complete an assessment of existing and needed research, data, information, traditional knowledge, decision-support tools, and training to support ocean, coastal, and Great Lakes decision-makers.
   - Develop and provide appropriate training curricula, decision-support tools, and information services to meet the needs of ocean, coastal, and Great Lakes decision-makers and other stakeholders, as identified in the interagency assessment.

5. Gaps and Needs in Science and Technology
   - Social science research and application related to the effective design and application of tools, technologies and information services (See Action 7).
   - Quantification and valuation of ecosystem services related to coastal management decision making.

D. Action 4 - Develop human capacity and the workforce.

Develop human capacity and a knowledgeable workforce, and provide scholarships, internships, fellowships, and other opportunities for high school, undergraduate, and graduate students, particularly from underrepresented groups, pursuing degrees in ocean science, management, and related fields.

1. Why Do This
   - Current graduation rates in geosciences are low, particularly for underrepresented groups.
   - U.S. competitiveness depends on a well-educated workforce.

2. Timeframe - Mid-term

3. Outcomes
   - More students, particularly from underrepresented groups, graduate in academic fields related to ocean science and management at the undergraduate and graduate level.
   - The number of students entering the workforce through Federally-supported fellowship and internship programs related to ocean science and management is increased.
   - K-12 students are engaged in extracurricular ocean-related Science, Technology, Engineering, and Mathematics (STEM) activities.

4. Milestones

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- Award scholarships, fellowships, and internships for high school, undergraduate, and graduate students that leverage Federal investment in research, laboratories, and natural areas to support education.
- Focus on underrepresented groups by working with professional societies, nonprofits, and minority-serving institutions when recruiting applicants for scholarship, fellowship, and internship programs.
- Develop a new post-doctoral program for ocean sciences.
- Host competitions and activities for high school students that demonstrate impact on students' choices of future academic and career paths.
- Support underwater and ocean technology programs for secondary and post-secondary education with Federal resources.
- Fund studies to track changes in the future ocean workforce.

5. Gaps and Needs in Science and Technology - None

E. Action 5 - Increase ocean literacy.

Increase ocean literacy and expand the accessibility and use of ocean content in formal and informal educational programming for students, teachers, and the public.

1. Why Do This
   - The Ocean Project study shows high public concern about but low understanding of ocean issues.
   - Studies by the National Research Council and others show effectiveness of formal and informal science education programs at raising levels of awareness and stewardship.

2. Timeframe - Mid-term

3. Outcomes
   - Greater access to Federally-funded ocean research for formal and informal education institutions.
   - Increased public awareness and understanding of ocean science issues.
   - Communities are better stewards of ocean, coastal, and Great Lakes resources.

4. Milestones
   - Support inclusion of ocean content in revised national science education standards.
   - Support regional ocean education plans.
   - Complete a study of environmental attitudes and knowledge in middle schools with environmental education programs.
   - Develop a comprehensive ocean science curriculum for middle school based on Ocean Literacy Essential Principles.

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- Use data from surveys of community understanding and attitudes of ocean issues to inform future educational programming, communications, and public engagement.
- Increase the numbers of scientists engaged in ocean education.
- Engage students and public audiences in ocean science and management through innovative programs and emerging technologies.
- Create new professional development opportunities for educators that use Federal ocean research and data; train educators to reach multicultural audiences.
- Increase use of Ocean Literacy Essential Principles and related principles by networks and partners that engage students, teachers, and the public.
- Increase outdoor and experiential learning opportunities in coastal watersheds.
- Develop infrastructure and demonstration projects that deliver ocean observing data for formal and informal education.
- Support citizen science programs that engage participants in ocean sciences.
- Use inventories of Federal STEM education programs to identify additional partnership opportunities.
- Support efforts to incorporate as appropriate native and traditional knowledge into ocean education materials.

5. Gaps and Needs in Science and Technology - None

F. Action 6 - Engage in ocean exploration.

Federal agencies will engage in exploration to expand our knowledge of little-known Great Lakes and oceanic biodiversity, biogeochemical processes, ecosystem services, and climate interactions to bring new understanding and benefits to research, management, policy, and the public.

1. Why Do This
   - Ninety-five percent of the ocean is poorly known or essentially unexplored, and the potential for discoveries to expand knowledge, lead to new energy sources, develop new products, and inspire the next generation of ocean scientists is enormous.
   - For the U.S. to be a global leader in ocean exploration and knowledge of the connections between human well-being and the natural environment, we need to explore currently unexplored or poorly-known Great Lakes and oceanic biodiversity, biogeochemical processes, ecosystem services, and climate interactions at the global-scale.

2. Timeframe - Mid-term

3. Outcomes
   - New ocean discoveries expand our knowledge and understanding of Great Lakes and oceanic biodiversity, biogeochemical processes, ecosystem services, and

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climate interactions, and this new knowledge informs management, policy, the public, and future research.
- Scientific insights and innovative technologies enhance the Nation's competitiveness by increasing scientific and technological capability and discovering new opportunities for biomedical and business development.
- The pace, efficiency, and scope of exploration are increased, and resulting discoveries are disseminated to the global scientific and societal enterprise.

4. Milestones
- Execute five expeditions in poorly-known or unknown Great Lakes and national and international ocean regions.
- Communicate new discoveries from five expeditions regularly to the public as well as to the scientific community.
- Establish five new cost-sharing partnerships with domestic and international governmental and nongovernmental entities that support global-scale systematic exploration.

5. Gaps and Needs in Science and Technology
- Innovative tools, technologies, and international partnership activities to provide the most cost-effective strategies for ocean exploration and discovery.
- A suite of common products related to ocean exploration and research agreed to by Federal agencies and partners.
- An easily accessible electronic library of scientific information and products related to ocean exploration, research, and education efforts.

G. Action 7 - Integrate social and natural scientific information.
Federal agencies and partners will integrate information from a broad range of social sciences with the natural sciences.

1. Why Do This
- Information from social sciences and economics must be routinely integrated with the natural sciences to inform research, policy development, and management decision-making, especially for ecosystem-based management and restoration, to improve public understanding of management actions.
- Incorporating social and natural sciences will support and enhance sustainable economies and other uses.
- Using social science research to apply decision theory to ocean issues will inform ocean policy decisions and assist in developing best management practices.

2. Timeframe - Long-term

3. Outcomes

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- Methods and metrics that integrate the social and natural sciences are developed.
- Knowledge of human behavior, attitudes and preferences, societal values, economics, and human use of and dependence on ecosystem services is routinely acquired and incorporated into ecosystem assessments, decision-making, and management of ocean, coastal, and Great Lakes resources.
- Public attitudes and preferences are routinely incorporated into ecosystem assessments, policy, and management decisions.

4. Milestones
   - Develop one or more pilot projects that use socioeconomics and natural sciences to identify, develop, and test valuation frameworks for ecosystem services.
   - Based on the results of the pilot projects, develop a framework for valuing the ecosystem services of the Nation's critical ocean, coastal, and Great Lakes resources.
   - Perform trends analyses to characterize human interactions with the ocean, coasts, and Great Lakes and identify 'cutting edge' issues, with intent to maintain relevant data collection and analyses for the long term.
   - Apply, adapt, or develop two new decision-support tools that integrate information from natural and social sciences and are targeted toward improving the ability of Federal, State, and Tribal authorities to meet their economic, environmental, public health and safety, social justice, and equity objectives related to ocean, coastal, and Great Lakes resources and uses.

5. Gaps and Needs in Science and Technology
   - More robust approaches to incorporate natural and social science perspectives and information in ongoing research, and policy development to support ecosystem-based management and restoration.
   - More quantitative data on ecosystem processes, functions, and services, such as for different landscape and habitat types and under different environmental conditions.
   - More broadly accepted methods for determining monetary and non-monetary values of ecosystem services that are relatively inexpensive and easy to implement and for the public to understand.

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Coordinate and Support
Strategic Action Plan
Full Content Outline

Objective: Better coordinate and support Federal, State, Tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government and, as appropriate, engage with the international community.

I. Overview of the Priority Objective

- One of the significant obstacles to effective management of the ocean, our coasts, and the Great Lakes is the complex set of Federal, State, Tribal, and local laws, authorities, mandates, and governance structures intended to manage their use and conservation.
- Consistent approaches to the management of resources, including ecosystem-based and adaptive management, are difficult to achieve given this shared, piece-meal, and overlapping jurisdictional model.
- The United States is party to numerous international agreements and subject to customary international law regarding use and protection of the ocean, coasts and the Great Lakes. The United States should engage both domestically and internationally to achieve increased cooperation and coordination on ocean issues.
- Through increased communication, coordination, and integration across all levels of government, we can streamline processes, reduce duplicative efforts, leverage resources, resolve disparities, and enhance synergy.
- In terms of coordination, the strategic action plan (SAP) will address:
    - Identification of needs, inconsistencies, and duplications in statutory authorities, policies, and regulations, and necessary and appropriate actions to address them;
    - Procedures to identify and align mutual and consistent management objectives and actions across jurisdictions, including those actions identified in other SAPs;
    - Tangible tools and procedures to prevent and resolve conflicts across jurisdictions and disagreements concerning jointly managed ocean, coastal, and Great Lakes resources; and
    - Opportunities for engaging the international community to further the objectives of the policy, as appropriate.
- In terms of support, the SAP will address:
    - Actions to assist the States, Tribes, territories, and local governments in advancing the network of regional partnerships to protect ocean, coastal, and Great Lakes health;
    - Evaluation of existing or new non-Federal funding sources and options to protect, maintain, and restore ocean resources; and
    - Legislative or regulatory changes necessary to simplify the sharing and transfer of resources among Federal, State, Tribal, and local agencies.

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II. Context and Continuity

- This Plan will establish mechanisms to enhance communication and coordination among Federal, State, Tribal, territorial, regional, and local governments, external resource managers, and other interested parties. Taken collectively, the individual mechanisms for cooperation recommended in this SAP provide a framework for facilitating future cooperation.
- The analysis of legal, statutory, and regulatory gaps and overlaps will support efforts to reconcile existing authorities and provide recommendations to enact additional legislation or regulation where relevant. It will also help identify opportunities for future collaboration and coordination, as well as develop a shared set of principles and objectives, through identification of agency authorizing language.
- Development of a central repository for information accessible via the National Ocean Council's (NOC) National Information Management System (NIMS) between regions, territories, States, Tribes, and local governments will facilitate the development of networks between similarly aligned actors, and enhance coordination of efforts with regional entities.
- Coordination and revealing overlap will enable managers to effectively leverage funding, and provide a real benefit and incentive to increasing cooperative efforts. Dissemination of Best Management Practices will similarly enhance operations.

III. Body of the Plan

A. Action 1 – Develop a regional communication framework under the National Oceanographic Partnership Program (NOPP).

1. Why Do This
   - Constituents of Federal, State, Tribal, and local governments need consolidated, readily accessible and deliverable information regarding existing regional ocean partnerships, assets, and resources to advance regional ocean governance.
   - Over the years, various levels of government have come together to address issues related to ocean, coastal, and Great Lakes management on a regional basis. These groups address many similar overarching concerns, such as restoration, education, and science, and in many cases are in alignment with the National Ocean Policy.
   - As these groups have matured, it has become clear that enhancing communication among them, and with the Federal government, could further the priorities addressed in the National Ocean Policy. Specifically, the ability to simplify access to the breadth of Federal capacities (e.g., funding, expertise, programs) would greatly enhance regional ocean governance. The creation of a website would facilitate information exchange and improve communication.
   - A website that served as a repository for national and regional planning documents, available resources for collaboration support, and other relevant information would be a valuable communication tool among these various

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identified regional entities, would facilitate information-sharing and mutual progress, and would help avoid duplication of efforts. To ensure that user group needs are met, input will be gathered from States, territories, Tribes, local governments, and Regional Ocean Governance (ROG) entities during website development. ROG entities include the Great Lakes Commission, the Governors' South Atlantic Alliance, the Gulf of Mexico Alliance, the Mid-Atlantic Regional Council on the Ocean, the Northeast Regional Ocean Council, and the West Coast Governors' Agreement on Ocean Health.

- This website will also be developed in coordination with the NIMS to facilitate the exchange of information and resources within and between Federal agencies and the various regional State, Tribal, and local government entities.
- Lastly, efforts will be coordinated with other SAP writing teams (e.g. Coastal Marine Spatial Planning, Ecosystem Based Management, Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure) to ensure the effective support and implementation of the National Ocean Policy.

2. Timeframe – Near-term

3. Outcomes

- Improved exchange of information between and among Federal, State, territorial, Tribal, and local government entities, as well as ROGs.
- Improved coordination and understanding among interested parties about which actions are underway at the national and regional level, and where partners could engage.
- Development of a website that includes:
    - Hotlinks connecting the various ROGs.
    - Lists of contact information for each ROG with e-mail info for all members.
    - Lists of key organizations that interface with the regional entities
    - Updated information about the activities of the NOC
    - Access by ROGs to funding, expertise, and program opportunities available to regional initiatives (e.g. National Environmental Policy Act projects).

4. Milestones

- Secure sufficient funding through NOPP for developing a website or web portal.
- Complete feasibility study of hosting the website or web portal via NOPP and integrating with the NIMS
- Complete a website or web portal that provides one-stop shopping for information about ocean governance.
- Enhance intra-Federal agency connection, and enhance interaction with States, through more regularly scheduled (quarterly as the ideal minimum) meetings.

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5. Gaps and Needs in Science and Technology – N/A

B. Action 2 –Identify, prioritize, and seek to resolve legal barriers to implementation of the National Ocean Policy.

Working through the NOC Legal Interagency Working Group, address legal barriers inhibiting effective implementation of the National Ocean Policy, such as uncertainty, inconsistency, or overlap of authorities. Conduct an analysis of overlaps or sufficiency in statutory authority on particular topics identified through this process. Develop forums whereby Federal, State, Tribal, local officials, and non-governmental organizations (NGO) can interact and exchange information to work through barriers to collaboration.

1. Why Do This
   - There may be insufficient or redundant authorities in Federal, State, and Tribal ocean management regimes. This effort will address these issues and align and coordinate competing interests in ocean management, and increase efficiency and effectiveness of ocean management actions.
   - This will further the National Ocean Policy's direction to "ensur[e] a comprehensive and collaborative framework for the stewardship of the ocean, our coasts, and the Great Lakes that facilitates cohesive actions across the Federal government...." It also furthers the principles stated in the National Ocean Policy; in particular it will help "ensure and advance coordination and collaboration across Federal, State, Tribal, and local jurisdictional lines" and "eliminate redundancy and encourage efficiencies and synergies."

2. Time Frame: Near-term to Mid-term

3. Outcomes
   - Identification of the most significant redundancies, conflicts, and inefficiencies in the current ocean management regime with respect to State, Tribal, and local equities.
   - Deliverables may include:
     - Review of reports of the various entities that have already assessed the authorities in U.S. ocean management.
     - Identification of any critical issues not currently being addressed by the NOC Legal Interagency Working Group, and prioritization for closer examination or action.
     - Legal analysis of these issues, which may include recommendations for legislative, regulatory, or administrative changes.

4. Milestones
   - Conduct review of existing reports and analyses
   - Identify any critical issues requiring further analysis
   - Conduct analysis and make recommendations

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5. Gaps and Needs in Science and Technology – N/A

C. Action 3 –Identify barriers and obstacles to successful collaboration efforts.
Examine barriers between and among Federal, State, Tribal, regional, territorial, and local entities. Conduct this activity in consultation with and with the participation of ROGs, Tribal, and representative groups and industries to achieve stakeholder perspectives as well as governmental perspectives. Determine the origin of obstacles to collaboration, be it gaps or overlaps in legislation, institutional culture of agencies, competition between entities, political pressure from select constituencies, or other possible reasons. Assess where there is the need for remedial engagement tools, and implement those tools in coordination with the NOC Legal Interagency Working Group, to achieve an early resolution of competing authorities and interests.

1. Why Do This
   - Effective management of ocean resources is sometimes delayed or obstructed by confusion, misdirection, and conflicts between agencies and laws.
   - Identifying barriers and obstacles among existing entities and proposing solutions will provide opportunities for greater collaboration and alignment.

2. Timeframe –Mid-term

3. Outcomes
   - Federal, State, Tribal, territorial, regional, local governments, and ROGs function in a more integrated manner and with greater efficiency.

4. Milestones
   - Engage the ROGs in this discussion, noting ROG methods of dispute resolution. Input from other levels of interest, including industry and insular islands and territories, should be sought.
   - Identify the most common conflicts and their causes. These might include jurisdictional overlap or uncertainty in statutes, tendencies toward mission creep, cultural differences in agencies and governments, or lack of communication among executing entities.
   - Identify solutions for the most problematic or frequent causes.

5. Gaps and Needs in Science and Technology – N/A

D. Action 4 – Identify and disseminate Best Management Practices (BMPs) utilized in Federal or regional partnerships.
Help ensure that National Ocean Policy implementation will be successfully and consistently managed despite the diverse planning groups with varied traditions and activities throughout the regions.

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1. Why Do This
    - Federal agencies, States, Tribes, local governments, and ROGs and other regional ocean partnerships have varied governance structures and ways to encourage important collaborators to participate in regional ocean planning and implementation efforts.
    - This action will help to evaluate successful existing coordination practices among Federal, State, Tribal, local, university, private-public partnerships, NGOs, coastal communities, and Fishery Management Councils to share creative solutions and lessons learned.

2. Timeframe—Mid-term

3. Outcomes
    - Identification of successful practices and models of Federal partnerships between and among Federal agencies, ROGs and other regional ocean partnerships, Tribes, and local communities for successful practices within the partnerships. Assess the tools and techniques used by successful models of coordination, understand the timeline involved in establishing a framework for cooperation, and assess the costs and benefits of various alternatives.
    - Identification of existing coordination mechanisms, evaluated in terms of the National Ocean Policy priorities, and development of processes to use them to support the goals identified in the National Ocean Policy.
    - Promotion and adoption of the positive results of current successful coordination and support mechanisms.

4. Milestones
    - Publish guidance that identifies and outlines how to incorporate existing successful coordination practices for other interagency teams and partnerships.
    - Integrate BMPs into existing regional management plans at a Federal-level and encourage that they be stepped down into all plans.

5. Gaps and Needs in Science and Technology – N/A

E. Action 5 – Identify specific ways to prioritize and coordinate resources, reduce spending overlap, and leverage funding between and among Federal agencies, Tribes, and ROGs. Once those mechanisms are identified, encourage agencies to leverage resources through collaborative efforts using partnership organizations.

1. Why Do This

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- Improved coordination within the Federal Government, between Federal, Tribal, State, regional, territorial, and local bodies, and through government-private partnerships will enable all parties to better leverage limited resources.
- This action will identify and inventory specific ways to leverage funding sources among and between Federal agencies, States, Tribes, local governments, ROGs, NGOs, and the private sector.
- We will explore existing capacity building collaborations, including but not limited to NOPP, Cooperative Ecosystem Studies Units (CESU) National Network, Landscape Conservation Cooperatives (LCC), the National Estuarine Research Reserve Program, the National Sea Grant Program, State coastal management programs, and NGOs to encourage stronger participation in using these programs to carry out the objectives of the National Ocean Policy.

2. Timeframe —Long-term

3. Outcomes
   - Determination of how to best leverage existing and future ocean-focused budgets, as well as work plans within and across the Federal government through coordination with the Office of Management and Budget (OMB).
   - Identification of overlapping or related resources that are being provided by State, Tribal, and local governments, as well as non-profits or private entities.
   - Identification of programs and projects with greater opportunities for leveraging funding resources through partnerships with Federal agencies and ROGs.
   - Reduction of obstacles and streamlining cross-Federal coordination processes (e.g., interagency agreements, General Services Administration smart buys, grants and cooperative assistance)
   - Agencies better utilize and support existing collaborative partnerships.
   - Leveraging of Federal, State, Tribal, local government, university, and nonprofit programs that work with coastal communities.

4. Milestones
   - Produce a budget in coordination with OMB that identifies existing funding sources within the Federal budget that support the nine priority objectives.
   - Identify and compile the common goals among the Federal agencies, States, Tribes, local governments, ROGs, and Federal partnerships. From the common goals, identify those funds which may be strategically leveraged to maximize the benefits relative costs.
   - Evaluate existing efforts to streamline cross-Federal coordination processes to ensure that real or perceived obstacles among the agencies related to implementing the National Ocean Policy are addressed.
   - Work with NOPP, CESU, the LCCs, and coastal management programs to identify opportunities for encouraging participation in these collaborative efforts.

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5. Gaps and Needs in Science and Technology – N/A

F. Action 6 –Identify appropriate opportunities for engaging the international community about the National Ocean Policy.

Elicit international support for and improve coordination on ocean, coastal, and Great Lakes issues, in particular with countries that share the United States maritime boundaries.

1. Why Do This
   - Implementation of our National Ocean Policy will be facilitated by enhanced communication and collaboration with the international community.
   - Doing so will increase awareness of the National Ocean Policy by other countries and international organizations, and will increase support for the objectives of the National Ocean Policy from key international partners.
   - Coordination with international partners is critical in responding to projected changes from climate change.

2. Timeframe – Mid-term

3. Outcomes
   - Increased awareness of the National Ocean Policy by other countries and international organizations.
   - Increased support for the National Ocean Policy objectives and strategies from key international partners.
   - Development and implementation of similar policies by other countries and in other regions.

4. Milestones
   - Create an inventory of bilateral and multilateral agreements/discussions (including inter-agency, inter-ministerial, and inter-governmental) by a sponsoring Federal agency so that common interests and efforts may be more closely coordinated between agencies.
   - Develop additional international partnerships, where relevant, to effectively promote our National Ocean Policy.
   - Identify international organizations that address ocean and maritime issues in the National Ocean Policy
   - Identify countries that may have an interest in exchanging information on matters related to the National Ocean Policy.

5. Gaps and Needs in Science and Technology – N/A

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Resiliency and Adaptation to Climate Change and Ocean Acidification
Strategic Action Plan
Full Content Outline

Objective: Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.

I. Overview of the Priority Objective

- Research, observations, and modeling needed to forecast regional and local scale climate change impacts and related vulnerabilities for natural resources, health, infrastructure, and livelihoods, including social and economic impacts.
- Better integration of ocean and coastal science into the broader climate dialogue and measures to improve understanding of the connections among land, water, air, ice, and human activities.
- Evaluation of potential social and economic costs related to sea-level rise, such as accelerating erosion, increased saltwater intrusion, and more severe coastal and inland flooding.
- Adaptive actions to identify climate change impacts and related vulnerabilities, such as ocean acidification, and the development of ecological and economic resilience strategies and priorities for research and monitoring to address these strategies.
- Changes to local and regional ocean and lake management systems that incorporate changing climate risks and elements of resilient systems.
- A comprehensive approach to understanding human health implications of policies for the ocean, our coasts, and Great Lakes, and for identifying opportunities for the protection and enhancement of human health.

II. Context and Continuity

- The National Ocean Policy calls for better understanding of the ocean, coastal and Great Lakes environments and the changes happening there.
- Strategies to act on this recommendation should be developed and implemented to reduce vulnerability, increase resilience, and improve the adaptation of systems to climate change impacts.
- This Strategic Action Plan includes a set of interdependent actions that will yield better understanding of, preparation for, and response to the impacts of climate change and ocean acidification impacts on communities and ecosystems. The Plan includes a coordinated approach of gathering observations, conducting foundational and interdisciplinary research to enhance understanding of the impacts of climate change and ocean acidification, developing improved models and forecasts at appropriate geographic and temporal scales, and conducting vulnerability assessments of human and natural systems. These advances will serve as a platform for the provision of accessible, timely, useful, and relevant science to inform and support the implementation of adaptation actions.
- This Strategic Action Plan outline was prepared in coordination with other strategies, plans, and assessments addressing climate change adaptation that are available, currently under preparation or nearing completion, including the National Fish, Wildlife, and Plants Climate Adaptation Strategy;

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National Climate Assessment; the Freshwater National Action Plan called for by the Interagency Climate Change Adaptation Task Force; and U.S. Global Change Research Program Strategic Plan.

III. Body of the Plan

A. Action 1 – Improve understanding of the impacts of climate change and ocean acidification.
Advance scientific understanding of the impacts of climate change and ocean acidification on ocean, coastal and Great Lakes ecosystems and communities to provide an information basis for forecasting, vulnerability assessments, and adaptation efforts.

1. Why Do This
   - Preparing for and responding to the impacts of climate change and ocean acidification requires improved understanding of the scale, scope and intensity of these impacts on the Nation's valuable ocean and coastal ecosystems and the communities that depend on them.
   - This action will provide the information needed for improved forecasts of changes in ecological, economic, and social systems due to climate change and ocean acidification.
   - An integrated research agenda, including physical, natural, and social sciences, will address critical gaps in understanding and build a foundation for the development of models, tools, and services that support the needs of decision makers at all levels.
   - This action will also advance understanding and decrease the uncertainties surrounding the physical, chemical and biological impacts of climate change and ocean acidification and how humans would prepare for and respond to those changes.
   - This action supports and extends Action 1 in the Inform Decisions and Improve Understanding SAP.

2. Timeframe – Long-term

3. Outcomes
   - Improved scientific knowledge of the scale and scope of impacts from climate change and ocean acidification on coastal and ocean ecosystems to support the implementation of actions that strengthen resiliency of ocean and coastal ecosystems and communities.

4. Milestones
   - Conduct strategic research on the response of key species to multiple stressors (e.g. pH, temperature, and nutrients) in ocean and coastal ecosystems.
   - Improve understanding of how changes at the organismal level for key species will alter ecosystem structure and function using techniques such as evolutionary genetics, and laboratory, field, and mesocosm experiments on single and multi-species assemblages.
   - Improve understanding and valuation of the impacts of climate change and ocean acidification on ecosystem services (e.g., fisheries, storm protection) and the communities/economies that depend on them.

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- Develop integrated (e.g., coupled natural and human system) research projects on regional ecosystem responses to climate change and ocean acidification impacts, including thermal and pH change, alterations in oceanic circulation patterns, variations in precipitation and freshwater input, and biogeographic range shifts.
- Integrate social, cultural, behavioral, and economic sciences into studies and models of climate change and ocean acidification impacts.
- Conduct research that assesses the roles and relative importance of coastal habitats in carbon storage and sequestration to increase the ability to incorporate these valuable ecological services into restoration, management, adaptation and mitigation efforts.

5. Gaps and Needs in Science and Technology
   - Understanding of potential for physiological acclimation and evolutionary adaptation, with emphasis on ecologically and economically important organisms.
   - Expanded implementation of alkalinity as a tracer and incorporation of particulate inorganic carbon (PIC) and remineralization formulations in the biogeochemistry ocean general circulation model (BOGCM).

B. Action 2 – Forecast the impacts of climate change and ocean acidification at decision-relevant scales.

Forecast the impacts of climate change and ocean acidification on ocean, coastal, and Great Lakes ecosystems and communities at temporal and spatial scales relevant for use in vulnerability assessments, adaptation planning, and decision-making.

1. Why Do This
   - The planning and management communities have identified a need for valid points of reference when preparing for future conditions and decisions are often made at state to local levels.
   - As current knowledge of climate change impacts is assimilated, and new knowledge is being produced, the ability to predict the future state of the ocean, our coasts, and the Great Lakes as they respond to the effects of climate change is becoming even more necessary to support planning and management
   - Projections are urgently needed to plan and conduct vulnerability assessments, to inform adaptation efforts, and to avoid maladaptive activities.
   - No single, reliable information broker is consistently meeting the demand, and the existing patchwork quilt of data, information, and services is inefficient and impedes a coordinated, ecosystem-based approach.
   - The federal government can fill an urgent need by assembling the best science from federal agencies and the greater research community into best projections of what changes to expect at different spatial scales in the coming decades.
   - These projections must be maintained through regular updates and recalibrated as new science and observations provide greater clarity; in addition, they must be disseminated to practitioners through an integrated framework of climate information and services.

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2. Timeframe – Long-term

3. Outcomes
   - For the upcoming 15, 30, 60 and 100 years, develop a "best" storyline for how the future will likely vary from historical/present conditions through projected impacts to:
     - Physical/chemical oceanography (e.g. temperature, salinity, and pH change, changes to currents and circulation patterns, wave climate, tidal range).
     - Geomorphology (e.g., shoreline erosion/progradation, tidal wetlands).
     - Hydroclimatology (e.g., variations in the timing of precipitation and freshwater input, storm frequency).
     - Biology and ecology (e.g. ocean and coastal biological resources, species composition, habitat shifts, potential for invasions).
     - Human and social systems (e.g. hazards, jobs, infrastructure, communities, cultural resources).
     - Coupled natural and human systems.
   - Projected regional changes in relative sea-level and Great Lakes water levels.

4. Milestones
   - Synthesize literature and compile existing data and models to provide the initial set of projections.
   - Coordinate modeling and projections with the National Climate Assessment.
   - Continue development of the Earth System Prediction Capability (NEON, IOOS, GEOSS, etc.) with respect to development of a fully coupled ocean observation, data assimilation, and modeling capability for the ocean, our coasts, and the Great Lakes.

5. Gaps and Needs in Science and Technology
   - Better, more integrated scientific data and information to support the development of forecasts and projections.
   - Federal capacity for maintaining, updating, disseminating and archiving model code and results to support management and decision making.

C. Action 3 – Strengthen and integrate observations from the Nation's existing array of protected areas, research sites and observing systems into a coordinated framework of "sentinel sites and systems" to provide information critical for improved forecasts, vulnerability assessments, and adaptation strategies.

Strengthening and integrating observational and monitoring networks from the Nation's existing array of protected areas (e.g., National Marine Sanctuaries, National Estuarine Research Reserves, National Estuary Program, coastal National Wildlife Refuges, coastal National Parks), research sites (e.g., coastal NEON, Long-Term Ecological Research sites, OceanSITES) and observing systems (e.g., IOOS, HAB and pathogen warning systems, NOAA fisheries and protected species stock assessments, NOAA Coral Reef Monitoring Network) into a coordinated set of "sentinel sites and systems" is a highly efficient and effective way to provide managers and communities with the information they need about how coastal and ocean conditions and resources are changing over time.

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1. Why Do This
   - To effectively prepare for and respond to increasing risks and impacts, managers and stakeholders need credible and consistent information on how ecosystems are being impacted now and are likely to be in the future in order to develop, implement, evaluate, and adjust management efforts over time.
   - Linking and enhancing existing observations at protected areas and other key locations are efficient and effective ways to meet these needs.
   - This action will advance a coordinated set of "sentinel sites and systems" that deliver information on past and current conditions, early warnings of changes to come, and improved forecasting and ability to track changes in coastal and ocean ecosystems in a changing climate.

2. Timeframe – Long-term

3. Outcomes
   - A coordinated set of observations and monitoring in existing protected areas, research sites, and observation systems that allows for more comprehensive understanding of climate change and ocean acidification processes, impacts, and trends.
   - A system of "sentinel sites" that provide the management community with the information needed to develop and implement adaptation actions.

4. Milestones
   - Complete inventory and assessment of existing observations and monitoring capabilities in networks/systems of coastal and ocean protected areas, research sites, and observing systems.
   - Based on the inventory (above), determine critical gaps in information/coverage and solutions for addressing these gaps.
   - In collaboration with the National Climate Assessment, integrate existing observational and monitoring efforts into a suite of indicators of community and ecosystem impacts (physical, biological, chemical, cultural, social, economic) to track changes in vulnerability and resiliency through time.
   - Create and implement an interagency plan for standardized monitoring of the impacts of climate change and ocean acidification through existing networks of protected areas using standardized and/or interoperable techniques, databases, and indicators (see above) when and wherever possible, to maximize integration of information across networks and agencies.
   - Integrate relevant socioeconomic monitoring information (e.g., U.S. Census and Bureau of Labor Statistics data) with ecosystem monitoring information within regions to understand changes in coupled human-natural systems through time.
   - Identify existing observations on changes in species phenology (i.e., the annual timing of major life cycle events such as migration, reproduction, flowering) in coastal and ocean

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ecosystems, and develop a plan to provide for incorporating and accessing this information as part of the National Phenology Network.

- Deploy chemical sensors at existing coastal/ocean observing systems to monitor the variability and change at local to regional levels in biogeochemistry, particularly with regard to carbon system parameters (pH, DIC, TA, pCO2), temperature, oxygen dynamics, and nutrients.
- Deploy biological sensors at existing coastal/ocean observing systems to monitor the seasonal measurements of calcification rates and other CO2-sensitive processes not currently measured at time-series sites in order to assess the long-term response of ecosystems to ocean acidification.
- Disseminate and implement best practices, including guidance for relevant parameters that should be measured at each observing system, standardized chemical and biological monitoring protocols, and quality assurance and quality control procedures. This milestone should be coupled with appropriate training opportunities.

5. Gaps and Needs in Science and Technology

- Comprehensive monitoring in protected areas with appropriate instrumentation, methods, and quality control to provide an integrated, geographically-distributed database that can be used to estimate poorly understood spatial and temporal patterns of ocean acidification and sea level rise in estuaries and coastal zones.
- Advancements in the design of chemical and biological sensors that will allow for ready and accurate *in situ* measurements of multiple carbon system parameters (pH, DIC, TA, pCO2) and biological responses, and automatic collection of metadata, where feasible.
- Strategies to eliminate or minimize biofouling of sensors so that they can be used in marine environments for extended periods.
- Incorporation of instrumentation for monitoring the impacts of climate change and ocean acidification into existing coastal and ocean observational and monitoring networks.
- Integration and coordination between existing social, behavioral, and economic monitoring efforts and ecosystem monitoring efforts.
- Management and delivery (access) of data and information.

D. Action 4 – Provide accessible, timely, and relevant climate change and ocean acidification information, tools, guidance, and services to support decision making at all scales.

1. Why Do This

- Federal agencies must work together to provide decision makers at all levels with pertinent, comprehensive, accessible, and timely information for understanding, planning for, and responding to the impacts of climate change and ocean acidification.
- This action will support efforts to build resilience across ocean, coastal, and Great Lakes ecosystems and communities.

2. Timeframe – Mid-Term

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3. Outcomes
   - Enhanced ability of individuals, communities, and governments at all scales to identify their needs, and ultimately, to implement forward-looking, adaptive actions that build ecosystem, societal, and economic resilience.

4. Milestones
   - Make geospatial data, especially information on relative locations of water and land surfaces, shallow bathymetry, and cardinal habitat and ecological characteristics, available to ocean, coastal, and Great Lakes communities as a basis for adaptation planning.
   - Develop an interagency plan for LiDAR mapping, to acquire and maintain more precise shallow bathymetry and terrestrial elevation data in order to ensure comprehensive and accurate topographic information for coastlines, enabling response to and planning for changing landforms, water levels, and other effects of coastal inundation.
   - Provide accessible, standardized guidance for incorporating climate change and ocean acidification information into ecosystem management and coastal and marine spatial planning activities.
   - Support economic and non-economic valuation of ecosystem services.
   - Integrate information, tools, and services on coasts and oceans into the emerging online interagency climate information clearinghouse/portal, which will include:
     - Best-available scientific data and information.
     - User-friendly projections.
     - Transferable decision-support tools.
     - Best practices.
     - Relevant contacts from adaptation activities across the Nation.
     - An active support mechanism to facilitate dialogue among users.
   - Foster a "community of practice" by bringing together coastal climate change adaptation practitioners to share strategies and lessons learned.
   - Coordinate Federal climate services (e.g. data, guidance, tools, etc.) to maximize utility of information for decision-makers at all scales.
   - Develop a strategic plan for continuously identifying information needs of decision makers and addressing them through a use-inspired, integrated research agenda.
   - Provide a standard suite of regional and decadal climate projections at the scale appropriate for decision-making.
   - Provide guidance on the effective use of best-available regional and decadal climate projections, including associated uncertainties.

5. Gaps and Needs in Science and Technology
   - Geopositioning (LiDAR, shallow bathymetry, etc.) products, data and derived elevation products to support a wide range of operational needs and to establish a consistent baseline for planning assumptions, regulatory decision making, and scientific research.

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- Expanded availability of geopositioning information and a unified portal for access to the data to support work to conduct robust national assessments of natural resource and landform response to sea-level change and of the vulnerability of infrastructure and human communities.

E. Action 5 – Assess vulnerability of the built and natural environments and their interactions in a changing climate.

1. Why Do This
   - Addressing the inherent links between the impacts of climate change on the natural environment and the consequences for human communities and infrastructure is fundamental to improving the resiliency of ecosystems, communities, and economies.
   - This action will support decision-makers with information they need to develop actions that reduce vulnerability and strengthen resiliency and adaptation of ocean and coastal ecosystems and communities in a changing climate.

2. Timeframe – Mid-Term

3. Outcomes
   - Strategically assessing the vulnerability of ocean and coastal ecosystems and coastal communities in a changing climate.

4. Milestones
   - Establish methods, best practices, and standards for vulnerability assessments, including the consequences of climate change and ocean acidification for economic, ecological, cultural, and social systems, infrastructure, and technology.
   - Conduct coupled vulnerability assessments that address the interactions of the built and natural environments in the face of a changing climate.
   - Complete comprehensive climate change vulnerability assessments for federally funded and/or managed coastal facilities, infrastructure, cultural resources, and ecosystems.
   - Identify the most vulnerable areas, as well as areas most likely to be resistant/resilient to climate change impacts, to help decision-makers design effective adaptation plans.
   - Develop partnerships, guidance, tools, and best practices to help support vulnerability assessments at local, state, tribal, and regional scales (See Action 4).

5. Gaps and Needs in Science and Technology
   - Pathways for incorporating improved knowledge about sensitivity, exposure, and adaptive capacity, as well as future environmental changes and impacts, into vulnerability assessments (See Actions 1, 2 and 3).

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F. Action 6 – Design, implement and evaluate adaptation strategies in order to reduce vulnerabilities and promote risk-wise decisions.

1. Why Do This
   - The Nation's coastal and ocean resources are already being impacted by climate change and ocean acidification, and these impacts are expected to increase in the future.
   - Coordinated action is needed at all levels to reduce vulnerability and impacts to the built and natural environments.
   - There is an opportunity to make significant progress in this area through building on current efforts at local, state, tribal, and regional levels.
   - There is an urgent need for immediate and prolonged investment now in adaptation plans and actions for repair, replacement or expansion of existing critical infrastructure (e.g., water and waste water treatment plants, hospitals, coastal highways, etc.) to address current and future impacts as well as reduce future losses.
   - This action will help to reduce current and future vulnerabilities and impacts to climate change and ocean acidification by enhancing and increasing the design, implementation, and evaluation of adaptation plans for built and natural environments.
   - Accomplishing this action will directly advance the nation's ability to be "climate ready."

2. Timeframe – Long-term

3. Outcomes
   - Reduced vulnerability and improved resilience of communities, ecosystems, and infrastructure through actions that lead to "climate smart" siting and design, restoration and protection of ecosystem services, improved public health and safety, reductions in the loss of life and property, and decreased costs of responding to disasters.

4. Milestones
   - Promote, build on and incentivize design, implementation, and evaluation of adaptation strategies in local, state, regional, tribal, and federal decision making.
   - Develop tools, capacity, and best practices for adaptation planning at local, state, tribal, regional, and national scales.
   - Identify, protect, connect, and restore key areas needed to promote resilience, sustain biodiversity, ecosystem function and ecosystem services, and maintain plant, fish, and wildlife corridors along coasts and lakeshores.
   - Incorporate species migration patterns and ecosystem protection measures into all publicly funded infrastructure projects.
   - Promote regional frameworks (e.g., Interagency Climate Change Adaptation Task Force regional adaptation consortia, Landscape Conservation Cooperatives, CMSP Regional Planning Bodies) for coordinated adaptation planning, implementation, and evaluation across geographic scales and organizations.

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- Promote ecosystem-based approaches to adaptation to use the adaptive services of natural systems to help reduce vulnerabilities and risks to people and the built environment.
- Achieve a no-net increase in the amount of property and infrastructure in high-hazard areas.
- Mitigate vulnerability of coastal communities to the effects of climate change and ocean acidification. Develop plans for fortification, retreat, or other strategies that ensure continuity of critical services and reduced exposure to hazards. Consider ecosystem-based approaches (as opposed to gray infrastructure) when feasible.
- Implement pre-disaster mitigation planning and recovery to prepare for climate change. Revise Federal guidelines and programs to encourage more resilient and sustainable forms of rebuilding or retreat.
- Reduce the impacts of stressors over which we have more direct control (e.g., pollution, habitat destruction and resource extraction) to enhance the resiliency of coastal, ocean, and Great Lakes ecosystems to climate change and ocean acidification.
- Modify policies, practices, programs or projects that promote maladaption (increased vulnerability and risks to communities or natural environments).
- Expand the interpretation, and where necessary, issue proposals to strengthen the Coastal Zone Management Act and the Stafford Act to include and better support climate change adaptation efforts.
- Develop strategies to address the unique needs for adaptation of cultural resources on shores and under water, including consultation with tribes and State Historic Preservation Offices.
- Ensure that coastal and ocean ecosystems and coastal communities are included, where relevant, in Federal agency adaptation planning efforts under Executive Order 13514.
- Complete development of the National Fish Wildlife and Plant Climate Adaptation Strategy to safeguard the nation's valuable natural resources and the communities that depend on them in a changing climate.
- Include consideration of climate change and ocean acidification impacts and costs in all federal financing (grants, loans) programs that support the maintenance or construction of public infrastructure in coastal areas.

5. Gaps and Needs in Science and Technology

- Feasible alternative scenarios for the future operations, maintenance, and relocation of built infrastructure (e.g., coastal roads, port facilities, dam operation) to mitigate the effects of climate change on ecosystems.
- Evaluation and prediction of new coastal migration corridors and potential new habitat for ecosystems.
- Methods and standards for evaluation of resilience and adaptation that include economic, ecological, cultural, and technological consequences of climate change and ocean acidification.

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Regional Ecosystem Protection and Restoration
Strategic Action Plan
Full Content Outline

Objective: Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, state, tribal, local, and regional levels.

I. Overview of the Priority Objective

- Ocean, coastal, and Great Lakes ecosystems continue to suffer significant adverse impacts resulting from urban and agricultural development and other human activities. These ecosystem threats are being exacerbated by other stressors like the impacts of climate change and invasive species. While progress has been made in addressing some of these challenges, fish and wildlife habitat continues to be degraded and destroyed. Because many of these threats cross jurisdictional boundaries, increasing Federal support for regional approaches to ecosystem protection and restoration is necessary.

II. Context and Continuity

Ocean, coastal, and Great Lakes ecosystem protection and restoration are being carried out at state and regional scales through implementation of Federal and state resource management and land-use planning initiatives. State plans include, but are not limited to, ocean plans, coastal zone management plans, wildlife action plans, and regional ocean governance plans.

- The Governors in five regions have established state-led regional ocean governance bodies to set coastal and ocean use, management, protection, and restoration priorities: Northeast Regional Ocean Council, Mid-Atlantic Regional Council on the Ocean, South Atlantic Alliance, Gulf of Mexico Alliance, and the West Coast Governors' Agreement on Ocean Health.
- Federal agencies are also engaged in various regions through interagency collaborations focused on ecosystem restoration and management, such as the Gulf Coast Ecosystem Restoration Task Force, Federal Leadership Committee for the Chesapeake Bay (Executive Order 13508), Great Lakes Inter-Agency Task Force (Executive Order 13340), Great Lakes Restoration Initiative, South Florida Ecosystem Restoration Task Force, Puget Sound, and the California Bay-Delta Conservation Plan. Additionally, through groups like the U.S. Coral Reef Task Force (USCRTF) and the Aquatic Nuisance Species Task Force (ANSTF), interagency efforts are coordinated across several regions to preserve and protect coral reef ecosystems and to prevent and control aquatic nuisance species, respectively. Regional initiatives and numerous local efforts are also supported by the 18 joint ventures, established under the *North American Waterfowl Management Act*, the National Fish Habitat Action Plan (NFHAP) network of Fish Habitat Partnerships, Landscape Conservation Cooperatives (LCCs), and the regional planning bodies being established to conduct coastal and marine spatial planning (CMSP). Through these diverse initiatives, Federal agencies are coordinating their activities and authorities, and ensuring that

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their ecosystem protection and restoration projects use the best available science and promote resiliency and adaptation to the effects of climate change. These initiatives also provide a mechanism to facilitate coordination among the Federal, state, and local governments, and stakeholders, and to build shared capacity to address the threats to ocean, coastal, and Great Lakes ecosystems.

The National Ocean Policy (NOP) calls for development of a Regional Ecosystem Protection and Restoration Strategic Action Plan (SAP) to address project prioritization, collaboration and coordination, science-based planning, impacts of invasive species, and protection, maintenance, and restoration of populations and essential habitats. Future updates will provide an opportunity to include next steps to advance solutions to the issues in this SAP, identify different issues and priorities, and support actions in different geographic areas.

- This SAP is intended to provide a framework for Federal activities that support existing regional ecosystem protection and restoration efforts, strengthen and expand partnerships with non-Federal entities (i.e., state, tribal, local governments, regional ocean governance organizations, academic institutions, non-governmental organizations (NGOs), private and public entities) and jointly align regional priorities and goals.
- This SAP contains a discrete set of actions to address priority issues where increased coordination and prioritization among Federal agencies and their non-Federal partners, enhancement of program effectiveness, or development and improvement of methodologies and protocols will help achieve conservation success.
- Although this SAP is national in scope, several of the actions address issues specific to a region or a resource. The actions in this SAP will build upon, and be informed by, the processes, priorities, and ongoing programs at the regional, state, and local levels. It is meant to be a bottom-up process. Ongoing collaboration and coordination with the variety of regionally-focused ecosystem restoration efforts will also occur.
- This SAP will be coordinated with several other SAPs that include actions at a regional scale, including Ecosystem-Based Management (EBM) to adopt EBM principles in the regional planning and management of ocean and coastal resources, Coordinate and Support, Changing Conditions in the Arctic, Water Quality and Sustainable Practices on Land, and the Coastal and Marine Spatial Planning (CMSP) SAP work with relevant stakeholders in each of nine regions identified in the NOP.

III. Body of Plan

A. Action 1 – Support shared regional ecosystem protection and restoration priorities.

Federal agencies collaborate with state and regional ecosystem protection and restoration initiatives throughout the U.S., but do not always effectively coordinate with each other in these efforts. Agencies will align Federal resources to support the shared priorities among the Federal and regional ocean and Great Lakes plans.

Building on the existing geographic initiatives and regional activities and experience, the SAP will create mechanisms for the sharing of information, data, and ideas between

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geographically based initiatives and provide opportunities for addressing areas of overlap, common concern, and mutual benefit. Activities under this action should be aligned with the Water Quality and Sustainable Practices on Land SAP.

This SAP will focus initially on regions where Federal agencies are working collaboratively with states, local governments, tribes, and other stakeholders to support regional ecosystem priorities, and be expanded to include other regions in future SAP updates. "Bottom-up" input from regions will be essential to updating the SAP. The Great Lakes, the Gulf of Mexico, and the Chesapeake Bay watershed are examples of geographic regions where efforts will be focused initially:

- Great Lakes: Building on existing partnerships, support the prioritization, development, and implementation of eight multi-agency aquatic nuisance species plans for early detection, rapid assessment and rapid response. If funds allow, a Federal interagency early detection, rapid assessment, and rapid response team will be established to conduct aquatic nuisance species response activities under Federal responsibility.
- Gulf of Mexico: Collaborate with the Gulf of Mexico Alliance and the Gulf Coast Ecosystem Restoration Task Force to support ongoing regional sediment management planning efforts. Beneficial use of sediment is a key tool for regional restoration projects (e.g., coastal wetlands, shellfish beds and living shorelines, sea grass beds, barrier islands). More detail on this action will be developed as the Gulf Coast Ecosystem Restoration Strategy is developed in the coming months.
- Chesapeake Bay: Support the land conservation goals under the Chesapeake Bay Executive Order 13508, by coordinating Federal programs supporting the conservation of public and private lands that provide important habitat and other ecosystem services, and sustain working landscapes and communities.
- Future SAPs will be coordinated with regional ocean and Great Lakes governance organizations to identify actions in (1) Mid-Atlantic region, (2) Puget Sound and San Francisco Bay and the West Coast region, (3) the Florida Everglades and the South Atlantic region, (4) the Gulf of Maine and the Northeast region, and (5) in regions where regional ocean governance organizations are not established (Alaska/Arctic, Caribbean, and Pacific Islands regions).

1. Why Do This

   Aligning resources will help to:

   - accomplish protection and restoration goals identified in both the Federal and regional ocean governance plans;
   - promote better coordination between Federal agencies and regional entities in identifying protection and restoration priorities, and implementing projects;
   - protect and restore ecosystem integrity and ecosystem services, support recovery of listed species, ensure sustainable populations of commercial

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and recreational fish and other wildlife, build resilience to climate change, enhance recreational opportunities, and provide other societal benefits; and
- more effectively utilize sediments to restore wetlands and barrier islands in the Gulf of Mexico and develop information useful to improve sediment management in other areas of the country.

2. Timeframe – Mid-term

3. Outcomes
   - Lessons-learned analysis of successful protection and restoration projects.
   - Mechanism for sharing lessons learned and best practices in coastal and wetlands restoration between regionally and geographically based efforts.
   - Improved understanding of Federal opportunities and barriers to effective regional collaboration.
   - Identification of federal programs and efforts, competing mandates, and overlapping jurisdictions.
   - Support to efforts of the Great Lakes initiatives to reduce and control aquatic nuisance species.
   - Increased beneficial management and use of sediment for restoration projects in priority coastal areas, particularly in the Gulf of Mexico.
   - Strategic allocation of Federal land conservation funds in the Chesapeake Bay watershed.

4. Milestones
   - Complete and implement state and Federal interagency rapid assessment and response plans to prevent and control aquatic nuisance species in the Great Lakes.
   - Carry out a series of mock exercises to practice responses under the State and Federal plans and conduct actual responses throughout the Great Lakes Basin.
   - Assess, compile, and strategically integrate sediment management plans for priority coastal areas in the Gulf of Mexico and develop lessons learned documentation.
   - Conduct regular interagency meetings to align Federal assistance to support regional land conservation goals and identify opportunities for interagency collaboration.
   - Conduct a lessons-learned analysis of successful restoration and mitigation projects.
   - Compile assessment of regional and local initiatives, identifying Federal programs, grants and opportunities that can be brought to bear.

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5. Gaps and Needs in Science and Technology
    - Inventory of aquatic nuisance species that could potentially be introduced into the Great Lakes, their biology and life histories, and vectors by which they could be introduced.
    - Benthic data and maps for coastal areas in the Gulf of Mexico, including sediment type, contaminated sediment, and biological communities.

B. Action 2 – Strengthen conservation partnerships

Numerous innovative partnering efforts exist that contribute to progress in regional ecosystem protection and restoration. Enhanced mechanisms to increase partnerships are needed to bring together resources from Federal and non-Federal organizations to support restoration projects and facilitate the stewardship of ocean, coastal, and Great Lakes resources. As a first step towards building these the following actions will be taken:

- Encourage increased corporate support for ocean, coastal, and Great Lakes ecosystem protection and restoration by aligning the priorities of the Corporate Wetlands Restoration Partnership (CWRP) with other public-private organizations, including the regional joint ventures and Fish Habitat Partnerships. The Federal agencies will assist the CWRP Board to broaden its mission, expand its membership nationally, and increase its support of ocean, coastal, and Great Lakes ecosystem protection and restoration.
- Support an umbrella structure for a network of Coastal Conservation Corps to build local capacity to provide jobs and workforce training for a new generation of natural resource professionals, and engage citizens in protection, restoration, and stewardship of ocean, coastal, and Great Lakes ecosystems.
- Formalize Federal participation in the National Fish Habitat Action Plan (NFHAP), to protect, restore, and enhance our waterways and fisheries throughout the country.

1. Why Do This
    - Partnerships are critical to achieving the protection and restoration needed for coastal habitats that provide ecosystem services. Entities that make significant contributions towards protection and restoration include corporate, citizen-based, and local, tribal and state-led partnerships.
    - Corporations can provide an important source of investment in the conservation of ocean, coastal, and Great Lakes habitats. The CWRP provides a vehicle for corporations to invest in conservation either by providing direct project support or through the CWRP Foundation. CWRP has successfully engaged the private sector in working with Federal agencies to support coastal habitat protection and restoration. To date, the CWRP has contributed $4.5 million, which has leveraged $112 million of Federal, state, tribal, local, and non-governmental funds.
    - Several states have Conservation Corps programs that promote environmental stewardship, create jobs, and foster a commitment to community service that aligns with the goals of the America's Great Outdoors Initiative. Benefits to

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local economies and ecosystem health can be expanded by supporting a coordinated network of local Conservation Corps. This action is linked to Action 4 in the Inform Decisions and Improve Understanding SAP, which addresses development of human capacity and the workforce.

- The NFHAP is an existing nationwide partnership–based investment strategy to increase the return on fish habitat conservation. There are 21 partnerships across all 50 States that benefit jobs, recreational and commercial fishing communities, and address the impacts of climate change.

2. Timeframe – Long-term

3. Outcomes
   - The CWRP provides project support for ocean ecosystem protection and restoration.
   - CWRP membership is expanded by 50 percent with a chapter in all 29 coastal States.
   - Increased corporate partnerships through CWRP to complete Federal ocean, coastal, and Great Lakes ecosystem protection and restoration projects.
   - Coastal Conservation Corps coordinating body is established and aligned with other national and regional initiatives, notably the America's Great Outdoors Initiative, to enlist citizens, including low-income and disadvantaged youth, to conduct coastal ecosystem protection and restoration projects and expand opportunities and funding for youth employment and training.
   - As appropriate and to the extent allowed by law, regional ecosystem conservation projects funded by Federal grant programs are coordinated with the objectives of the Fish Habitat Partnerships.
   - Increased capacity of a non-governmental Coastal Conservation Corps to engage citizens in ecosystem protection and restoration projects.

4. Milestones
   - Amend the CWRP Charter to include support of ocean ecosystem protection and restoration.
   - Coordinate between Coastal America Regional Implementation Teams and CWRP to increase ocean, coastal, and Great Lakes protection and restoration project identification.
   - Increase, by 50 percent, annual CWRP financial and in-kind contributions to Federal ocean, coastal, and Great Lakes protection and restoration projects.
   - Enable one coastal Conservation Corps to participate in the network in each region of the U.S.
   - Clarify and formalize the respective roles of the agencies in supporting the National Fish Habitat Action Plan (NFHAP). Create an expanded NFHAP Federal Caucus that includes active participation by all Federal agencies whose activities affect fish habitat.

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5. Gap and Needs in Science and Technology – None

C. Action 3 –Reduce coastal wetland loss and improve understanding of coastal wetland status and trends

To reduce, and work toward the goal of reversing, coastal wetland loss, the NOC (principally EPA, USACE, USFWS, and NOAA) will work together and in cooperation with states and tribes to identify the underlying factors responsible for the loss of wetlands in coastal watersheds. Pilot watersheds will be selected, in consultation with local, tribal, and state entities affected by their loss, based on where wetland loss is greatest due primarily to human activities and the availability of reliable and historic data. The NOC agencies will compile existing information for the pilot watersheds, including wetlands inventories, coastal change analyses, geospatial data, permits and other types of data on natural processes to assess the status of the coastal wetlands and the causes of observed losses. This assessment will result in recommendations on how all levels of government could collaborate to improve the management of coastal wetlands and reduce losses nationwide.

As an ongoing effort, NOAA and USFWS will produce an assessment of coastal wetland status and trends using data collected for the USFWS *Status and Trends of Wetlands* reports.

1. Why Do This

- Coastal wetlands are among the most productive ecosystems on Earth, providing critical services to communities and wildlife. According to the *Status and Trends of Wetlands in the Coastal Watersheds of the Eastern United States 1998-2004,* coastal wetlands were being lost at a faster rate than non-coastal wetlands. Development (urban, rural, and unclassified) was responsible for about 70 percent of the wetland loss in coastal watersheds. Remaining wetland losses occurred as a result of natural processes such as storms, erosion, subsidence, and sea-level rise.
- Of those wetlands lost as a result of development, some were authorized under Section 404 of the *Federal Water Pollution Control Act of 1972* (Clean Water Act) and offset by compensatory mitigation (programmatic no net loss). Others have resulted from unauthorized activities in violation of a variety of Federal and state environmental statutes. Still other losses may have occurred because the wetlands involved were not subject to any regulatory program. This assessment will more precisely identify causes of coastal wetland losses and potential program improvements to stem these losses.

2. Timeframe – Long-term

3. Outcomes

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- A better understanding of the underlying causes of wetland losses in rapidly developing areas and areas that are expected to be impacted by future development.
- A better understanding of the magnitude of unauthorized coastal wetland losses and how Federal, tribal, and state agencies might collaborate to reduce and ultimately reverse these losses.
- A better understanding of the extent of the losses that were beyond the scope of Federal regulatory programs and how such losses might be reduced in the future.
- Recommendations of actions Federal agencies could take to improve the management of coastal wetlands (e.g., education, restoration, protection, regulation) and communication of this understanding to regional programs.

4. Milestones

- Identify coastal watersheds for pilot assessments with updated wetland inventories and high-quality geospatial data, if available.
- Complete analyses of data and information from the 2011 Status and Trends of Wetlands in the Conterminous United States, NOAA's Coastal Change Analysis Program, the Section 404 program, and geospatial sources.
- A report recommending actions Federal agencies can take, in coordination with state, and tribal agencies, to improve the management of coastal wetlands and reduce losses nationwide.
- An assessment of the status and trends of coastal wetlands. The assessment will be included as a chapter in future *Status and Trends* reports, published by the USFWS every decade.

5. Gap and Needs in Science and Technology

- Reliable and consistent data on the location, size, type, and cause of coastal wetland losses.
- High resolution imagery that can detect changes in land use status from undeveloped to developed.

D. Action 4 – Create carbon-based incentives for coastal habitat conservation

Coastal wetlands, mangroves, and sea grasses sequester vast amounts of carbon in their plant material and sediments (up to five times the rate of tropical rainforests per unit area). These carbon sequestration and storage capabilities are important ecosystem services that can be evaluated and considered to increase the restoration and avoided loss of these habitats. Key first steps to take advantage of these benefits are developing carbon sequestration/storage protocols for coastal wetlands and exploring policy options for incorporating the carbon sequestration services of these habitats into Federal decision-making.

1. Why Do This

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- A more comprehensive understanding of the services provided by coastal wetlands promotes the conservation and restoration of these important habitats.
- Although carbon sequestration is a valuable ecosystem service, it is not explicitly quantified in Federal policies governing impacts to coastal habitats. Undertaking an analysis of policy options to potentially include carbon storage in the assessment of ecosystem services would be the first step in determining if policy changes could provide additional incentives for conservation (and disincentives for habitat destruction).
- Significant opportunities exist to channel private investment into coastal habitat protection and restoration, by bringing these projects into a voluntary carbon market or promoting the carbon services provided by these habitats; however, a protocol must first be developed that provides a reliable framework for evaluating and potentially quantifying carbon gains.
- This action supports the resilience of ecosystems to climate change, as presented in Action 6 of the Resiliency and Adaptation to Climate Change and Ocean Acidification SAP.

2. Timeframe – Near-term

3. Outcomes
   - Increased private investment is channeled into coastal habitat protection and restoration.
   - Increased protection and restoration of salt marsh, mangrove, and sea grass habitats and increased mitigation requirements for impacts to these systems.
   - Increased capacity for governments to implement voluntary restoration and protection programs.
   - Reliable framework developed for implementing coastal habitat conservation projects to create offset credits.
   - Greater understanding of Federal policy opportunities and barriers for including carbon sequestration in ecosystem service assessment calculations.

4. Milestones
   - Adoption of methodologies to assess carbon sequestration capacity for different coastal wetland types, mangroves, and sea grasses.
   - Identification of demonstration sites appropriate for carbon sequestration and emission research, with emphasis on sites already identified for the purposes of long-term ecological research (e.g., National Wildlife Refuges, National Estuarine Research Reserves, National Estuary Programs, and other sites that are part of the Long-term Ecological Research Network).
   - Development of a greenhouse gas offset protocol for coastal wetland conservation for use in voluntary carbon markets.

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- Completion of assessment of Federal policy opportunities and barriers for including carbon sequestration in ecosystem service assessment calculations.

5. Gaps in Science and Technology
   - Research to compare rates of carbon sequestration and carbon emission in different regions and under varying conditions (e.g., degraded vs. restored) is needed to understand the full nature of coastal ecosystem carbon services. This research gap is being addressed by the Resiliency and Adaptation to Climate Change and Ocean Acidification SAP.

E. Action 5 – Ensure full mitigation for injuries to coral reef ecosystems

To improve the protection and restoration of coral reef ecosystems, Federal agencies responsible for coral reef protection, restoration, and mitigation will develop standard protocols for coral reef ecosystem mitigation options and execute an agreement to use them as the basis for coral reef mitigation efforts. The USCRTF state and territory members will play key roles in contributing to the actions outlined here.

1. Why Do This
   - Responsibilities for mitigation assessment and policies regarding mitigation of impacts to coral reef ecosystems are distributed among four Federal agencies (EPA, USACE, DOI, and NOAA). Enhanced coordination will increase efficiency and effectiveness and improve scientifically sound mitigation, protection, and restoration of coral reef ecosystems.
   - Establishing a common set of protocols for mitigating impacts of human activities to coral reef ecosystems will result in scientifically sound and consistent coral reef mitigation projects.

2. Timeframe – Long-term

3. Outcomes
   - Identify and recommend assessment metrics specific to coral reef ecosystem functions and services.
   - Adoption of standard coral reef ecosystem mitigation protocols by the four Federal agencies with mitigation responsibilities.
   - Performance criteria, monitoring protocols, and mechanisms to track success or failure of mitigation.
   - Regionally specific guidance of measures necessary to reduce and mitigate coral reef ecosystem degradation and to restore damaged coral reefs.
   - A *Reef Managers Guide to Mitigation and Restoration* that provides guidance for managers on best management practices related to mitigation.

4. Milestones

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- Establish a restoration and mitigation working group (including USACE and EPA) to act as a convening body for the USCRTF and other interested parties for coral reef ecosystem restoration and protection issues.
- Conduct a lessons-learned analysis of successful mitigation projects.
- Compile standard protocols for mitigation options to facilitate sound, consistent, and replicable restoration and mitigation of affected coral reef ecosystems.
- Prepare recommendations for improved policies and practices regarding compensatory mitigation related to coral reef ecosystems.
- Develop Draft and Final Functional Assessment for Coral Reef Ecosystem Mitigation.
- Develop a draft and final *Reef Managers Guide to Mitigation and Restoration*.

5. Gaps and Needs in Science and Technology
   - Document successful mitigation/restoration efforts for coral reefs.
   - Develop a standardized, regionally scalable methodology for assessing coral condition and valuing impacted resources. Because coral reef ecosystems are complex and their services vary considerably, even within a local area, assessment of their ecological value and mitigation costs must be conducted on a case-by-case basis.
   - Evaluate declining baseline conditions of coral reefs as a complicating factor in the assessment of restoration and mitigation success.

F. Action 6 – Reduce the threat of aquatic nuisance species

Aquatic nuisance species damage ecosystems by reducing biological diversity and adversely affect humans by hindering economic development, interfering with recreational and commercial activities, decreasing aesthetic values, and serving as vectors of disease. Through the Aquatic Nuisance Species Task Force (ANSTF), Federal agencies are working together to control aquatic nuisance species through regulation, management, and education.

- Agencies will work with the ANSTF to identify priority nuisance species needing immediate action.
- As an example, one known priority is the Indo-Pacific lionfish. Federal agencies will collaborate with non-Federal partners and stakeholders to develop an innovative inventory and control plan for the Indo-Pacific lionfish that can be adapted for transfer to other marine invasive species.

1. Why Do This
   - Support of ANSTF efforts emphasizes the need to prevent the introduction and dispersal of aquatic nuisance species, and provides the opportunity to address priority issues on a regional basis.
   - Because each region poses a set of unique challenges and available resources, mechanisms to increase partnerships are needed to bring together the

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expertise, strengths, and resources from Federal, state, international agencies, Fishery Management Councils, academic institutions, and other organizations to effectively control invasive populations.

- As an example of the benefits of addressing priority aquatic nuisance species, an initial programmatic response can address Indo-Pacific lionfish. In less than a decade, the Indo-Pacific lionfish has become widely established along the Southeast U.S. and Caribbean, and poses a threat to many native reef fish populations through direct predation and competition for food and space resources. The lionfish is the first marine aquatic invasive finfish to become established within Western Atlantic waters; thereby the species is capable of providing new information on fundamental ecological processes including dispersal, competition, and community structure. This information would benefit ecosystem-based management of native reef fisheries through improved understanding of dispersal and connectivity, prevention of future invasions, control of established invaders, and opportunity to implement a control plan across international boundaries.

2. Timeframe – Near-term

3. Outcomes
   - A list of priority aquatic nuisance species to address in key geographic areas.
   - A lionfish control plan with goals and actions to reduce their threat to native ecosystems is implemented.

4. Milestones
   - Develop an initial set of priority aquatic nuisance species coordinated with affected regional entities.
   - Establish a Lionfish Control Committee in coordination with the ANSTF, and that Committee completes a draft lionfish control plan.

5. Gaps in Science and Technology
   - Better tools for lionfish control and management, including a better understanding of lionfish ecology in its native habitat and understanding of impacts across different reef systems.

G. Action 7 – Identify nationally significant marine and Great Lakes aquatic areas in need of protection.

Healthy and productive ocean and Great Lakes ecosystems support a variety of species, promote recreational opportunities, provide resilience to the effects of climate change, and support coastal communities through economic growth and increased employment opportunities. Three actions will be initiated as a first step to strengthening place-based conservation of marine and Great Lakes resources:

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- Consult with the states and the CMSP Regional Planning Bodies about the existing and potential uses of areas and appropriate levels of protection.
- Develop a process for identifying ecologically important areas via a pilot map analysis.
- Characterize and prioritize marine areas of national significance, including consideration of ecosystem services, by reactivating the National Marine Sanctuary Site Evaluation List (SEL).

1. Why Do This
   These actions inform planning for future marine protected areas and ocean planning:
   - A marine gap analysis is needed to identify areas that are nationally significant, ecologically important, and provide important ecosystem services. This analysis will integrate resource characterization and human use data at regional scales and inform the CMSP process.
   - The SEL is a decision support tool designed to evaluate areas nominated for designation as marine sanctuaries, and is one of a number of tools that could be used to identify areas that are nationally significant due to their qualities (e.g., conservation, cultural, esthetic).

2. Timeframes – Mid-term

3. Outcomes
   - A protocol for evaluating nationally significant and ecologically important marine areas for protection that is science-based and balances human uses with conservation.
   - Updated and repopulated Sanctuary Evaluation List (SEL).
   - Recommendations of mechanisms to provide the appropriate level of protection to sustain ecosystem services for the listed sites.

4. Milestones
   - Establish an interagency working group to develop the gap analysis protocol.
   - Reactivate and repopulate the SEL with marine areas that have been identified as nationally significant due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities.
   - Conduct an inventory of other information sources that could be integrated into the gap analysis.
   - Pilot the gap analysis protocol in two U.S. regions as part of the CMSP planning process.

5. Gaps in Science and Technology
   - Identification of potential protected areas requires using the best available scientific information and nominations from participating Federal and state

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agencies and contributors. This will be coordinated with the Inform Decisions and Improve Understanding SAP.

H. Action 8 – Improving the effectiveness of coastal and estuarine habitat restoration projects

Several Federal agencies fund and implement coastal and estuarine habitat restoration projects. It is important that these efforts are coordinated, evaluated, and tracked to ensure that restoration implementation is effective and efficient. The Estuary Habitat Restoration Council, established under the *Estuary Restoration Act of 2000* (ERA), is an established vehicle to bring Federal agencies together to jointly solve habitat restoration issues. To further these efforts, Federal agencies, beginning with the Estuary Habitat Restoration Council members, will: (1) improve the effectiveness of coastal and estuarine habitat restoration projects by updating and adopting the ERA monitoring protocols; (2) work to identify socio-economic monitoring parameters; and (3) input estuary restoration project tracking information into the National Estuaries Restoration Inventory (NERI).

1. Why Do This
    - Monitoring allows practitioners to track project success, determine which restoration methodologies are the most successful and cost effective, document ecosystem services provided, and identify when adaptive management is required.
    - The ERA establishes a collaborative process among Federal agencies for addressing the threats to the health of our Nation's estuaries. The Act recognizes the importance of project monitoring and tracking to the success of any estuarine conservation program. The ERA established an interagency Estuary Habitat Restoration Council made up of DOI-FWS, NOAA, USACE, EPA, and USDA-NRCS.
    - The ERA required NOAA, in consultation with the Estuary Habitat Restoration Council (ERA Council), to establish minimum monitoring requirements for projects funded under the Act. These monitoring requirements have been established and are applicable to all coastal habitat restoration projects. Project effectiveness would benefit through consistent use of requirements for project monitoring.
    - The ERA also requires NOAA, in consultation with the ERA Council, to develop NERI, which maintains a publically accessible database of information concerning estuarine habitat restoration projects carried out under the Act, as well as for other projects that meet the minimum monitoring requirements. Using this database reduces duplicative and competing databases and helps to streamline restoration activities.

2. Timeframe – Mid-term

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3. Outcomes
    - Adoption and implementation of the ERA coastal and estuarine habitat restoration monitoring protocols by Federal agencies involved in coastal habitat restoration.
    - Identification of socio-economic monitoring parameters for coastal and estuarine habitat restoration projects.
    - Incorporation of estuarine restoration data into NERI from all Estuary Habitat Council agencies' project tracking databases.

4. Milestones
    - With input from states and stakeholders, conduct review and subsequent update of ERA monitoring protocols; include suggestions for socio-economic parameters.
    - Evaluate interagency database needs and solutions, and update the existing NERI database accordingly to allow use by all restoration agencies.
    - Fifty percent of new estuarine restoration projects conducted by the Estuary Habitat Restoration Council agencies use ERA monitoring protocols.

5. Gaps in Science and Technology
    - Need to review and update restoration monitoring protocols at least once a decade.
    - Clarify Federal policy regarding geospatial data for projects on private lands.

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Changing Conditions in the Arctic
Strategic Action Plan
Full Content Outline

Objective: Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.

I. Overview of the Priority Objective

- Address environmental stewardship needs in the Arctic Ocean (including contiguous Bering, Chukchi, and Beaufort Seas) and adjoining coastal areas in light of climate and environmental change, as well as increasing accessibility to human activity.
- Improve efforts to conserve, protect, and sustainably manage Arctic marine resources, effectively respond to the risk of increased pollution and other environmental degradation on humans and marine life, and adequately safeguard living marine resources.
- Develop new collaborations to better monitor and assess environmental conditions and to devise procedures to respond to emergencies such as environmental accidents.
- Achieve consistency and coordination with the implementation of the United States Arctic Region Policy as promulgated in the National Security Presidential Directive 66/Homeland Security Presidential Directive 25 (2009).
- Improve the scientific understanding of the Arctic system and how it is evolving in response to climate change and other forcers.

II. Context and Continuity

- The Arctic is a frontier. While it is considerably less developed than other U.S. maritime areas, access to the region is increasing rapidly. To achieve National Ocean Policy goals, the U.S. will require fundamental research, improved coordination, and new infrastructure.
- Alaska Native communities rely on the Arctic environment for important cultural, subsistence, and ceremonial practices. Identification and implementation of the strategic actions in this plan will be undertaken with their active engagement.
- Seven themes were identified as focus areas for this action plan:
  - An integrated Arctic observing network.
  - Arctic climate and environmental change (understand, forecast, predict).
  - Arctic mapping and charting.
  - A safe, secure, and reliable Arctic Marine Transportation System.
  - Stewardship of the Arctic marine environment and sustainable development of resources.
  - Resilient and healthy Arctic communities and economies.
  - Domestic and international policy and partnerships in the Arctic.
- As one of nine national priority objectives "Changing Conditions in the Arctic" is unique. It is the only one that is place-based, or focused on a single region. As a result, many topics in the Arctic strategic action plan are also addressed in other plans, or are even their primary focus. To be

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fully successful, the actions in the Arctic plan must be considered and implemented within the broader context of the other eight objectives.

- This Strategic Action Plan outline is consistent with other efforts, including the U.S. Global Change Research Program Strategic Action Plan.

III. Body of the Plan

A. Action 1: Improve Arctic environmental response management.
Develop management systems and procedures to protect communities and ecosystems from oil spills and other accidents associated with resource extraction (oil and gas) and Arctic marine transportation (e.g., commercial shipping and tourism). Specifically, inform the development and implementation of response coordination mechanisms such as the Environmental Response Management Application (ERMA®), a geospatial decision-support tool.

1. Why Do This
   - Exploration and development of natural resources in the Arctic, and a rise in marine traffic will increase the probability of accidents.
   - Taking action to prevent, prepare for, and respond to environmental emergencies will better protect communities and ecosystems.
   - To protect subsistence resources which provide the nutritional benefits and cultural practices of Alaska Native communities.
   - Procedures to respond to Arctic Ocean oil spills are specifically called for in the "Report of the National Commission on the BP Deepwater Horizon Oil Spill."
   - Responds to the National Ocean Policy goals to "respect and preserve our Nation's maritime heritage, including our social, cultural, recreational, and historical values," and, "support sustainable, safe, secure, and productive access to, and uses of the ocean, our coasts. . ."

2. Timeframe – Mid-term

3. Outcomes
   - Better protection of sensitive areas of the U.S. Arctic through more efficient resource management and emergency preparedness.
   - Increased coordination among Federal agencies in cooperation with state agencies, local, and Tribal governments, and international bodies.
   - Specific plans and understanding of responsibilities to prepare and respond to emergencies related to resource development and marine transportation.
   - Community participation in the development of oil spill prevention planning and response measures and coordination mechanisms.
   - Well-coordinated sharing of resources and information related to pollution response within the U.S. and across the Arctic.

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- Scientific support for prevention and management of a large pollution event in the Arctic is well coordinated among Federal and state agencies and local and Tribal governments.
- A comprehensive understanding of the impacts of a large pollution event in the Arctic on traditional livelihoods, sensitive ecosystems, economies, and security.

4. Milestones
   - Complete the development and implementation of ERMA® to prepare for Arctic oil spill response, assessment, and restoration.
   - Finalize and test contingency plans to ensure adequacy of response equipment, trained personnel, and nearshore protection strategies. Use existing response preparedness efforts, such as the Aleutian Island Risk Assessment.
   - Cross-train emergency responders (for example, response to oil in sea ice).
   - Assess and compile scientific research as well as traditional knowledge related to the impacts of resource development and pollution applicable to the Arctic.
   - Integrate Federal efforts to study oil spilled in ice-covered waters.
   - Support substantial U.S. participation in efforts to create an Arctic-wide agreement on oil spill preparedness and response that may ultimately lead to international standards for maritime activities including oil and gas operations in the Arctic.
   - Participate in joint training and workshops with other Arctic nations on oil spill prevention and response mechanisms and procedures, including deployment exercises in Arctic conditions.
   - Develop cooperative agreements with Tribal, local, State, Federal and other Arctic nations' governments for sharing response assets and resources across the Arctic in the event of a large pollution event, including: (1) worldwide inventory of equipment available for deployment in the Arctic; (2) command, control and communications strategies, and; (3) international guidelines for spill response in broken-ice and ice-covered environments.
   - Partner with industry to ensure the development of oil spill prevention, containment, and response infrastructure, plans, and technology that are proven effective in ice-covered seas.

5. Gaps and Needs in Science and Technology
   - Better spill containment technology that is suited for operation in the Arctic environment.
   - Increased coordination among scientists, resource managers, and constituents on the potential effects of a large pollution event in the Arctic; for example, marine mammal biologists and scientists studying ice flows working together on impacts of oil in an ice environment or scientists working more effectively with resource managers to better articulate information needs facilitating better emergency response.
   - Increased sharing across agencies of tools such as ERMA®.

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- Participation of U.S. Federal scientists in development of spill containment technology already taking place within industry.
- Local community training and education related to the impacts of resource development.
- International participation in Arctic-wide spill response efforts.

B. Action 2 – Observe and forecast Arctic sea ice.
Observe, predict, forecast, and ultimately project the extent, thickness, and age of summer and winter sea ice in the Arctic Ocean and contiguous seas. The timeframe and extent of the forecasts will be designed for a variety of stakeholders, and will support safe operations and ecosystem stewardship.

1. Why Do This
   - Sea ice forecasting is the most urgent and timely ocean issue to address in the Arctic region; continued rapid loss of sea ice will be a major driver of changes across the Arctic. The loss of sea ice affects marine access, regional weather, global climate, marine and terrestrial ecosystems, and coastal communities.
   - This action advances ocean stewardship, the economy, and national security by providing situational and domain awareness, and improves foundational science to understand and detect climate and ecosystem change.
   - Improving daily to weekly sea ice forecasts will benefit community activities (e.g., safer subsistence hunting, storm preparation/defense), support the management of protected marine resources, and improve the safety of general maritime activity.
   - Longer-term sea ice forecasts are needed for infrastructure planning, ecosystem stewardship under rapidly changing conditions, and projection of global climate impacts forced by changes first occurring in the Arctic.
   - All-season observations from platforms and ice camps on and under Arctic sea ice will improve our understanding of Arctic environmental variability.

2. Timeframe – Long-term

3. Outcomes
   - Accurate, quantitative, daily forecasts to decadal predictions of sea ice support safe operations and ecosystem stewardship.

4. Milestones
   - Conduct workshop on sea ice forecasting to prepare initial implementation plan.
   - Initiate interagency activity to improve application of remote sensing and buoy/mooring data to sea ice forecasting (DOD funding pending).
   - Initiate cataloging for U.S. Arctic Sea Ice Atlas.

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- Train and expand Volunteer Observing Ship and coastal community participation in sea ice observation program; catalogue user requirements for sea ice products, services and delivery.

5. Gaps and Needs in Science and Technology
   - Improved applications of remote sensing and buoy/mooring data for sea ice characteristics and sea ice vector analysis.
   - New real-time *in situ* observational technologies for atmosphere, ice, and ocean variables that control sea ice movement, melt, and growth.
   - Coordination with and access to charter and non-charter vessels capable of working in Arctic areas during spring, summer, and fall seasons.
   - Improved understanding of the links between sea ice an oceanography, such as through heat flux and circulation.
   - New sea ice models that: assimilate advanced observing data; output sea ice thickness, concentration, location with time at higher temporal and special resolution; and couple ice/ocean/atmospheric processes.

C. Action 3: Establish a distributed biological observatory.
Implement an international distributed biological observatory (DBO) in the Pacific Arctic sector focused on six locations along a latitudinal gradient from the northern Bering to the western Beaufort seas.

1. Why Do This
   - Scientific research will provide a better understanding of how climate change affects Arctic biology, and what steps will be necessary to improve stewardship of the Arctic marine ecosystem.
   - Changes in location and timing of the seasonal ice edge can have profound effects on benthic and pelagic marine ecology and human activity. These same changes also affect the ability of ice-dependent marine mammals to reproduce and rear young on ice.
   - Planktonic changes can affect distribution and abundance of baleen whales that are important to subsistence cultures. Likewise, stranding of ice-dependent species on land likely reduces their survival or reproductive rate and may make the animals less available to subsistence hunters.
   - Relationships between ice edge retreat, changes in plankton dynamics, loss of summer sea ice, and foraging success of whales and ice dependent species is poorly understood, as are the effects of these changes on Alaska Natives who depend upon these species.
   - Acidification of Arctic Ocean surface waters is projected to be greater than for any other marine waters on the planet, with largely unknown consequences.
   - The DBO will address the large uncertainties in the responses to climate and ecosystem changes in the biological domain including plankton, fish, birds, marine mammals and invasive species.

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- The DBO will provide baseline information necessary to assess and mitigate potential impacts to subsistence activities of offshore resource development.

2. Timeframe – Long-term

3. Outcomes
   - Biological information gained from an Arctic biological observatory network will improve the ability of all participating agencies to determine the effects of their actions on marine resources, resulting in improved conservation, protection, and management of Arctic coastal and ocean resources.
   - Improved understanding of how Arctic ecosystem and climate changes will affect subsistence cultures in the region.
   - New collaborations and partnerships formed in implementing this network will increase our ability to monitor and assess environmental conditions under changing climate scenarios.

4. Milestones
   - DBO partners conduct DBO research cruises.
   - Pacific Arctic Group (PAG) meeting to review results from 2010 and 2011 pilot activities, plan for 2012 pilot activities.
   - DBO partners conduct DBO research cruises.
   - PAG meeting to review all pilot activities, plan for 2013.
   - International report on DBO activities and results to date.
   - DBO partners conduct DBO research cruises.
   - PAG meeting to review pilot activities; plan for 2014.
   - Updated DBO concept and implementation plan for longer-term implementation.
   - DBO partners perform DBO plans and prepare annual assessments on physical and ecological state of Pacific Arctic marine environment.

5. Gaps and Needs in Science and Technology
   - New technologies for continuous, year-round, real-time observations of key physical, chemical, and biological variables.
   - Coordination with and access to charter and non-charter vessels capable of working in Arctic areas during the spring, summer, and fall.
   - Improved use of community-based observations and instrumented animals.
   - Ecological implications of increasingly early ice edge retreat, absence of summer sea ice, increased severity of storms during the ice-free season.
   - Ecological implications of ice-dependent species forced to spend time on land, including impacts of human disturbance.
   - Ecological implications of ocean acidification on Arctic marine ecosystems, especially plankton and calcareous benthic organisms important as prey items to subsistence species.

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D. Action 4: Improve Arctic communication.
Participate in cross-cutting efforts to improve existing maritime communication networks/architecture with a focus on support for scientific research, environmental risk reduction and incident management, and sustainable, safe, secure, and productive access to and uses of the Arctic.

1. Why Do This
   - Significant gaps exist in Arctic communication systems that increase the risk of environmental damage and loss of life and property at sea.
   - Effective communication systems are a cornerstone for devising "early warning and emergency response systems" to "respond to emerging event in the Arctic Region such as environmental disasters."
   - Ability of users, vessels, and aircraft to communicate with each other and to receive information, such as real-time weather and sea ice forecasts, will significantly decrease the risk of environmental damage and loss of life and property at sea.
   - Leverages similar efforts being undertaken for other national interests in the region, including implementation of National Ocean Policy as promulgated in Executive Order 1357, and National Security Presidential Directive 66/ Homeland Security Presidential Directive 25 (§§ III(B), (E), (F) and (H)).

2. Timeframe – Long-term

3. Outcomes
   - A system that addresses the most urgent gaps in communications and meets relevant user needs in the Arctic region.
   - Prevention of/Response to allisions, collisions, and groundings.
   - Prevention of/Improved Response to environmental disasters and loss of life and property at sea.
   - Minimize injury to marine mammals from vessels strikes and entanglement in fishing gear.

4. Milestones
   - All to be developed in coordination with other interagency efforts:
     - Inventory of existing communication capabilities and gaps.
     - Baseline of the performance capabilities of MF/HF/VHF/UHF communications systems to air and surface vessels in the Arctic.
     - Baseline of the performance of air, surface, and available shore-based sensors.
     - Analysis of communication capabilities and gaps in the Arctic Region.
     - Analysis and recommendations for the most cost-effective means to reduce communication gaps and boost capabilities in the Arctic Region.

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- Implementation of recommendations to reduce communication gaps and boost capabilities in the Arctic Region commensurate with available resources and user needs.

5. Gaps and Needs in Science and Technology
   - Analysis of Arctic communications environment.
   - Analysis of alternatives.

E. Action 5: Advance Arctic marine mapping and charting.
This action will support accurate hydrographic surveys and biological/shoreline mapping that is essential for up-to-date nautical charts of U.S. Arctic waters and the Alaskan coastline, and for habitat characterizations for ecosystem stewardship and restoration.

1. Why Do This
   - Compared to the rest of the nation, the Arctic geospatial reference system (geodetic control, water level, hydrology, and shoreline) is poorly known.
   - This action contributes fundamental data essential for:
     - Nautical charting for safe navigation;
     - Sustainable, secure and productive access to the Arctic maritime environment;
     - Environmental management and emergency response planning;
     - Sea level change impact assessments;
     - Inundation modeling;
     - Biological assessments;
     - Awareness of environmental conditions in the Arctic domain;
     - Coastal community adaptation strategies for increased resilience to storm hazards and climate change impacts; and
     - Improve the resiliency of ocean economies and commerce.

2. Timeframe – Long-term

3. Outcomes
   - Improved maritime safety in the Arctic.
   - Resilient ocean economies and commerce.
   - Better tools for coastal communities to develop adaptation strategies and disaster planning.
   - Improvement to the underlying geospatial framework of data that supports scientific research and economic decision-making in the Arctic Ocean region.

4. Milestones
   - Complete airborne gravity data collection over the State of Alaska to help correct meters-level errors in positioning to centimeter level.

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- Explore potential partnerships to establish Continuously Operating Reference Stations and water level stations for accurate datums and positions.
- Conduct Waterway Analysis and Management System (WAMS) assessments and Port Access Route Studies (PARS) of the Arctic region, focusing on areas indicted by risk/return analysis, to support decisions on mapping and charting priorities and waterways management.
- Prioritized list of Arctic maritime regions and shorelines for surveying.
- Establish mapping guidelines and/or standards to facilitate integrated ocean and coastal mapping.
- Coordinate mapping operations for maximal efficiency and coverage.
- Acquire Arctic hydrographic and shoreline data for accurate nautical charts and storm surge models.
- Update nautical charts, environmental sensitivity indices, and other Arctic feature maps.
- Archive data at national data centers to facilitate additional uses and scientific study.
- Continue to work with the International Maritime Organization to develop safe and secure shipping and prevention of marine pollution by ships in the Arctic.

5. Gaps and Needs in Science and Technology
   - New *in situ*, underwater, airborne, and satellite observing technologies able to withstand the rigors of the Arctic environment to fill gaps in hydrographic, shoreline, and biological datasets.

F. Action 6: Improve coordination on Arctic Ocean issues.

Implementing this strategic action plan requires coordination of scientific research, natural resource management, and national and international marine stewardship policies concerning the Arctic Ocean. The roles and responsibilities of Arctic interagency policy groups must be clearly defined to efficiently share information.

1. Why Do This
   - To clarify the sometime overlapping efforts of the following Arctic interagency policy groups within the Federal government: the Interagency Arctic Research Policy Committee (IARPC), the Arctic Policy Group (APG), and the Arctic Region Interagency Policy Committee (ARIPC) associated with NSPD-66/HSPD-25.
   - To support, as appropriate, U.S. participation in the working groups of the Arctic Council and to clarify the links between domestic and international Arctic activities.
   - Helps leverage existing resources, capabilities, and knowledge among agencies; shares information to reduce duplication and increase interagency coordination; and increases government efficiency by using established groups.
   - This action will be coordinated with the Coordinate and Support SAP.

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2. Timeframe – Near-term

3. Outcomes
   - Increased sharing of data and information to improve understanding of the changing Arctic Ocean and natural resource management decision-making.
   - Clear communications among Federal agencies, the State of Alaska, Alaska Native communities, and international organizations through IARPC, APG, ARIPC, and bilateral activities with Arctic states.
   - Incorporation of traditional and local knowledge into scientific research and decision-making.
   - Integration of a wide-range of data types (satellite, *in situ* observations, charts).
   - Coordination and leveraging of agencies' Arctic Ocean resources.
   - Increase awareness of Arctic Ocean activities.

4. Milestones
   - IARPC report released by the National Science and Technology Council that clarifies interagency roles, responsibilities, and mechanisms for coordinated decision-making.
   - IARPC proposed structure for information sharing aligned with open.gov.
   - Routine coordination with regional groups including the Alaska Climate Change Executive Roundtable (ACCER), North Slope Science Initiative (NSSI), Landscape Conservation Cooperatives (LCCs), Arctic Ocean Observing System (AOOS).
   - Integrate national and international efforts by increasing coordination among IARPC, APG, and ARIPC.

5. Gaps and Needs in Science and Technology – None.

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Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure
Strategic Action Plan
Full Content Outline

Objective: Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system and integrate that system into international observation efforts.

I. Overview of the Priority Objective

- Our ability to understand weather, climate, ocean, geological/geophysical, and living marine resource processes and dynamics, to forecast key environmental conditions, and to strengthen ocean management decision-making at all levels is informed by a sound knowledge base and the integration of new tools and data.
- Efficient and effective coordination of tools, continued development of new tools and infrastructure, and their integration into a cohesive, unified, robust system is becoming increasingly difficult as more and more data collection and processing systems come on line.
- New observation technologies supported by robust infrastructure give us the ability to observe and study global processes at all scales, and advance our knowledge and understanding of the ocean, our coasts and the Great Lakes.
- The actions in this outline are intended to support acquisition and delivery of the knowledge and understanding needed to make progress on the other eight national priority objectives and further implement the National Ocean Policy.

II. Context and Continuity

- To be fully successful, the actions in this plan must be considered and implemented within the broader context of the other eight priority objectives in the National Ocean Policy. Observations, mapping, and infrastructure provide the means to gather information necessary to make progress in all areas of the policy's implementation.
- Meeting the objectives of the National Ocean Policy requires:
    - Geospatial information (data, charts and interpretive maps) obtained through coordination and leveraging of ocean and coastal mapping programs, resources and capabilities among federal and non-federal entities, including where appropriate, international collaborations.
    - Systems and associated infrastructure to improve data collection for national priority objectives, including the means to develop and test new technologies.
    - A framework for data integration across a diverse range of specialties and locations that will improve coordination for decision-making.
- Addressing our ability to observe the ocean, our coasts, and the Great Lakes and to deliver data needed to support informed decisions is an ongoing effort. This plan highlights the near-term

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actions that will be undertaken now and lays the foundation for continuing efforts in the mid- and long-term.

- Ultimately this and successive plans are intended to result in progress in the following areas:
  - A nationally integrated system of ocean, coastal, and Great Lakes observing systems.
  - Delivery of data on key ocean, coastal, and Great Lakes variables.
  - Effectiveness of unmanned vehicles and satellite remote sensing platforms.
  - Improved capabilities and reduced gaps in the National Oceanographic Fleet of ships and related facilities.
  - Improved data management, communication, access, and modeling systems for the timely integration and dissemination of data and information products.
- These areas form the focus of the actions identified in this plan.

III. Body of the Plan

A. Action 1 – Examine the status of the National Oceanographic Fleet.

Provide a status report on the National Oceanographic Fleet, and identify ways to improve its utilization to achieve the priorities of the National Ocean Policy. The National Oceanographic Fleet is comprised of the federally-owned oceanographic ships operated by both Federal and academic organizations.

1. Why Do This
   - The National Oceanographic Fleet is essential to achieve the priorities of the National Ocean Policy.
   - This action seeks to identify fleet capabilities and gaps, and to improve coordination and management of existing fleet resources to close some of these gaps.

2. Timeframe – Near-term

3. Outcomes
   - Identification of National Ocean Policy at-sea survey (oceanographic and living-marine resource) and research missions, especially in the Arctic.
   - The current National Oceanographic fleet's status, capacities, and capabilities become the basis for planning survey and research work.

4. Milestones
   - Report on National Ocean Policy at-sea survey (oceanographic and living-marine resource) and research missions priorities.
   - Update the "Federal Oceanographic Fleet Status Report."
   - Complete analysis and selection of fleet effectiveness performance measurements.
   - Complete evaluation of a prototype platform allocation planning tool.

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

- Assess the capabilities for oceanographic ships to support multi-mission agency activities in the Arctic.

5. Gaps and Needs in Science and Technology
   - New ship designs to improve operational efficiencies at sea.

B. Action 2 – Examine the status of unmanned and satellite remote sensing systems.
Provide a status report on the use and application of unmanned and satellite remote sensing systems, and identify ways to improve utilization of these systems, to achieve the priorities of the National Ocean Policy. The current inventory of federal and non-federal unmanned systems includes Unmanned Undersea Vehicles (both tethered and autonomous), Unmanned Air Systems, and Unmanned Surface Vehicles.

1. Why Do This
   - Air and sea unmanned systems already available from federal and non-federal partners can extend or multiply the reach of survey (oceanographic and living-marine resource) and research missions.
   - The potential for these systems to aid in science and emergency response activities.

2. Timeframe – Mid-term

3. Outcomes
   - Improved and more cost effective data collection to meet National Ocean Policy survey and research mission requirements.

4. Milestones
   - Report on National Ocean Policy Priority Objective observation requirements suitable for accomplishment with unmanned systems.
   - Complete an inventory of available federal and non-federal unmanned systems.
   - Complete analysis and selection of unmanned system utilization performance measurements.
   - Complete evaluation of a prototype unmanned system inventory and planning tool.
   - Assess the potential of developing unmanned sub-ice data collection vehicles.
   - Report on regulatory restrictions or obstacles that limit use of federal and non-federal unmanned systems, and identify ways to enable better use of these systems to achieve NOP priorities.

5. Gaps and Needs in Science and Technology
   - Access to regulated airspace for unmanned aerial vehicle operations.
   - Improved battery technology for unmanned or autonomous underwater vehicles.
   - Integration of unmanned systems into multi-purpose observing systems.

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- Coordination of autonomous operations of individual and swarms of unmanned systems.
- Sustained critical global and regional ocean time series observations.

C. Action 3 – Use advanced observation and sampling technologies to observe and study global processes.

Use advanced observation and sampling technologies currently funded to observe and study global processes at all scales and to further develop observational capabilities.

1. Why Do This
   - Short- to mid-term observing projects that utilize innovative observing tools and infrastructure provide significant advances in knowledge and understanding of the ocean, the coast, and the Great Lakes. These programs serve as a test-bed for addressing the science and technology gaps across the national priority objectives and the strategic action plans.
   - These activities are related to and will be coordinated with those listed under the Strategic Action Plan for Informing Decisions and Improving Understanding.

2. Timeframe – Mid-term

3. Outcomes
   - Scientific technique for integrating short-term data with sustained long-term ocean observing.
   - Scientific technique for integrating coastal and ocean, remote and in situ, physical and biological observations, and relating these observations to socio-economic data.
   - Real-time ocean data from the Ocean Observatories Initiative observing system for use in implementing the National Ocean Policy.
   - New scientific information for exploring the complexities of land, ocean, atmosphere, ice, biological, and social interactions.

4. Milestones
   - Implement data and/or modeling techniques which support a global mapping capability for seasonal changes in, for example, ocean surface topography, currents, waves, winds, phytoplankton content, nutrients, sea-ice extent, rainfall, sunlight reaching the sea, and sea surface temperature.
   - Release of report on Opportunities in Ocean Observations and Ecosystem Health.
   - Complete an inventory of unique national coastal and ocean facilities (and associated data) that fall outside normal assessments.

5. Gaps and Needs in Science and Technology
   - Improved battery technology for unmanned vehicles and moored buoy sensor systems.

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

- Improved data communication technology from moored buoy sensor systems.
- Improved optical and biological sensors.
- Improved understanding of interrelations between the physical ocean phenomenon, the ocean observational data and the data identifying socioeconomic impacts.

D. Action 4 – Implement the Integrated Ocean Observing System (IOOS).
Implement IOOS to sufficient functional capability to provide standardized data discovery and access to a minimum set of ocean observing data from federal and non-federal sources.

1. Why Do This
   - IOOS initial capability will provide long-term, sustained, verified and validated ocean observations to meet the data needs of the National Ocean Policy
   - In particular, it will contribute to the extensive data needs for monitoring requirements of ecosystem-based management, water quality and sustainable practices on land, changing conditions in the Arctic, and ecosystem restoration and protection, as well as the Coastal and Marine Spatial Planning (CMSP) decision-making processes and the inform decisions and improve understanding strategic area.

2. Timeframe – Mid-term

3. Outcomes
   - A sustained IOOS that is responsive to and reflects priorities identified across federal agencies, regional planning entities, and state and local stakeholder communities.
   - Coordinated development that advances the individual and shared objectives of, and provides for integration across, targeted observing efforts including, for example, biological (e.g. Ocean Biographic Information System) and water quality (National Water Quality Monitoring Network) communities.
   - Improved access to standardized data to support the following societal goals: maritime commerce, safety at sea, weather and climate forecasts and effects, national and homeland security, sustainable living marine resources, and monitoring ecosystem health.

4. Milestones
   - Release IOOS certification standards.
   - Provide an independent cost estimate to implement the Integrated Ocean Observing System.
   - Implement the "National Water Quality Monitoring Network for U.S. Coastal Waters and Their Tributaries" design, which represents an integrated, multi-disciplinary approach, leveraging State and other diverse sources of data, information, and programs and linking observational capabilities from land-to-sea.

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

5. Gaps and Needs in Science and Technology
   - Improved socio-economic information to quantify benefits of a long-term sustained global ocean, coastal, and Great Lakes capability and to refine products delivered to better meet needs.
   - Advancements in ability to synthesize outputs from models of different scales.
   - Common data management practices to effectively and efficiently utilize data from multiple, disparate collection systems and long-term data stewardship.

E. Action 5 – Coordinate and leverage ocean and coastal mapping efforts.
Coordinate and leverage ocean and coastal mapping programs, resources, capabilities, and capacities among federal and non-federal entities, for the provision of mapping data, value-added decision-support products, and state-of-the art mapping technologies.

1. Why Do This
   - Coordination and leveraging across mapping efforts will more efficiently and effectively meet National requirements for ocean and coastal mapping services, data, products, capabilities, tools, technologies, and research and development.
   - Addressing these requirements supports and advances priority objectives of the National Ocean Policy.

2. Timeframe – Long-term

3. Outcomes
   - Better informed decision-making as a result of improved user access to and identification of authoritative ocean and coastal mapping data.
   - Improved coordination in defining ocean and coastal mapping data gaps and efficiencies in allocating mapping acquisition resources.
   - Improved support for ocean and coastal decision-makers through improved mapping data integration and product development coordination.

4. Milestones
   - Complete development of a national ocean and coastal mapping inventory that will serve as a clearinghouse for mapping data and interpretive information and a registry of data acquisition activities.
   - Develop an annual national ocean and coastal mapping/data acquisition plan.
   - Make mechanisms available for leveraging the expertise, personnel, platforms, sensors, processing capabilities, etc. of federal and non-federal partners.

5. Gaps and Needs in Science and Technology
   - Autonomous air, surface and underwater technologies to support acquisition of mapping data.

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

- Ability to efficiently acquire seafloor data in shallow, turbid water and efficiently and accurately measure topography and shallow bathymetry in wetland and marsh environments.
- Improvements in automated seafloor and land characterization techniques.
- Improvements in capabilities to merge multiple source seafloor and land data and create seamless environmental characterizations.

F. Action 6 – Develop an integrated observation data management system.
Develop an integrated physical, biological, chemical, geological/geophysical, ecological and observation data management system as part of the larger, overarching observing infrastructure to support the national priority objectives.

1. Why Do This
   - Meeting the data and information requirements of all the priority objectives in an integrated and collaborative manner will help enable the delivery of end-to-end data services including data collection, management, stewardship, integration, and product dissemination via Web based sources. This will maximize the utility of ocean and coastal observing capacity for the Nation.

2. Timeframe – Long-term

3. Outcomes
   - National, enterprise-wide data and information management, archive, access, and long-term stewardship systems and supporting policies that ensure the full value of the Nation's investment in ocean, coastal, and Great Lakes data and information.
   - A national data management and stewardship system that promotes the use of authoritative observations and mapping data.
   - Support for an operational integrated National Information Management System by identifying existing systems and integrative functions and based on authoritative data to support coastal and marine spatial planning (CMSP).

4. Milestones
   - Define Federal and non-Federal partners' data and information management, archive, access, and long-term stewardship systems modeled on the *U.S. IOOS®: A Blueprint for Full Capability*.
   - Ensure data collected from existing systems are submitted to the relevant national archive centers for long-term stewardship in a manner that supports the National Information Management System and other activities, and are easily retrievable in a format useable for decision-making.
   - Ensure mapping data are readily accessible through Federal geospatial systems, through support of the inventory work of the Interagency Committee on Ocean and Coastal Mapping.

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- Agree to, among international stakeholders, formats for data transmission via the Global Telecommunications System (GTS), metadata and version control, as well as best practices for observing and quality.

5. Gaps and Needs in Science and Technology
   - Improved data interoperability between observing networks to facilitate sharing across agencies and partners.
   - Common data management practices to effectively and efficiently utilize data from multiple, disparate collection systems and long-term data stewardship.

INTERIM

This is a preliminary document that constitutes an important but interim step toward completion of the full strategic action plan.

Strategic Action Plan Outline Fact Sheet

Overview

As part of President Obama's charge for Federal agencies to implement the *National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes*, the National Ocean Council is responsible for developing strategic action plans to achieve nine priority objectives that address some of the most pressing challenges these resources face.

What is a Strategic Action Plan?

The nine priority objectives provide a bridge between the National Ocean Policy and action on the ground and in the water. Strategic action plans will identify specific and measurable near-term, mid-term, and long-term actions, with appropriate milestones, performance measures, and outcomes that Federal agencies will take to meet each priority objective. Each plan will explicitly identify key lead and participating agencies; gaps and needs in science and technology; potential resource requirements; ways to conduct activities more efficiently; and steps for integrating or coordinating current and out-year budgets. Collectively, the strategic action plans will constitute the implementation strategy for the National Ocean Policy. By having a unifying National Ocean Policy that clearly articulates our priorities and addresses them through the development of strategic action plans, the Federal government can more effectively ensure that the limited Federal resources we have are targeted and deliver demonstrable outcomes and results, such as predictability for users, more efficient and coordinated decision making, and improved sharing of data and technology.

Who is Developing the Strategic Action Plans?

Under the direction of the National Ocean Council, experts from the Council's 27 Federal agencies and offices are drafting the strategic action plans with a heavy emphasis on obtaining input from National, regional, and local stakeholders and the public. The Council's two Interagency Policy Committees (IPCs)-the Ocean Resource Management IPC and the Ocean Science and Technology IPC - are overseeing the development of the strategic action plans. The IPCs coordinate activities for all plan preparation and review draft and final products prior to submission to the Council. Through this process we are bringing together experience and authorities in science, natural resource management, economic development, infrastructure planning, public health, and social services as well as essential knowledge from the individuals who live and work along our Nation's coasts.

What are Strategic Action Plan Content Outlines?

As a first step in developing strategic action plans, the NOC writing teams have developed what we call 'content outlines' for each plan. The purpose of the outlines is to provide an initial view as to how Federal agencies might address the priority objectives as described in the National Ocean Policy. They are preliminary documents that constitute an important but interim step toward completion of the strategic action plans. The outlines, by design, do not and are not intended to

provide all of the details that will be provided in the plans. Nor is there necessarily the same level of specificity across all outlines. The outlines serve as an early and valuable point in the plan development process for focusing public and stakeholder input. The outlines were informed by the comments received during our initial scoping period that closed on April 29.

Each outline presents, in bulleted form, potential actions to address its priority objective. They briefly describe the reason for taking the action, expected outcomes and milestones, gaps and needs in science and technology, and the timeframe for completing the action. They also provide an overview of the priority objective the strategic action plan will address, and the greater context for the plan in implementing the National Ocean Policy.

In developing the outlines - and ultimately the full plans - the writing teams were operating under certain parameters that guided their discussions. Each plan is to have approximately six actions that are focused on Federal efforts. The actions are to be succinct, feasible activities based on measurable and achievable outcomes within the milestones and timeframe indicated. They are to be consistent with the President's management and budget goals, especially in consideration of the current budget climate in which little to no new resources likely will be available in the near- to mid-term. In that light, the actions are intended to focus on eliminating redundancy, encouraging efficiency, and evaluating and prioritizing ongoing and new activities. Options for long-term activities requiring additional resources will be considered as plans are developed in the out-years. Overall the strategic action plans should be adaptive to allow for modification and addition of new actions based on new information or changing conditions. The plans and their implementation would be assessed and reviewed annually by the National Ocean Council and modified as needed based on the success or failure of the agreed upon actions.

We Want to Hear From You

You have the opportunity to review these outlines and provide input during the June 2 to July 2 public comment period. To submit your comments please visit:
http://www.whitehouse.gov/administration/eop/oceans/sap

We welcome your general input, and also pose the following questions within the context of the nine national priorities:

- What changes on the water, to the coasts, or in the Great Lakes would make the biggest difference for you and how would you like to see these reflected in the strategic action plans?
- Do the actions address your community's needs or key concerns? If not, what areas should be considered for inclusion?
- How can the Federal government be a more effective partner to help make these changes?

Comments received will be provided to the IPCs and the writing teams for consideration as they develop the full draft strategic action plans. Draft plans are expected to be released for public review in the fall. Final plans are expected to be completed in early 2012.

Ecosystem-Based Management

Objective

Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes.

Why Do This?

Traditional management of ocean, coastal, and Great Lakes resource uses focuses on single sector management (i.e., single species or activity type) and does not adequately consider the whole ecosystem. This may result in the loss of resources, economic hardship, and environmental risk. Ecosystem-based management (EBM) is an integrated approach to resource management that considers the entire ecosystem, including humans, and the natural elements that are integral to ecosystem functions. EBM is informed by science to conserve and protect our cultural and natural heritage by sustaining diverse, productive, resilient ecosystems and the services they provide, thereby promoting the long-term health, security, and well-being of our Nation. EBM will enable decision-makers to incorporate the cumulative effects of multiple activities on entire ecosystems, and identify approaches for assessing trade-offs among these activities with the goal of maintaining ecosystem health and services.

Potential Actions and Expected Outcomes

- **Establish Ecosystem-based Management Leadership and Collaboration** – Federal agencies will work with State, tribal, and local authorities and regional governance entities to apply successful EBM approaches in the areas of greatest need. This will lead to a more efficient and effective management of the oceans, coasts, and Great Lakes by promoting a common understanding and implementation of the EBM approach.

- **Establish an Interagency Ecosystem-based Management Science Framework** – A nation-wide interdisciplinary and integrated science-based framework will improve our understanding of ecosystem functions and how the interactions between and within human and natural systems affect ecosystem health and services. It will leverage, integrate, and coordinate existing scientific programs and observations, monitoring, and research capabilities, and identify future scientific needs to understand changes over time.

- **Inform Decision-making to Support Ecosystem-based Management** – Products, services, and communication tools will be developed and provided to support EBM. This will enable agencies to share and discuss ecological, economic, social, physical, and other types of data and information needed to facilitate EBM and adaptive management approaches.

- **Incorporate Ecosystem-based Management Principles into Existing Policy and Governance** – Legislative and regulatory roadblocks to implementing EBM will be identified. EBM principles will be incorporated into Federal, regional, State, territorial, tribal, and local project planning and environmental review processes to support rapid and effective implementation of EBM throughout our Nation's marine and coastal ecosystems. This will enhance ocean, coastal, and Great Lakes stewardship, rather than a fragmented process that only looks at individual components of or influences on an ecosystem.

Coastal and Marine Spatial Planning

Objective

Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning (CMSP) and management in the United States.

Why Do This?

Human uses of the ocean, our coasts, and the Great Lakes are expanding at a rate that challenges our ability to plan and manage them under the current sector-by-sector approach. Regionally-driven CMSP which fully incorporates the principles of adaptive, integrated, comprehensive, and ecosystem-based management (EBM) will provide a much more effective and cost-efficient means to objectively and transparently guide and balance allocation and stewardship decisions for the use and protection of our ocean, coastal, and Great Lakes waters and resources.

Potential Actions and Expected Outcomes

- **Establish 9 Regional Planning Bodies (RPBs) to undertake CMSP and develop initial CMS plans for sustainable use and long-term stewardship of the ocean, our coasts, and the Great Lakes -** A regionally-based framework to implement CMSP will allow for the variability of economic, environmental, and social aspects among the different areas of the United States.

- **By 2015, applicable non-confidential and other non-classified Federal data identified for inclusion into the National Information Management System and Data Portal -** Availability of data and information through a National Information Management System and Data Portal to the RPBs, other decision-makers, ocean users, stakeholders, and the public will directly support successful CMSP efforts.

- **Preserve and enhance opportunities for sustainable and beneficial ocean use through the promotion of regulatory efficiency, consistency, and transparency as well as improved coordination across Federal agencies -** Improving regulatory efficiency and coordination across Federal agencies will minimize the burdens of regulatory delays, increased scrutiny, costly litigation, and economic constraints.

- **Reduce cumulative negative impacts on environmentally sensitive resources and habitats -** Defining and analyzing existing conditions and forecasting future conditions of distinct areas as part the CMSP process *before* any particular activity is considered will help decision-makers minimize or avoid negative cumulative impacts to marine ecosystems, while promoting compatible sustainable uses of our ocean, coastal, and Great Lakes resources.

Inform Decisions and Improve Understanding

Objective

Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.

Why Do This?

Scientific research, monitoring, and assessment, coupled with forecasts, models, and other decision-support tools, will build knowledge of ocean, coastal, and Great Lakes ecosystems and processes and ensure that management, policies, and planning are based on sound science. Formal and informal education programs will create opportunities for enhanced appreciation of coastal and ocean issues, and better prepare the diverse, ocean-literate workforce of the future. Success in building our knowledge and applying it to improve management also relies on an engaged and informed public.

Potential Actions and Expected Outcomes

- **Prioritize research activities based on "Science for an Ocean Nation: An Update of the Ocean Research Priorities Plan"** – This new plan provides a valuable framework to advance knowledge, improve understanding, and inform decision based on the best available science.
- **Provide science to support emerging sustainable uses of resources** – Fundamental and applied scientific information and technology will ensure that emerging and future uses of ocean, coastal, and Great Lakes resources are economically and ecologically sustainable.
- **Provide science support for managers and policy-makers** – Robust decision-support tools and processes - based on sound research, data and information - will support effective and rapid management of growing uses of ocean, coastal, and Great Lakes resources.
- **Develop human capacity and the workforce** – U.S. competitiveness depends on a well-educated workforce. Scholarships and other opportunities for students pursuing degrees in ocean science, management, and related fields, particularly from underrepresented groups, will contribute to the development of this workforce.
- **Increase ocean literacy** – Expanding the accessibility to and use of ocean information for education programs will increase awareness and stewardship of ocean, coastal, and Great Lakes resources.
- **Engage in ocean exploration** –Exploration and discovery will expand knowledge of little-known Great Lakes and oceanic biodiversity, biogeochemical processes, ecosystem services, and climate interactions. These discoveries have the potential to lead to new energy sources, new products, and inspire the next generation of ocean scientists.
- **Integrate social and natural scientific information** – Integrating information from social and natural sciences, especially for ecosystem-based management and restoration, will inform research, policy development, and decision-making, and support and enhance sustainable economies.

Coordinate and Support

Objective

Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government, and as appropriate, engage with the international community.

Why Do This?

One of the significant obstacles to effective management of the ocean, our coasts, and the Great Lakes is the complex set of Federal, State, tribal, and local laws, authorities, mandates, and governance structures intended to manage their use and conservation. Furthermore, the United States is party to numerous international agreements and subject to customary international law regarding use and protection of the ocean and the Great Lakes. This makes it difficult to achieve consistent approaches to resource management, including ecosystem-based and adaptive management. Through increased communication, coordination, and integration across all levels of government, we can streamline processes, reduce duplication, and leverage resources.

Potential Actions and Expected Outcomes

- **Develop a regional communication framework under the National Oceanographic Partnership Program** – Improved information exchange, communication, and coordination among interested parties will enhance our ability to work across jurisdictions to advance National Ocean Policy goals.
- **Identify, prioritize, and seek to resolve legal barriers to implementation of the National Ocean Policy** - Legal barriers inhibiting effective implementation of the National Ocean Policy, such as uncertainty and inconsistency or overlap of authorities, will be addressed. Identifying overlaps in statutory authority on particular topics will lead to greater efficiencies.
- **Identify barriers and obstacles to successful collaborative efforts** – Examining barriers and offering opportunities to work together among regional, State, and Federal entities will allow regional ocean governance (ROGs) entities to function with greater integration and efficiency.
- **Identify and disseminate Best Management Practices (BMPs) utilized in Federal or regional partnerships** – Successful practices among Federal agencies, ROGs, and other regional ocean partnerships will be evaluated. Their use will help ensure successful and consistent National Ocean Policy implementation throughout the regions.
- **Identify specific ways to prioritize and coordinate resources, reduce spending overlap, and leverage funding between and among Federal agencies and ROGs** - Collaboration among agencies will streamline processes, enhance coordination and leverage resources. This will improve processes and maximize benefits relative to costs.
- **Identify appropriate opportunities for engaging the international community about the National Ocean Policy** - Engage with international partners bilaterally and multilaterally to achieve increased cooperation and coordination on ocean issues. Improved international communication and coordination will facilitate implementation of the National Ocean Policy.

National Ocean Council: Strategic Action Plan Outline Overview

Resiliency and Adaptation to Climate Change and Ocean Acidification

Objective

Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.

Why Do This?

Global climate change and its associated impacts pose serious threats to ecosystems and coastal communities. Warming ocean temperatures have a profound impact on the distribution of rainfall over watersheds, the melting of ice sheets, and the distribution and productivity of species. Sea-level rise, increased severe storm events, rapid erosion, and salt water intrusion threaten low-lying coastal communities. At the same time, climate change is predicted to lower the water levels of the Great Lakes, thereby altering water cycles and supply, habitat, and economic uses of the Lakes. Ocean acidification is expected to have significant and largely negative impacts on marine food webs, ocean ecosystems, and biological diversity. We have an opportunity and a responsibility to develop strategies for reducing the vulnerability, increasing the resilience, and improving adaptation of human and natural systems to climate change impacts.

Potential Actions and Expected Outcomes

- **Provide critical information about the impacts of climate change and ocean acidification -** Access to this information will result in more accurate forecasts of the scale, scope, and impacts of climate change and ocean acidification.

- **Forecast the impacts of climate change and ocean acidification** - These forecasts will support improved vulnerability assessments, adaptation planning, and decision-making.

- **Strengthen and integrate observations from protected areas, research sites, and observing systems** - Coordinating observations from the Nation's sentinel sites will provide managers and communities with the ability to track changes in habitats and species over time.

- **Provide critical climate change and ocean acidification information, tools, guidance, and services** - This action will result in an enhanced ability of individuals, communities, and governments at all scales to identify their needs and ultimately to implement forward-looking, adaptive actions that build ecosystem, societal, and economic resilience.

- **Assess vulnerability of the built and natural environment in a changing climate –** Federal agencies will work with State, local, and tribal governments, non-governmental organizations, academia, and the private sector to conduct vulnerability assessments to inform more effective resilience and adaptation strategies.

- **Deploy and assess the effectiveness of resilience and adaptation strategies** - This will result in informed siting and design, protection of ecosystems, improved public health and safety, reductions in the loss of life and property, and decreased cost of responding to disasters.

Regional Ecosystem Protection and Restoration

Objective

Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, State, tribal, local, and regional levels.

Why Do This?

Essential coastal and the Great Lakes habitats continue to suffer significant losses and degradation due to coastal development, sea-level rise, and associated human activities, as well as external stressors such as invasive species and climate change. Critical habitat loss and degradation of ecosystem services is apparent in many regions. Addressing challenges that cross jurisdictional boundaries and sectors on a regional and ecosystem scale will lead to more effective resource management.

Potential Actions and Expected Outcomes

- **Support Shared Regional Ecosystem Protection and Restoration Priorities –** Aligning Federal resources in three regions will improve our ability to protect and restore regional ecosystems.
- **Strengthen Conservation Partnerships –** This will bring together Federal and non-Federal expertise, strengths, and resources to increase support for the protection and restoration of ocean, coastal, and Great Lakes habitats that provide the ecosystem services.
- **Reduce Coastal Wetland Loss –** To address the alarming loss of coastal wetlands, Federal agencies will assess their causes. The findings will result in recommendations that will help Federal agencies take actions to reverse wetland losses.
- **Develop Carbon-based Incentives for Coastal Habitat Conservation –** A protocol will be developed and policy options explored for incorporating the carbon sequestration value of coastal habitats into Federal decision-making.
- **Ensure Full Mitigation for Injuries to Coral Reef Ecosystems –** Establishing standard protocols for coral reef ecosystem assessment and mitigation among the four Federal agencies responsible for coral reef protection, restoration, and regulation.
- **Reduce the Threat of Marine Invasive Species –** Federal agencies will coordinate planning to control marine invasive species and the resulting impacts to marine ecosystems, beginning with the Indo-Pacific lionfish.
- **Protect Nationally Significant Marine and Great Lakes Aquatic Areas –** Federal agencies will work with non-Federal partners to develop a process to identify marine areas that are ecologically important and nationally significant, and recommend the appropriate levels of protection.
- **Improve the Effectiveness of Project Monitoring and Tracking -** Federal agencies will adopt the monitoring protocols in the *Estuary Restoration Act of 2000* and add estuary restoration project information into the National Estuaries Restoration Inventory.

Water Quality and Sustainable Practices on Land

Objective

Enhance water quality in the ocean, along our coasts, and in the Great Lakes by promoting and implementing sustainable practices on land.

Why Do This?

Pollution from diffuse sources throughout the country caused by poor land management practices negatively impacts water quality in ocean, coastal, and Great Lakes ecosystems, resulting in harmful algal blooms, expansive dead zones, marine debris, and increased incidents of human illness. Addressing this problem requires a strong commitment to coordination and cooperation between multiple sectors and among Federal, State, tribal, local authorities, and regional governance structures.

Potential Actions and Expected Outcomes

- **Reduce rural and urban sources of excessive nutrients and sediments** – This action will enhance aquatic ecosystem health, reduce costs to wastewater treatment plants, retain storage capacity in flood control structures, and enhance recreational opportunities.

- **Assess hypoxia status, trends, and impacts nationwide -** Severe oxygen depletion or hypoxia is the most readily recognized symptom of impaired water quality. Studying hypoxia will help to mitigate or prevent mass fish kills, loss of reefs, economic impacts on commercial and sport fisheries, and degradation of ecosystem health.

- **Reduce trash and marine debris through pollution prevention and removal –** This action will use a comprehensive approach to mitigate the adverse effects of marine debris and trash in our watersheds, the ocean, our coasts, and the Great Lakes on human health, the environment, and the economy.

- **Assess health risks of coastal waters -** A better understanding of current and emerging health risks from impaired water quality, as well as the connections between upstream sources of pollution and downstream effects, will enhance disease surveillance, environmental/wildlife monitoring and watershed modeling, and inform remediation efforts.

- **Provide warning and reduce public health risks of coastal waters -** Connecting environmental monitoring with disease surveillance will help to quickly identify threats and notify communities of risks associated with contaminated recreational and drinking waters, seafood, and beaches; reduce health risks from pollutants; and help safeguard coastal resource-dependent economies.

- **Identify and protect high quality coastal waters** – This action will help to ensure the sustainability of ocean, coastal, and Great Lakes ecosystems and their associated public benefits.

Changing Conditions in the Arctic

Objective

Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.

Why Do This?

Human-induced climate change is having the most immediate impact on polar regions. The Arctic, and indeed the world, faces serious consequences from accelerated permafrost thawing and carbon release, reductions in Arctic sea ice volume and extent, coastal erosion, and global sea-level rise from melting glaciers and ice caps. Increased human activity brings additional stressors that impact Arctic ecosystems and communities. At the same time, diminishing sea ice presents opportunities to further develop resources and to increase marine transportation. Working with all stakeholders, including the State of Alaska, and Alaska Native communities, we have an opportunity to develop scientifically informed plans to sustainably manage and encourage use of the Arctic while also continuing to protect it.

Potential Actions and Expected Outcomes

- **Improve Arctic environmental response management -** Developing new systems and procedures will help protect ecosystems, local communities, and subsistence resources from the effects of oil spills or other accidents associated with resource extraction and increasing Arctic marine transportation.

- **Observe and forecast Arctic sea ice -** Observing, predicting, and ultimately projecting the extent, thickness, and age of Arctic sea ice will improve daily forecasts and decadal predictions to help support safe, secure, and reliable marine operations and ecosystem stewardship.

- **Establish a distributed biological observatory -** Integrating biological and other oceanographic data from a network of observatories in the Pacific Arctic will improve understanding of climate and environmental change effects on marine ecosystems and communities that rely on them.

- **Improve Arctic communication -** Improving marine communication networks/architecture will support research, reduce environmental incidents, contribute to safe navigation, and facilitate emergency response, and search and rescue.

- **Advance Arctic marine mapping and charting** - Accurate hydrographic surveys and biological/shoreline mapping of U.S. Arctic waters and the Alaskan coastline are needed to improve the Arctic marine transportation system and to characterize habitats for ecosystem stewardship and restoration.

- **Improve coordination on Arctic issues -** Defining the roles and responsibilities of the Arctic interagency policy groups, as well as links to international efforts, such as through the Arctic Council, will result in greater government efficiency through decreased duplication of effort and increased sharing of resources, knowledge, and information.

Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure

Objective

Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrate that system into international observation efforts.

Why Do This?

Our ability to understand weather, climate, and ocean conditions, to forecast key environmental processes, and to strengthen ocean management decision-making at all levels requires accurate data and information. Coordination and integration of the many available data collection, processing, management and access tools and infrastructure into a cohesive, unified, robust system will promote greater efficiency and effectiveness in shared efforts that significantly advance our knowledge and understanding of the ocean, our coasts, and the Great Lakes.

Potential Actions and Expected Outcomes

- **Examine the status of the National Oceanographic Fleet**–This action will identify ways to improve the coordination, management, and utilization of the National Oceanographic Fleet to achieve the Policy's priorities. The current Fleet's status, capacities, and capabilities will form the basis for planning survey and research work.

- **Examine the status of unmanned and satellite remote sensing systems–** Air and sea unmanned systems can extend or multiply the reach of survey and research missions, and are very effective in emergency situations. This action will identify ways to further take advantage of their effectiveness.

- **Observe and study global processes using advanced observation and sampling technologies –** Short- to mid-term observing projects that utilize innovative observing tools and infrastructure will provide significant advances in knowledge and understanding and address science and technology gaps in our long-term ocean observing systems.

- **Implement the Integrated Ocean Observing System (IOOS) –** A functional Integrated Ocean Observing System will provide long-term, sustained, verified and validated ocean observations to support federal, regional, state and local community stakeholder priorities.

- **Coordinate and leverage ocean and coastal mapping efforts –** Engaging providers and users in identification of information gaps and efficiencies in information development and delivery will lead to improved user access to information that supports policy and management decision-making.

- **Develop an integrated observation data management system –** A web-based data inventory, management, archive, and distribution system will capitalize on the Nation's investment in ocean, coastal, and Great Lakes data and information and allow their effective use by multiple groups addressing all National Ocean Policy objectives including Coastal and Marine Spatial Planning.

We want to hear from you!

Public comments on these Strategic Action Plan Outlines are being accepted at:

http://www.whitehouse.gov/administration/eop/oceans/sap

Eugene Brower; Charlie Edwardsen JR.; Caroline Cannon clear message communicate/inform Doreen Lampe Tribal govts.

E.B. O discharge, small boat harbors, people dictating, Mayors & points rest for oil/gas development

Robert Edwardson: Ocean livelihood/need GG assests

Nathaniel Olmann; Safe boat harbor designation, ice shove prevention -

George Olmann; - Erosion losing shoreline 20 ft last year needs to be addressed

Point Hope: oil & gas & subsistence issues in conflict

Gambell 1, 2-3.

Caroline Cannon: Ocean valuable want them in community communication problems / tribal control on CZM. Owners of ocean. Food security. Use local traditional knowledge. Arctic Policy will impact residents the most.

Pt. Lay-Leo Fer: Cruise ship traffic issue to harvest/timeline for ships. Decision making equal blw all villages. Share information.

Cully Corp. Dolly Norton: Policies new will it continue after this administration - what happens in 2018?

Doug Vincent Lang/Dept of F&G/Key to economic activity/fishing 60% of fish from Alaska. More coastline - Clearly defined outcomes & timelines, missing. Question legal authority of President. Invest in infrastructure. Need more resources NOT rules.

Price Leavitt/ED of ICAS/Subsistence important/wish to pass on/EBM like/moral obligation to future generations. Need EBM as soon as can. Rush to develope resources Better coordination blw agencies. One oil spill could ruin it all. OSR needs to be proven. Culmative Impacts need to be considered. INUA. tribes - - -

Rossman: WHISPERING/Afraid of changing ice conditions. Need to observe.

Nuiqsut: ∅ Rosemary

Bob Harachek: saying same things 30 yrs. little no action. Hope this body acts. Cultural/traditional knowledge needs emphasis. CZM Keep it Development inevitable - we can work together for best development. Residents integral part of Arctic

Glen Shannon: BASC Rules shouldn't be made at a distance. Need better telecommunication system - fiber optics. Long list of projects, ocean acidification. Sound through water impacts animals - needs to study.

Kain Okpik - stewards of lands. People grow tired of the meetings.

Gordon Brower. CZM Hard to be responsible steward.

Anne - People are part of ecosystem so need to be part of EBM. Traditional/local knowledge - had to be trusted to survive. Longer time depth for ecosystem.

Baseline data needed.

National Policy for Stewardship of the Ocean, Our Coasts, and the Great Lakes

Regional Listening Session
Strategic Action Plan Content Outlines

Barrow, Alaska
June 9, 2011

National Ocean Council

Today's Listening Session

4 PM to 9 PM

- Opening Comments – Jim Kendall DOI/BOEMRE
- Listening Session Background and Overview – Eileen Sobeck DOI NOC Representative, Amy Holman NOAA, and CDR Shane Montoya U.S. Coast Guard
- Public Comments, including Telephone comments from other North Slope Commenting

National Ocean Council

27 fed agencies working together = NOC

Executive Order 13547

- Establishes our Nation's first ever ***National Policy*** for Stewardship of the Ocean, our Coasts, and the Great Lakes
- Creates an interagency ***National Ocean Council*** to provide sustained, high-level, and coordinated attention to advance the National Policy
- Prioritizes ***9 categories for action*** that seek to address the most pressing challenges facing the ocean, our coasts, and the Great Lakes
- Establishes ***a flexible framework for effective coastal and marine spatial planning*** to address conservation, economic activity, user conflict, and sustainable use of ecosystem services

National Ocean Council

9 action items

Deadline = beg of next year

CMSP = regional effort regional planning body for Alaska

What is the National Ocean Policy about?

An America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are

healthy and resilient, safe and productive, and understood and treasured

so as to promote the well-being, prosperity, and security of present and future generations.

National Ocean Council

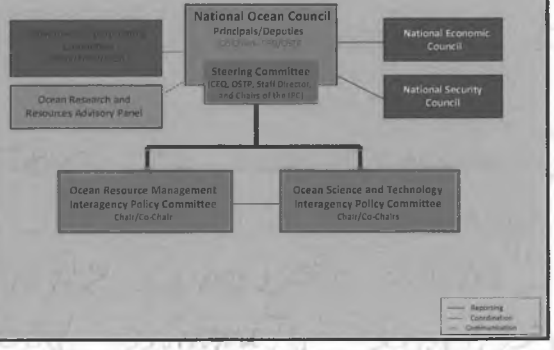
Why Do We Need a National Ocean Policy?

Provides a unifying framework to:

- Improve Federal management efforts to ensure healthy marine environments, sustainable economic growth, jobs, and recreational opportunities
- Foster coordination and communication among all levels of government to minimize duplication of effort, inefficiency, waste, and conflict
- Prioritize and focus efforts around key areas to maximize the investment of limited resources at the Federal level and ensure accountability for the effectiveness of such investments

National Ocean Council

National Ocean Council



Targeted Implementation Strategy

Strategic Action Plans

- The NOC is charged with developing *strategic action plans for* the nine priority objectives. Plans must--
  - Identify *specific and measurable* near-, mid-, and long-term actions to be taken to further the objective
  - Include smaller-scale efforts to build on existing activities, as well as more complex, larger-scale actions;
  - Identify leading and participating agencies in these efforts;
  - Identify gaps and needs in science and technology;
  - Determine resource requirements including steps for integrating and coordinating budgets

National Ocean Council

Strategic Action Plans

- Plans will be adaptive to allow for modification and addition of new actions based on new information or changing conditions
- Plans and their implementation would be assessed and reviewed annually by the NOC and modified as needed based on the success or failure of the agreed upon actions
- As the NOC develops and revises the plans, it will ensure substantial opportunity for public participation. Final plans, revisions, and reports of how well plan performance measures are being met would be made publicly available

National Ocean Council

Strategic Action Plan Content Outlines

- An interim step toward completion of the full draft strategic action plans
- Represent an early and important point in the SAP development process for seeking public and stakeholder input
- Provide an *initial* view as to how federal agencies might address the priority objectives
- By design, do not and are not intended to provide all of the details that will be provided in the full plans

National Ocean Council

Schedule and Additional Opportunities for Public Engagement

- Public Comment Website provided initial input into development of Strategic Action Plans – Closed April 29
- Release of Draft Full Content Outlines for Public Review – June 2011
- Public comment period and listening Sessions to provide input on the Content Outlines and development of full draft plans – June 2011
- Release of Draft Strategic Action Plans for Public Review- October 2011
- Public Comment period, stakeholder roundtables, and other means to provide input on the draft plans – October/November 2011
- Release of Final Strategic Action Plans – Early 2012
  - Comments on the Strategic action plan Outlines are now being accepted http://www.WhiteHouse.gov/administration/eop/oceans/comment

National Ocean Council

Why are we holding this Listening Session?

Why are we holding these listening sessions?
•We wish to inform local and regional stakeholders and the general public about our efforts to implement the National Ocean Policy
•We seek your input on the strategic action plan outlines

What's at stake?
•The plans being developed will shape Federal focus, actions, and resources with respect to the nine national priorities

Who should participate?
•Local residents, resource users, industry, and the general public- essentially anyone with interest in our ocean, coastal, and Great Lakes resources. This is a chance to help shape the Federal plans.

National Ocean Council

Questions to consider

- **We welcome your general input, and also pose the following questions within the context of the nine national priorities:**
  - What changes on the water, coasts, or Great Lakes would make the biggest difference for you and how would you like to see to see these reflected in the strategic action plans?
  - Do the potential actions address your community's needs or key concerns? If not, what areas should be considered for inclusion?
  - How can the Federal government be a more effective partner to help make these changes?

National Ocean Council

Examples of comments we have *received or anticipate*

- Subsistence hunting and gathering must be considered and protected. The ocean is our garden. The whales, other marine mammals, and fish must be managed and protected to ensure our way of life.
- With increased maritime traffic in the Arctic comes the need for better navigational aids, charts, weather data and forecasts, monitoring, spill prevention, incidence response, and enforcement capacity.
- Ensure that implementation of a National Ocean Policy is done in such a way that is helpful rather than harmful to the important national interests, including the interest of commercial and recreational users of the oceans and marine-related energy and natural resources.
- While the Arctic marine ecosystem is known to be rich and complex, it is poorly understood. There are broad data gaps, and unfortunately the Arctic marine ecosystem it difficult and expensive to study

National Ocean Council

We want to hear from you!

Public comments on these Strategic Action Plan Outlines are being accepted at:

http://www.whitehouse.gov/administration/eop/ceq/initiatives/oceans

National Ocean Council

Interior's Ocean and Coastal Role

Stewards of our Nation's Ocean, Coastal and Great Lakes Resources

As the principal resource steward of our Nation's Ocean, Coastal and Great Lakes Resources, the Interior Department uses science-based management to inform conservation, responsible use, and to increase our understanding of the environment. Interior is responsible for protecting and providing access to these significant resources and works with other federal agencies and partners to accomplish Interior mission goals.

Through diverse programs and responsibilities for scientific research, cultural preservation, energy and wildlife management, Interior manages and conserves ocean and coastal lands and waters to protect native species and their habitats, provide recreational opportunities for the public, and ensure safe and responsible natural resource energy development. Interior scientists conduct extensive ocean, coastal, and Great Lakes research and mapping to predict, assess, and manage impacts on coastal and marine environments. In collaboration with our partners, Interior integrates effective multiple-use management from upland ecosystems to deep oceanic waters.

Interior's Mission for Ocean, Coasts and Great Lakes

To uphold the Department's ocean, coastal and Great Lakes stewardship responsibilities through science-based management, conservation, responsible use, and increased understanding of the environment.

Interior contributes to implementing the National Ocean Policy

- Secretary Salazar and Chief of Staff Laura Davis serve on the National Ocean Council (NOC);
- Interior is a member of the NOC Steering Committee, co-chairs the Ocean Resources Management Interagency Policy Committee, and participates in the Ocean Science and Technology Interagency Policy Committee;
- Interior serves on all nine teams drafting the National Ocean Policy Strategic Action Plans, with the lead on the two Priority Objectives: "Coordinate and Support" and "Regional Ecosystem Protection and Restoration";
- Interior is hosting the National Coastal and Marine Spatial Planning Workshop, June 21-23, 2011

Interior manages vast coastal and ocean resources:

- 180 marine and coastal National Wildlife Refuges
- more than 35,000 miles of coastline
- 1.7 billion underwater acres of Outer Continental Shelf
- 3.6 million acres of coral reef ecosystems
- 180 island and coastal refuges
- 34 million acres in 84 coastal parks
- 4 Marine National Monuments --including Papahanaumokuakea Marine National Monument (with NOAA and the State of Hawaii)

Meeting Today's Ocean Challenges

Interior Bureaus work with other federal agencies and partners with diverse responsibilities to manage and conserve the Nation's ocean, coastal and Great Lakes natural resources and cultural heritage, to provide scientific and management information about those resources, and to honor trust responsibilities and special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The **National Park Service** established its Ocean Park Stewardship Action plan to protect ocean parks, engage visitors in stewardship, and increase exploration and ocean mapping. NPS manages 84 coastal Parks with over 86 million annual recreation visits.

The **U.S. Geological Survey** works closely with academic institutions, states, and other Federal agencies to better understand the processes that affect the health and sustainability of our natural resources. Sound Waves, a monthly newsletter, features coastal and marine research news from across the USGS. http://soundwaves.usgs.gov/

The **Fish and Wildlife Service** conserves and promotes the enjoyment and use of marine, coastal, and Great Lakes species and habitat. It manages the 550-unit National Wildlife Refuge System, 180 of which are found in marine, coastal, and Great Lakes environments.

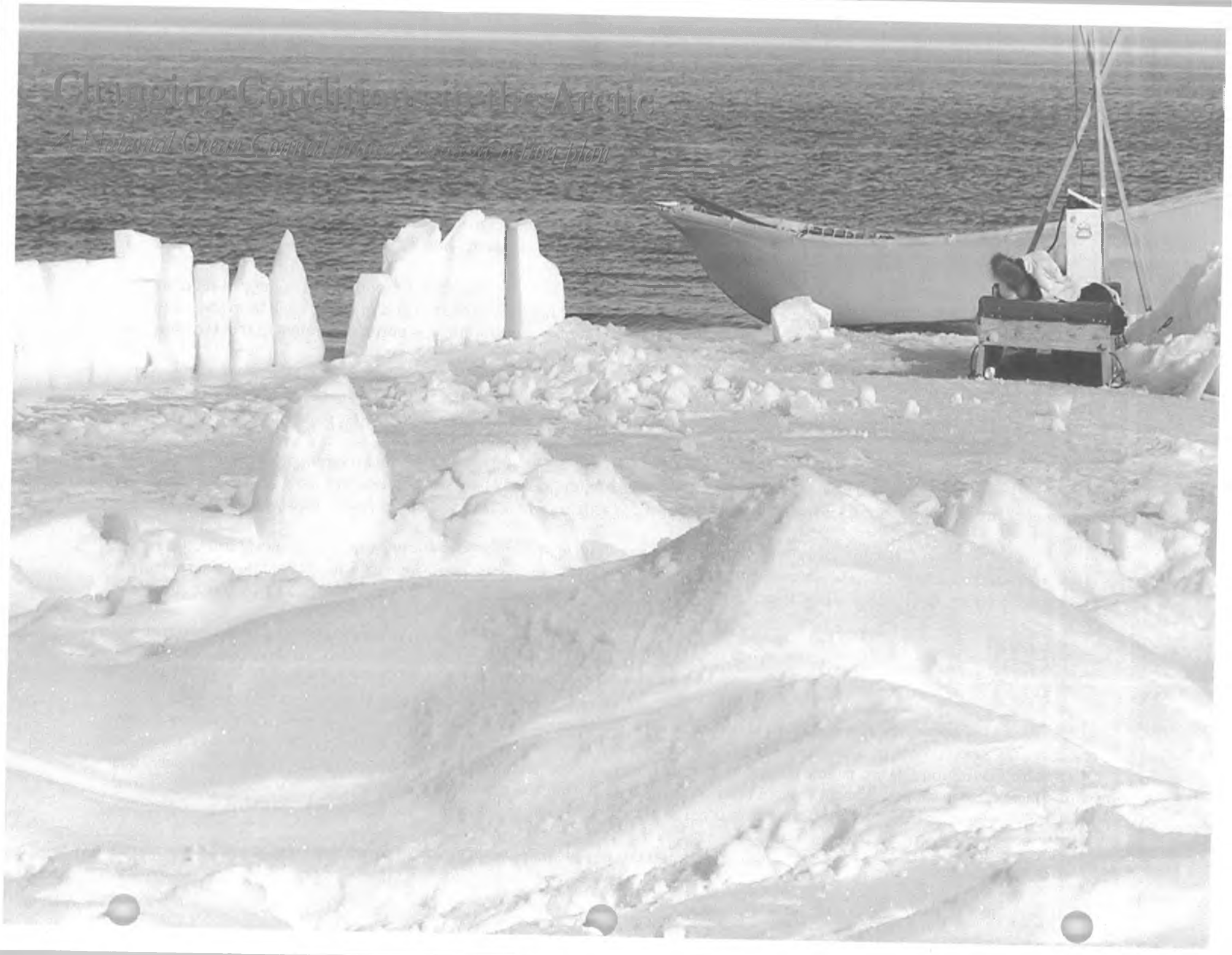
The **Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)** plays a key role in America's energy supply by managing renewable and mineral resources on the 1.7 billion acres of the Outer Continental Shelf (OCS), a significant source of our Nation's energy supply. The agency is responsible for overseeing the safe and environmentally responsible development of our Nation's traditional and renewable ocean energy and mineral resources. BOEMRE publishes Ocean Science, a science and technology journal. http://www.gomr.boemre.gov/homepg/regulate/environ/ocean_science/

The **Bureau of Land Management** manages the California Coastal National Monument which spans the entire 1,100 mile length of the California Coastline and extends 12 nautical miles from the shoreline.

The **Office of Insular Affairs** advances protection and sustainable management of coral reef resources in the insular areas through financial and technical assistance to support local initiatives.

For more information, please visit:
www.doi.gov/initiatives/ocean

USGS science for a changing world


Changing Conditions in the Arctic
A National Ocean Council priority action plan

What does a strategic action plan mean to the local residents of the Arctic?

Your home is feeling the impacts of climate change far more than the rest of the world. The Arctic and local subsistence lifestyles face serious consequences from loss Arctic sea ice, coastal erosion, and sea-level rise from melting glaciers and ice caps. Longer periods of open water allow for additional resource development and increased ship traffic. . Increased human activity brings additional stress - and these things impact your communities and the places you hunt and travel through. Working with all stakeholders, including the State of Alaska, and Alaska Native communities, we have an opportunity to develop plans, based on sound science, to sustainably manage and encourage use of the Arctic while also continuing to protect it.

Actions and Anticipated Outcomes from the Plan

- **Improve Arctic environmental response management –** Oil spills and other accidents associated with resource extraction and increasing shipping are of high concern to Arctic residents. Developing new management systems and procedures will help protect subsistence resources – your whales, seals, walrus, fish, etc.-- and local communities, from impacts.

- **Observe and forecast Arctic sea ice –** Local hunters realize the value of knowing the ice. Observing, predicting, and ultimately projecting where the ice is, its thickness, and age, will improve daily forecasts and long term predictions which, in turn, supports safe and reliable activities on the water.

- **Establish a distributed biological observatory –** Collecting scientific data from stations (biological observatories) located in many different areas of the US Arctic will help us to understand the effects of climate change on the ocean, its inhabitants and communities that rely on them.

- **Improve Arctic communication –** Work together with involved parties to improve marine communications in the Arctic. Improved communications through improved infrastructure will support scientific research and help to reduce the risks of hunting/working in the marine environment.

- **Advance Arctic marine mapping and charting –** Good maps are essential to keep ships on route (and out of danger). They are also critical to understanding the impacts of climate change (for example: recording the land that is being lost along the coastline) and habitats that are important to the wildlife that live in the Arctic.

- **Improve coordination on Arctic Ocean issues –** Local people may have noticed that they are getting more and more requests to attend hearings, public comment sessions and open houses. This is because there is a lot going on in the Arctic. The better we can work together, the more efficient the government will be through the sharing of resources, knowledge, and information.

Documents 2011 (File 2)

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Changes in the Arctic: Background and Issues for Congress

Ronald O'Rourke, Coordinator
Specialist in Naval Affairs

October 15, 2010

Congressional Research Service
7-5700
www.crs.gov
R41153

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

The diminishment of Arctic sea ice has led to increased human activities in the Arctic, and has heightened concerns about the region's future. The United States, by virtue of Alaska, is an Arctic country and has substantial interests in the region. On January 12, 2009, the George W. Bush Administration released a presidential directive, called National Security Presidential Directive 66/Homeland Security Presidential Directive 25 (NSPD 66/HSPD 25), establishing a new U.S. policy for the Arctic region.

Record low extent of Arctic sea ice in 2007 focused scientific and policy attention on its linkage to global climate change, and to the implications of projected ice-free seasons in the Arctic within decades. The Arctic has been projected by several scientists to be perennially ice-free in the late summer by the late 2030s.

The five Arctic coastal states—the United States, Canada, Russia, Norway, and Denmark (of which Greenland is a territory)—are in the process of preparing Arctic territorial claims for submission to the Commission on the Limits of the Continental Shelf. The Russian claim to the enormous underwater Lomonosov Ridge, if accepted, would reportedly grant Russia nearly one-half of the Arctic area. There are also four other unresolved Arctic territorial disputes.

The diminishment of Arctic ice could lead in the coming years to increased commercial shipping on two trans-Arctic sea routes. Current international guidelines for ships operating in Arctic waters are being updated, with a targeted completion date of 2010.

Changes to the Arctic brought about by warming temperatures will likely allow more exploration for oil, gas, and minerals. Warming that causes permafrost to melt could pose challenges to onshore exploration activities. Increased oil and gas exploration and tourism (cruise ships) in the Arctic increase the risk of pollution in the region. Cleaning up oil spills in ice-covered waters will be more difficult than in other areas, primarily because effective strategies have yet to be developed.

Large commercial fisheries exist in the Arctic. The United States is currently meeting with other countries regarding the management of Arctic fish stocks. Changes in the Arctic could affect threatened and endangered species. Under the Endangered Species Act, the polar bear was listed as threatened on May 15, 2008. Arctic climate change is also expected to affect the economies, subsistence, health, population, societies, and cultures of Arctic indigenous peoples.

Two of the Coast Guard's three polar icebreakers—*Polar Star* and *Polar Sea*—have exceeded their intended 30-year service lives. The Coast Guard since 2008 has been studying how many polar icebreakers, with what capabilities, should be procured as replacements for *Polar Star* and *Polar Sea*. The possibility of increased sea traffic through Arctic waters also raises an issue concerning Arctic search and rescue capabilities.

The Arctic has increasingly become a subject of discussion among political leaders of the nations in the region. Although there is significant international cooperation on Arctic issues, the Arctic is also increasingly being viewed by some observers as a potential emerging security issue. In varying degrees, the Arctic coastal states have indicated a willingness to establish and maintain a military presence in the high north. U.S. military forces, particularly the Navy and Coast Guard, have begun to pay more attention to the region.

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Introduction

The diminishment of Arctic sea ice has led to increased human activities in the Arctic, and has heightened concerns about the region's future. Issues such as Arctic sovereignty claims; commercial shipping through the Arctic; Arctic oil, gas, and mineral exploration; endangered Arctic species; and increased military operations in the Arctic could cause the region in coming years to become an arena of international cooperation, competition, or conflict. The United States, by virtue of Alaska, is an Arctic country and has substantial political, economic, energy, environmental, and other interests in the region. Decisions that Congress, the executive branch, foreign governments, international organizations, and commercial firms make on Arctic-related issues could significantly affect these interests.

This report provides an overview of Arctic-related issues for Congress, and refers readers to more in-depth CRS reports on specific Arctic-related issues. Congressional readers with questions about an issue discussed in this report should contact the author or authors of the section discussing that issue. The authors are identified by footnote at the start of each section.

This report does not track legislation on specific Arctic-related issues. For tracking of legislative activity, see the CRS reports relating to specific Arctic-related issues.

Background[1]

Definitions of the Arctic

There are multiple definitions of the Arctic that result in differing descriptions of the land and sea areas encompassed by the term. Policy discussions of the Arctic can employ varying definitions of the region, and readers should bear in mind that the definition used in one discussion may differ from that used in another. This CRS report does not rely on any one definition.

Arctic Circle Definition and Resulting Arctic Countries

The most common and basic definition of the Arctic defines the region as the land and sea area north of the Arctic Circle (a circle of latitude at about 66.30° North). For surface locations within this zone, the sun is generally above the horizon for 24 continuous hours at least once per year (at the summer solstice) and below the horizon for 24 continuous hours at least once per year (at the winter solstice).

The Arctic Circle definition includes the northernmost third or so of Alaska, as well as the Chukchi Sea, which separates that part of Alaska from Russia, and U.S. territorial and Exclusive Economic Zone (EEZ) waters north of Alaska. It does not include the lower two-thirds or so of Alaska or the Bering Sea, which separates that lower part of the state from Russia.

[1] Except for the subsection on the Arctic and the U.N. Convention on the law of the Sea, this section was prepared by Ronald O'Rourke, Specialist in Naval Affairs, Foreign Affairs, Defense, and Trade Division.

Eight countries have territory north of the Arctic Circle: the United States (Alaska), Canada, Russia, Norway, Denmark (by virtue of Greenland, a member country of the Kingdom of Denmark), Finland, Sweden, and Iceland.[2] These eight countries are often referred to as the Arctic countries, and they are the member states of the Arctic Council, an intergovernmental forum established in 1996.[3] A subset of the eight Arctic countries are the five countries that are considered Arctic coastal states: the United States, Canada, Russia, Norway, and Denmark (by virtue of Greenland).

Definition in Arctic Research and Policy Act of 1984

Section 112 of the Arctic Research and Policy Act of 1984 (Title I of P.L. 98-373 of July 31, 1984[4]) defines the Arctic as follows:

> As used in this title, the term "Arctic" means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers [in Alaska]; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain.

This definition, which is codified at 15 U.S.C. 4111,[5] includes certain parts of Alaska below the Arctic Circle, including the Aleutian islands and portions of central and western mainland Alaska, such as the Seward Peninsula and the Yukon Delta.

Other Definitions

Other definitions of the Arctic are based on factors such as average temperature, the northern tree line, the extent of permafrost on land, the extent of sea ice on the ocean, or jurisdictional or administrative boundaries.[6] A definition based on a climate-related factor could circumscribe differing areas over time as a result of climate change.

The 10° C isotherm definition of the Arctic defines the region as the land and sea area in the northern hemisphere where the average temperature for the warmest month (July) is below 10° Celsius, or 50° Fahrenheit. This definition results in an irregularly shaped Arctic region that excludes some land and sea areas north of the Arctic Circle but includes some land and sea areas south of the Arctic Circle. This definition currently excludes all of Finland and Sweden, as well as

[2] On November 25, 2008, voters in Greenland approved a referendum for greater autonomy that some observers view as a step toward eventual independence from Denmark. (Alan Cowell, "Greenland Vote Favors Independence," *New York Times*, November 26, 2008.)

[3] For more on the Arctic Council on the Internet, see http://www.arctic-council.org/.

[4] Title II of P.L. 98-373 is the National Critical Materials Act of 1984.

[5] As codified, the definition reads, "As used in this chapter...."

[6] For discussions and (in some cases) maps, see Susan Joy Hassol, *Impacts of a Warming Arctic* [Executive Summary]. Cambridge, Cambridge University Press, 2004, p. 4. Available online at http://amap.no/acia/; Oran R. Yong and Niels Einarsson, *Arctic Human Development Report*, Stefansson Arctic Institute, Akureyri, Iceland, 2004, pp. 17-18, available online at http://www.svs.is/AHDR/AHDR%20chapters/English%20version/Chapters%20PDF.htm; and Hugo Ahlenius, editor in chief, et al. *Vital Arctic Graphics, People and Global Heritage on Our Last Wild Shores*, UNEP/GRID-Arendal, Arendal, Norway, p. 6, available online at http://www.grida.no/publications/vg/arctic/.

some of Alaska above the Arctic Circle, while including virtually all of the Bering Sea and Alaska's Aleutian Islands.[7]

The definition of the Arctic adopted by the Arctic Monitoring and Assessment Programme (AMAP)—a working group of the Arctic Council—"essentially includes the terrestrial and marine areas north of the Arctic Circle (66°32' N), and north of 62° N in Asia and 60° N in North America, modified to include the marine areas north of the Aleutian chain, Hudson Bay, and parts of the North Atlantic, including the Labrador Sea."[8] The AMAP website includes a map showing the Arctic Circle, 10° C isotherm, tree line, and AMAP definitions of the Arctic.[9]

Some observers use the term "high north" as a way of referring to the Arctic. Some observers make a distinction between the "high Arctic"—meaning, in general, the colder portions of the Arctic that are closer to the North Pole—and other areas of the Arctic that are generally less cold and further away from the North Pole, which are sometimes described as the low Arctic or the subarctic.

U.S. Arctic Research

Arctic Research and Policy Act of 1984, As Amended

The Arctic Research and Policy Act of 1984 (Title I of P.L. 98-373 of July 31, 1984[10]) "provide[s] for a comprehensive national policy dealing with national research needs and objectives in the Arctic."[11] The act, among other things

- made a series of findings concerning the importance of the Arctic and Arctic research;
- established the U.S. Arctic Research Commission (USARC) to promote Arctic research and recommend Arctic research policy;
- designated the National Science Foundation (NSF) as the lead federal agency for implementing Arctic research policy;
- established the Interagency Arctic Research Policy Committee (IARPC) to develop a national Arctic research policy and a five-year plan to implement that policy, and designated the NSF representative on the IARPC as its chairperson;[12] and

[7] A map showing the line that results from 10° isotherm definition is available online at https://www.cia.gov/library/publications/the-world-factbook/reference_maps/pdf/arctic.pdf.

[8] Discussion entitled "Geographical Coverage," available online at http://www.amap.no/ (click on "About AMAP" and then the tab "Geographical coverage.")

[9] Discussion entitled "Geographical Coverage," available online at http://www.amap.no/ (click on "About AMAP" and then the tab "Geographical coverage.")

[10] Title II of P.L. 98-373 is the National Critical Materials Act of 1984.

[11] These words are taken from the official title of P.L. 98-373. (Arctic Research and Policy Act of 1984 is the short title of Title I of P.L. 98-373.) The remainder of P.L. 98-373's official title relates to Title II of the act, the short title of which is the National Critical Materials Act of 1984.)

[12] The IARPC currently includes more than a dozen federal agencies, departments, and offices. Additional information on the IARPC is available on the Internet at http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp.

- defined the term "Arctic" for purposes of the act.

The Arctic Research and Policy Act of 1984 was amended by P.L. 101-609 of November 16, 1990. For the texts of the Arctic Research and Policy Act of 1984 and P.L. 101-609, see **Appendix A** and **Appendix B**, respectively.

NSF FY2011 Budget Request For Arctic Research

NSF—the lead federal agency for implementing Arctic research policy (see "Arctic Research and Policy Act of 1984, As Amended")—carries out Arctic research activities through its Division of Arctic Sciences (ARC), which forms part of NSF's Office of Polar Programs (OPP). NSF is requesting a total of $527.99 million for OPP for FY2011, including $111.36 million for ARC and $54.0 million for U.S. Coast Guard polar icebreaker operations and maintenance in support of Arctic and Antarctic research activities.[13] NSF states in its budget request that

> OPP provides primary U.S. support for fundamental research in polar regions through several mechanisms. In addition, NSF provides interagency leadership for U.S. activities in polar regions. In the Arctic, NSF leads research planning as directed by the Arctic Research Policy Act of 1984. The NSF Director chairs the Interagency Arctic Research Policy Committee created for this purpose....
>
> Research in polar regions addresses critical aspects of the global earth system – glacial and sea ice, permafrost, terrestrial and marine ecosystems, the ocean, and the atmosphere – that help shape the global environment and climate. This work addresses the Administration's focus on making the U.S. a world leader on climate change and builds on a foundation established during the International Polar Year (IPY) 2007-2009.... Research in polar regions also offers opportunities for fundamental advances in each of the disciplinary sciences, ranging from the behavior of the Earth's inner core, the formation of galaxies, the biology of life in the cold and dark, and how Arctic residents and institutions are affected by environmental change.
>
> The Administration is assessing the overarching issues facing the Arctic, including those associated with impacts of climate change, increased human activity, new or additional information needs, and conservation of Arctic resources. This approach will necessarily include identifying implementation issues associated with the U.S. Arctic Policy released in January 2009.[14]

Regarding the $111.36 million requested for ARC for FY2011, NSF states

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[13] National Science Foundation, *FY 2011 Budget Request to Congress*, February 1, 2010, p. OPP-1 (pdf page 167 of 458). Regarding the $54.0 million requested for U.S. Coast Guard polar icebreaker operations and maintenance, NSF states:

> This budget line item funds the operation and maintenance of the [Coast Guard polar icebreaker] Polar Sea and the [Coast Guard polar icebreaker] Healy in support of NSF science and, on a reimbursable basis, the needs of other federal agencies. The U.S. Coast Guard estimates that $54.0 million will be needed to fund operation and maintenance of the two vessels in FY 2011, which includes significant funding for a triennial dry dock for each vessel.
>
> (National Science Foundation, *FY 2011 Budget Request to Congress*, February 1, 2010, p. OPP-16 (pdf page 182 of 458).)

[14] National Science Foundation, *FY 2011 Budget Request to Congress*, February 1, 2010, p. OPP-2 (pdf page 168 of 458).

> ARC is organized into several programs that support research in social science, earth system science, and a broad range of natural science. Educational projects are also supported. The Research Support & Logistics program assists researchers with access to the Arctic, improves safety and environmental stewardship, and increases the ability of researchers to share plans and results with local Arctic communities.... Arctic Sciences funds a broad range of activities to provide an integrated understanding of environmental change in the Arctic, including study of significant, system-scale environmental change and its human dimension.[15]

NSF's FY2011 budget also requests $1.6 million to fund the operations of USARC.[16]

January 2009 Presidential Arctic Policy Directive

On January 12, 2009, the George W. Bush Administration released a presidential directive establishing a new U.S. policy for the Arctic region. The directive, dated January 9, 2009, was issued as National Security Presidential Directive 66/Homeland Security Presidential Directive 25 (NSPD 66/HSPD 25). The directive was the result of an interagency review, and it superseded for the Arctic (but not the Antarctic) a 1994 presidential directive on Arctic and Antarctic policy. The directive, among other things,

- states that the United States is an Arctic nation, with varied and compelling interests in the region;
- sets forth a six-element overall U.S. policy for the region;
- describes U.S. national security and homeland security interests in the Arctic; and
- discusses a number of issues as they relate to the Arctic, including international governance; the extended continental shelf and boundary issues; promotion of international scientific cooperation; maritime transportation; economic issues, including energy; and environmental protection and conservation of natural resources.

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[15] National Science Foundation, *FY 2011 Budget Request to Congress*, February 1, 2010, p. OPP-9 (pdf page 175 of 458).

[16] Regarding this request, NSF states:

> USARC was created by the Arctic Research and Policy Act of 1984, (as amended, P.L. 101-609), to establish the national policy, priorities, and goals necessary to construct a federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences. This request provides funds to promote Arctic research, to recommend Arctic research policy, and to communicate research and policy recommendations to the rest of the Administration and the Congress, as well as supporting close collaboration with the National Science Foundation (NSF) as the lead agency responsible for implementing Arctic research policy and supporting cooperation and collaboration throughout the Federal Government. In addition, USARC gives guidance to the Interagency Arctic Research Policy Committee (IARPC) to develop national Arctic research projects and a five-year plan to implement those projects. USARC also supports interaction with Arctic residents, international Arctic research programs and organizations, and local institutions, including regional governments, in order to obtain the broadest possible view of Arctic research needs. USARC is an independent federal agency, funded through NSF's appropriations, specifically as an activity in the Research and Related Activities account.
>
> (National Science Foundation, *FY 2011 Budget Request to Congress*, February 1, 2010, p. USARC-1 [pdf page 189 of 458]. Additional information about USARC is available on the Internet at http://www.arctic.gov.)

The Obama Administration has not issued a new directive superseding NSPD 66/HSPD 25; it is currently operating under the Bush Administration's policy directive.[17] For the text of NSPD 66/HSPD 25, see **Appendix C**.

May 2010 National Security Strategy

In May 2010, the Obama Administration released a national security strategy document, which states:

> The United States is an Arctic Nation with broad and fundamental interests in the Arctic region, where we seek to meet our national security needs, protect the environment, responsibly manage resources, account for indigenous communities, support scientific research, and strengthen international cooperation on a wide range of issues.[18]

The Arctic and the U.N. Convention on Law of the Sea (UNCLOS)[19]

Background to UNCLOS

In November 1994, the United Nations Convention on the Law of the Sea (UNCLOS) entered into force. This convention establishes a treaty regime to govern activities on, over, and under the world's oceans. It builds on the four 1958 law of the sea conventions and sets forth a framework for future activities in parts of the oceans that are beyond national jurisdiction.[20] The 1982 Convention and its 1994 Agreement relating to Implementation of Part XI of the Convention were transmitted to the Senate on October 6, 1994.[21] In the absence of Senate advice and consent to adherence, the United States is not a party to the convention and agreement.

Part VI of UNCLOS and Commission on Limits of Continental Shelf

Part VI of the convention, dealing with the Continental Shelf, and Annex II, which established a Commission on the Limits of the Continental Shelf, are most pertinent to the Arctic as it becomes more accessible ocean space, bordered by five coastal states.[22] The convention gives the coastal state sovereign jurisdiction over the resources, including oil and gas, of its continental shelf.[23]

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[17] CRS communication with State Department official, October 8, 2010.

[18] *National Security Strategy*, Washington, May 2010, p. 50. The quoted sentence constitutes the entirety of the document's comments specifically on the Arctic. It is the final sentence of a section on "sustain[ing] broad cooperation on key global challenges" that includes longer discussions on climate change, peacekeeping and armed conflict, pandemics and infectious disease, transnational criminal threats and threats to governance, and safeguarding the global commons.

[19] This section prepared by Marjorie Ann Browne, Specialist in International Relations, Foreign Affairs, Defense, and Trade Division.

[20] The United States is party to the four conventions adopted in 1958: Convention on the Territorial Sea and the Contiguous Zone, Convention on the High Seas, Convention on the Continental Shelf, and Convention on Fishing and Conservation of the Living Resources of the High Seas.

[21] Treaty Document 103-39.

[22] Other relevant provisions of the Convention, applicable depending on the extent of Arctic melting, relate to navigation, high seas freedoms, fisheries, and exclusive economic zones.

[23] The continental shelf is the under-sea extension of a coastal state's land territory. Article 76 of the Convention defines the continental shelf, *inter alia*, as "the seabed and subsoil of the submarine areas that extend beyond its (continued...)

Under Article 76 of the convention, a coastal state with a broad continental margin may establish a shelf limit beyond 200 nautical miles. This jurisdiction is subject to the submission of the particulars of the intended limit and supporting scientific and technical data by the coastal state to the commission for review and recommendation.[24] The commission reviews the documentation and, by a two-thirds majority, approves its recommendations to the submitting state. Coastal states agree to establish the outer limits of their continental shelf, in accordance with this process and with their national laws. In instances of disagreement with the commission's recommendations, the coastal state may make a revised or new submission. The actions of the commission "shall not prejudice matters relating to delimitation of boundaries between States with opposite or adjacent coasts."[25] The "limits established by a coastal State on the basis of these recommendations shall be final and binding."[26]

U.S. Activities As a Non-Party to UNCLOS

As a non-party to the convention, the United States cannot participate as a member of the commission; it cannot submit a claim under Article 76. Over the years, however, it has submitted observations on submissions made by other states, requesting that those observations be made available online and to the commission. In addition, since 2001, the United States has gathered and analyzed data to determine the outer limits of its extended continental shelf. Starting in 2007, this effort became the Extended Continental Shelf Project, directed by an interagency task force under the lead of the Department of State.[27]

Some observers have suggested that a separate regime be negotiated to address the changing circumstances in the Arctic. They maintain that this phenomenon was not envisioned at the time the Law of the Sea Convention was negotiated. Still others suggest that the Arctic region above a certain parallel be designated a wilderness area, and they cite as precedent Article 4 of The Antarctic Treaty, under which any current claims to sovereign territory are frozen and

> No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antarctica or create any rights of sovereignty in Antarctica. No new claim, or enlargement of an existing claim, to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force.

Supporters of the Law of the Sea Convention maintain that changing circumstances in the Arctic strengthen their argument that the United States should become a party to the convention. In this way, they argue, the United States can be best situated to protect and serve its national interests, under both Article 76 and other parts of the convention.

(...continued)

[coastal state's] territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin."

[24] A coastal State party has 10 years from the entry into force of the Convention for submission of information on its proposed limits. In May 2001, the Meeting of States Parties to the Convention decided that for any State for which the Convention entered into force before May 13, 1999, the date of commencement of the 10-year time period for making submissions to the Commission is May 13, 1999.

[25] Annex II, Article 9. Article 83 of the Convention provides that questions relating to these boundary delimitation disputes shall be resolved by agreement between the States or by the Dispute Settlement options set forth in Part XV of the Convention.

[26] Article 76, para. 8.

[27] For more information, see http://www.state.gov/g/oes/continentalshelf/index.htm.

Issues for Congress

Climate Change and Loss of Arctic Sea Ice[28]

Record low extent of Arctic sea ice in 2007 focused scientific and policy attention on its linkage to global climate change, and to the implications of projected ice-free[29] seasons in the Arctic within decades. The Arctic has been projected by several scientists to be ice-free in the late summer in most years as soon as the late 2030s.[30] This opens opportunities for transport through the Northwest Passage and the Northern Sea Route, extraction of potential oil and gas resources, and expanded fishing and tourism (**Figure 1**). Loss of Arctic sea ice could also impact traditional livelihoods and cultures in the region and survival of polar bear and other animal populations, and raise risks of pollution, food supply, safety, and national security.

Like the rest of the globe, temperatures in the Arctic have varied over the past century, but show a significant warming trend, especially since the 1970s.[31] The annual average temperature for the Arctic region (from 60° to 90° N) is now about 1.8° F warmer than the average for the "climate normal" (the average from 1961 to 1990). Temperatures in October-November are now about 9° F above the seasonal normal. Scientists have concluded that most of the global warming of the last three decades is very likely caused by human-related emissions of greenhouse gases (GHG, mostly carbon dioxide); they expect the GHG-induced warming to continue for decades, even if, and after, GHG concentrations in the atmosphere have been stabilized.

Modeling of GHG-induced climate change is particularly challenging for the Arctic, but it consistently projects warming through the 21st century, with annual average Arctic temperature increases ranging from +1° to +9.0° C (+2° to +19.0° F), depending on the GHG scenario and model used. While such warming is projected by most models throughout the Arctic, some models project slight cooling localized in the North Atlantic Ocean just south of Greenland and

[28] This section prepared by Jane Leggett, Specialist in Energy and Environmental Policy, Resources, Science, and Industry Division.

[29] In scientific analyses, "ice-free" does not necessarily mean "no ice." The definition of "ice-free" or sea ice "extent" or "area" varies across studies. Sea ice "extent" is one common measure, equal to the sum of the area of grid cells that have less than a set percentage—frequently 15%—ice concentration. For more information, see the National Snow and Ice Data Center, http://nsidc.org/seaice/data/terminology.html.

[30] Muyin Wang and James E. Overland, "A Sea Ice Free Summer Arctic within 30 Years?," *Geophysical Research Letters* 36, no. L07502 (April 3, 2009): 10.1029/2009GL037820; Marika Holland, Cecilia M. Bitz, and Bruno Tremblay, "Future abrupt reductions in the summer Arctic sea ice," *Geophysical Research Letters* 33, no. L23503 (2006), http://www.cgd.ucar.edu/oce/mholland/abrupt_ice/holland_etal.pdf; David Adam, "Ice-free Arctic could be here in 23 years," *The Guardian*, September 5, 2007, http://www.guardian.co.uk/environment/2007/sep/05/climatechange.sciencenews. But see also Julien Boé, Alex Hall, and Xin Qu, "Sources of spread in simulations of Arctic sea ice loss over the twenty-first century," *Climatic Change* 99, no. 3 (April 1, 2010): 637-645; Wieslaw Maslowski, "Toward Advanced Modeling and Prediction of Arctic Sea Ice and Climate," in 2010 AAAS Annual Meeting, Session 1505, Toward Advanced Modeling and Prediction of Arctic Sea Ice and Climate, San Diego CA, February 19, 2010, http://aaas.confex.com/aaas/2010/webprogram/Paper1505.html; I. Eisenman and J. S. Wettlaufer, "Nonlinear threshold behavior during the loss of Arctic sea ice," *Proceedings of the National Academy of Sciences* 106, no. 1 (January 6, 2009): 28-32; Dirk Notz, "The Future of Ice Sheets and Sea Ice: Between Reversible Retreat and Unstoppable Loss," *Proceedings of the National Academy of Sciences* 106, no. 49 (December 8, 2009): 20590-20595.

[31] There was a regionally warm period in the Arctic from the mid-1920s to around 1940, which scientists have assessed to have been driven by natural climate variability. They have found that period to be distinctly different from the recent multi-decadal warming, in part because the current warmth is global.

Iceland. Most warming would occur in autumn and winter, "with very little temperature change projected over the Arctic Ocean" in summer months.[32]

The observed warmer temperatures in the Arctic have reduced sea ice extent and thickness, and the amount of ice that persists year-round ("perennial ice"); natural climate variability has likely contributed as well, such as in the record low ice extent of 2007. The 2007 record minimum sea ice extent was influenced by warm Arctic temperatures and warm, moist winds blowing from the North Pacific into the central Arctic, contributing to melting and pushing ice toward and into the Atlantic past Greenland. Warm winds did not account for the near-record sea ice minimum in 2008.[33]

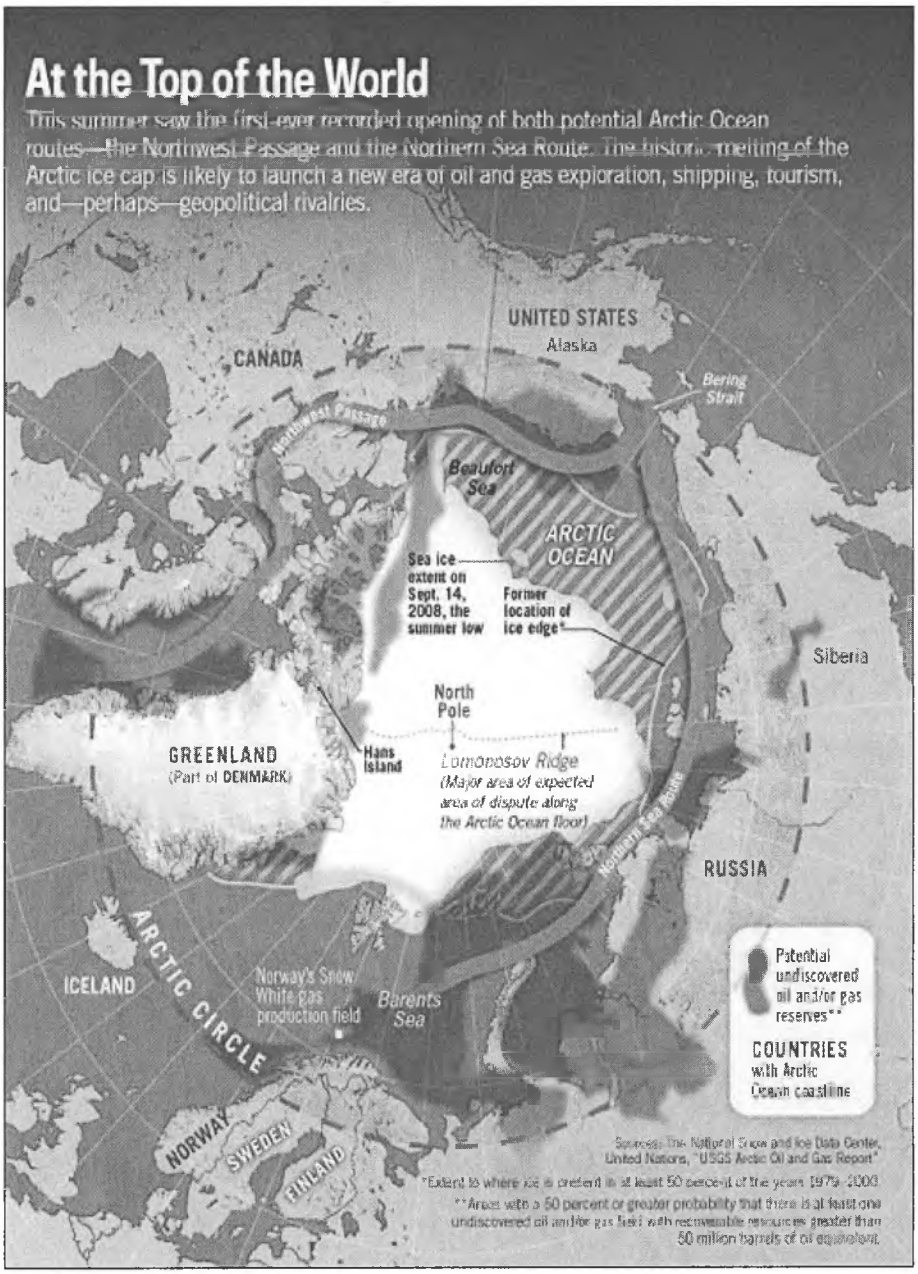
Due to observed and projected climate change, scientists have concluded that the Arctic will have changed from an ice-covered environment to a recurrent ice-free[34] ocean (in summers) as soon as the late 2030s. The character of ice cover is expected to change as well, with the ice being thinner and more fragile. The variability from year to year of both ice quantity and location could be expected to continue.

[32] William L. Chapman and John E. Walsh, "Simulations of Arctic Temperature and Pressure by Global Coupled Models," *Journal of Climate* 20, no. 4 (February 1, 2007): 609-632.

[33] J. Overland, J. Walsh, and M. Wang, *Arctic Report Card - Atmosphere* (NOAA Arctic Research Program, October 6, 2008), http://www.arctic.noaa.gov/reportcard/atmosphere.html.

[34] See footnote 29. Also, although one Canadian scientist has predicted that recurrent ice-free summers may begin sometime between 2013 and 2020, this is not consistent with other climate models' projections.

Figure 1. Arctic Sea Ice Extent in September 2008, Compared with Prospective Shipping Routes and Oil and Gas Resources



Source: Graphic by Stephen Rountree at *U.S. News and World Report*, http://www.usnews.com/articles/news/world/2008/10/09/global-warming-triggers-an-international-race-for-the-artic/photos/#1.

Territorial Claims and Sovereignty Issues[35]

Motivated in part by a desire to exercise sovereign control over the Arctic region's increasingly accessible oil and gas reserves (see "Oil, Gas, and Mineral Exploration"), the four Arctic coastal states other than the United States—Canada, Russia, Norway, and Denmark (of which Greenland is a territory)—are in the process of preparing territorial claims in the Arctic, including claims for expanded Exclusive Economic Zones (EEZs), for submission to the Commission on the Limits of the Continental Shelf. (As mentioned earlier—see "U.S. Activities As a Non-Party to UNCLOS"—the United States, as a non-party to UNCLOS, cannot participate as a member of the commission; it cannot submit a claim under Article 76. Over the years, however, it has submitted observations on submissions made by other states, requesting that those observations be made available online and to the commission. In addition, since 2001, the United States has gathered and analyzed data to determine the outer limits of its extended continental shelf.)

Russia has been attempting to chart the Arctic Ocean's enormous underwater Lomonosov Ridge in an attempt to show that it is an extension of Russia's continental margin. The Russian claim to this ridge, if accepted, would reportedly grant Russia nearly one-half of the Arctic area; a 2001 claim submitted by Russia was rejected as insufficiently documented. Canada also claims a portion of the Lomonosov Ridge as part of its own underwater continental shelf.[36] In August 2007, a Russian submersible on a research expedition deposited an encased Russian Federation flag on the seabed of the presumed site of the North Pole. The action captured worldwide attention, but analysts note that it did not constitute an official claim to the territory and was therefore a purely symbolic act.

At a May 2008 meeting in Ilulissat, Greenland, the five Arctic coastal states reaffirmed their commitment to the UNCLOS legal framework for the establishment of extended continental shelf limits in the Arctic.[37] (For further discussion, see "Extent of the Continental Margin" in "Oil, Gas, and Mineral Exploration.")

In addition to this process, there are four unresolved Arctic territorial disputes:

- Scientists have forecast that in coming decades, global warming will reduce the ice pack in Canada's northern archipelago sufficiently to permit ships to use the trans-Arctic shipping route known as the Northwest Passage during the summer months (see "Commercial Sea Transportation"). The prospect of such traffic raises a major jurisdictional question. Ottawa maintains that such a passage would be an inland waterway, and would therefore be sovereign Canadian territory subject to Ottawa's surveillance, regulation, and control. The United States, the European Union, and others assert that the passage would constitute an international strait between two high seas.
- The United States and Canada are negotiating over a binational boundary in the Beaufort Sea.

[35] This section prepared by Carl Ek, Specialist in International Relations, Foreign Affairs, Defense, and Trade Division.

[36] "Russia, Canada Make Competing Claims To Arctic Resources," *The Canadian Press*, September 16, 2010.

[37] "5 Countries Agree To Talk, Not Compete, Over the Arctic," *New York Times*, May 29, 2008.

- The United States and Russia in 1990 signed an agreement regarding a disputed area of the Bering Sea; the U.S. Senate ratified the pact the following year, but the Russian *Duma* has yet to approve the accord.
- Denmark and Canada disagree over which country has the territorial right to Hans Island, a tiny, barren piece of rock between Greenland and Canada's Ellesmere Island. Some analysts believe the two countries are vying for control over a future sea lane that might be created if the Arctic ice were to melt sufficiently to create a Northwest Passage. Others claim that the governments are staking out territorial claims in the event that future natural resource discoveries make the region economically valuable.[38]

In addition to these disputes, Norway and Russia had been at odds for decades over the boundary between the two in the so-called "Grey Zone" in the Barents Sea, an area believed to hold rich undersea deposits of petroleum. On September 15, 2010, Norwegian Prime Minister Jens Stoltenberg and Russian President Dmitry Medvedev signed an agreement in Murmansk, a Russian city near the Norwegian border. The accord awards roughly half of the 175,000 square kilometer area to each country; it spells out fishing rights, and provides for the joint development of future oil and gas finds that straddle the boundary line. Some observers believe it is noteworthy that Russia would concede sovereignty over such a large, resource-rich territory to a small, neighboring country. But others have noted that Moscow may be hoping for Norwegian cooperation in developing offshore resources, and eventually in winning approval when Russia submits its Article 76 UNCLOS claim.[39]

In August 2010, Canadian Foreign Minister Lawrence Cannon announced a new "Statement of Canada's Arctic Policy," which reaffirmed the government's commitment to Canada's sovereignty in the region, to economic and social development, to environmental protection, and to empowerment of the peoples in the north. The statement also emphasized the government's intention to negotiate settlements to its disputes with the United States over the Beaufort Sea boundary, and with Denmark over Hans Island. Minister Cannon declared that "making progress on outstanding boundary issues will be a top priority."[40]

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[38] For additional information, see Natalie Mychajlyszyn, *The Arctic: Geopolitical Issues*, Canadian Library of Parliament, October 24, 2008.

[39] "Russia, Norway Sign Deal On Barents Sea Border, Seek More Development in Mineral-rich Arctic," *Associated Press*, September 15, 2010.

[40] Cannon quoted in "Canada Seeks To Settle Arctic Borders," *Agence France Presse*, August 20, 2010. For additional information concerning Canada's August statement on Arctic policy, see "Statement on Canada's Arctic foreign policy: Exercising sovereignty and promoting Canada's Northern Strategy abroad," Foreign Affairs and International Trade Canada website, http://www.international.gc.ca/polar-polaire/canada_arctic_foreign_policy-la_politique_etrangere_du_canada_pour_arctique.aspx?lang=eng.

Commercial Sea Transportation[41]

Background

The search for a shorter route from the Atlantic to Asia has been the quest of maritime powers since the Middle Ages. The melting of Arctic ice raises the possibility of saving several thousands of miles and several days of sailing between major trading blocs.[42] If the Arctic were to become a viable shipping route, the ramifications could extend far beyond the Arctic. For example, lower shipping costs could be advantageous for China (at least its northeast region), Japan, and South Korea because their manufactured products exported to Europe or North America could become less expensive relative to other emerging manufacturing centers in Southeast Asia, such as India.[43] Melting ice could potentially open up two trans-Arctic routes (see **Figure 1**):[44]

- **The Northern Sea Route** (NSR, a.k.a. the "Northeast Passage"), along Russia's northern border from Murmansk to Provideniya, is about 2,600 nautical miles in length. It was opened by the Soviet Union to shipping in 1931 but was not opened to the rest of the world until 1991. Even so, these waters are little used by non-Russian ships.[45] This route would be applicable for trade between northeast Asia (north of Singapore) and northern Europe.
- **The Northwest Passage** (NWP) runs through the Canadian Arctic Islands. The NWP actually consists of several potential routes. The southern route is through Peel Sound in Nunavut, which has been open the past three summers and contains mostly one-year ice. However, this route is circuitous, contains some narrow channels, and is shallow enough to impose draft restrictions on ships. The more northern route, through McClure Strait from Baffin Bay to the Beaufort Sea north of Alaska, is much more direct, and therefore more appealing to ocean carriers, but more prone to ice blockage.[46] The NWP is potentially applicable for trade between northeast Asia (north of Shanghai) and the northeast of North America, but is considered by many to be less commercially viable than the NSR.[47]

[41] This section prepared by John Frittelli, Specialist in Transportation Policy, Resources, Science, and Industry Division. Vanessa Cieslak, Information Research Specialist, Knowledge Services Group, assisted in compiling information for the background part of this section.

[42] Extended daylight hours in the Arctic during the summer may also be an advantage.

[43] Presentation by Stephen Carmel, Senior Vice President, Maersk Line Ltd., Halifax International Security Forum, *Arctic Security: The New Great Game?* November 21, 2009, available at http://fora.tv/.

[44] A third but more remote possibility is a route directly over the North Pole.

[45] In the summer of 2009, two German-owned ships are believed to be the first non-Russian ships to transit the NSR, sailing from Korea to deliver oil-service equipment to the Russian Arctic and then sailing on to Rotterdam.

[46] This was the route pioneered by the *SS Manhattan*, an oil tanker modified for ice breaking in 1969 to carry Alaskan North Slope oil to the Atlantic. This was the first commercial passage through the NWP, but the building of the Alaskan pipeline was found to be the more economical means of transporting oil from the North Slope to the lower 48 states.

[47] Although the NWP is often compared to the alternative route through the Panama Canal in terms of distance and sailing days from Asia to the U.S. east coast, another alternative to consider is the shorter and faster transcontinental rail route across Canada or the United States.

Destination Traffic, Not Trans-Arctic Traffic

Almost all cargo ship activity currently taking place in the Arctic is to transport natural resources from the Arctic or to deliver general cargo and supplies to communities and natural resource extraction facilities. Thus, cargo ship traffic in the Arctic presently is mostly regional, not trans-Arctic. While there has been a recent uptick in Arctic shipping activity, this activity has more to do with a spike in commodity prices than it does with the melting of Arctic ice. Even so, recent activity is less than it has been in the past. The NSR continues to account for the bulk of Arctic shipping activity. The western end of the NSR, in the Barents Sea, is open year round. Further east, sections of the NSR are open for as little as two and a half months during the summer. From Murmansk, oil is transported to Europe, as well as ore and timber, while general cargo and fuel are delivered to the port by ship. Nickel and copper are also shipped from the northern coast of Russia. Coal has been shipped from Svalbard to Europe for almost a century. The Murmansk Shipping Company keeps the NSR route open with nuclear powered icebreakers. It is partially owned by LukOil, which has a fleet of ice-strengthened oil tankers. Norilsk Nickel, a large producer of nickel, is also a large shipper in NSR and is currently building five reinforced cargo vessels. In NWP waters, general cargo is shipped along Alaska's north coast between Point Barrow and Prudhoe Bay and zinc is shipped from the Red Dog Mine in Alaska. Crude oil tankers load at Bent Horn and Cameron Island in the Canadian Arctic.

Cruise Ship Activity

Considerable cruise ship activity takes place in Arctic waters. In the summer of 2007, three cruise ships reportedly sailed through the NWP from the Atlantic to Alaska's North Slope.[48] In the Barents Sea, there are regular cruise ships sailing to Svalbard. The inherent dangers for passenger ships in the Arctic have prompted calls for international regulations promoting the safety of cruise ships in the area. Some have suggested that cruise ships sail in pairs to provide assistance to one another, given the Arctic's remoteness and the difficulty land based rescuers would have in reaching a vessel in distress.[49] Requiring that Arctic cruise vessels have ice-strengthened hulls and be equipped with enclosed lifeboats could be other safety requirements. In 2003, some Arctic cruise and tourist operators formed the Association of Arctic Expedition Cruise Operators (AECO) to establish agreed-upon safety and environmental protection guidelines, but this organization only covers the portion of the Arctic around Greenland, Svalbard, and Jan Mayen.[50]

Unpredictable Ice Conditions Hinder Trans-Arctic Shipping

Arctic waters do not necessarily have to be ice free to be open to shipping. Multiyear ice can be over 10 feet thick and problematic even for icebreakers, but one-year ice is typically three feet thick or less. This thinner ice can be more readily broken up by icebreakers or ice class ships. However, more open water in the Arctic has resulted in another potential obstacle to shipping, namely unpredictable ice flows. In the NWP, melting ice and the opening of waters that were once covered with one-year ice has allowed blocks of multiyear ice from farther north, or icebergs from Greenland, to flow into potential sea lanes. The source of this multiyear ice is not predicted to dissipate in spite of climate change. Moreover, the flow patterns of these ice blocks

[48] "U.S. Needs to Prepare for Arctic Traffic Surge," *Anchorage Daily News*, February 12, 2008, p. A4.

[49] "Northern Waters," *The Globe and Mail* (Canada), August 14, 2008, p. A8.

[50] See http://www.aeco.no/index.htm for more information.

are very difficult to predict, and they have blocked potential routes for shipping.[51] Thus, the lack of ice in potential sea lanes during the summer months can add even greater unpredictability to Arctic shipping. This is in addition to the extent of ice versus open water, which is also highly variable from one year to the next and seasonally. As mentioned above, "ice free" does not mean "no ice" and the presence of even small blocks of ice or icebergs from a melting Greenland ice sheet requires slow sailing.

The unpredictability of ice conditions is a major hindrance for trans-Arctic shipping in general, but can be more of a concern for some types of ships than it is for others. For instance, it would be less of a concern for cruise ships, which may have the objective of merely visiting the Arctic rather than passing through the Arctic and could change their route and itinerary depending on ice conditions. On the other hand, unpredictability is of the utmost concern for container ships that carry thousands of containers from hundreds of different customers, all of whom expect to unload or load their cargo upon the ship's arrival at various ports as indicated on the ship's advertised schedule. Other ships carrying entirely one commodity in bulk from one port to another for just one customer could have more flexibility in terms of a delivery window, but would not likely risk an Arctic passage under prevailing conditions.

Ice is not the sole impediment to Arctic shipping. Adverse weather is also an impediment. This includes not only severe storms, but also intense cold, which can impair deck machinery. During the summer months when shipping is most likely to occur, heavy fog is most common in the Arctic. Operating costs are higher in the Arctic. Ship size is an important factor in reducing freight costs, and many ships sailing in other waters would require two icebreakers to break a path wide enough for them to sail through.[52] Also, icebreakers or ice-class cargo vessels burn more fuel than is required to sail through open water and ships would have to sail at slower speeds. The shipping season in the Arctic only lasts for a few weeks. Icebreakers and other special required equipment would sit idle the remainder of the year. None of these impediments by themselves may be enough to discourage Arctic passage but they do raise costs, perhaps enough to negate the savings of a shorter route. Thus, from a shipper's perspective, shorter via the Arctic does not necessarily mean cheaper and faster.[53]

Basic Navigation Infrastructure Is Lacking

Considerable investment in navigation-related infrastructure would be required if trans-Arctic shipping were to become a reality. Channel marking buoys and other floating visual aids are not possible in Arctic waters because moving ice sheets will continuously shift their positions. Therefore, marine surveys and ice charts would need to be relied on exclusively. For some areas in the Arctic, however, these surveys and charts are out of date and not sufficiently accurate.[54] To remedy this problem, aviation reconnaissance of ice conditions and satellite images would need to

[51] S.E.L. Howell and J.J. Yackel, "A Vessel Transit Assessment of Sea Ice Variability in the Western Arctic, 1969-2002: Implications for Ship Navigation," *Canadian Journal of Remote Sensing*, vol. 30, no. 2, 2004.

[52] "Arctic Unlikely to See Major Shipping Growth," *New Zealand Transport and Logistics Business Week*, April 24, 2008.

[53] Presentation by Stephen Carmel, Senior Vice President, Maersk Line Ltd., Halifax International Security Forum, *Arctic Security: The New Great Game?* November 21, 2009, available at http://fora.tv/.

[54] In July and August 2010, NOAA is surveying the Bering Straits area in order to update its charts but states that it will take more than 25 years to map the prioritized areas of navigational significance in U.S. Arctic waters. See http://www.noaanews.noaa.gov/stories2010/20100720_fairweather.html.

become readily available for ship operators.[55] Ship-to-shore communication infrastructure would need to be installed where possible. Refueling stations may be needed, as well as, perhaps, transshipment ports where cargo can be transferred to and from ice capable vessels at both ends of Arctic routes. Shipping lines would need to develop a larger pool of mariners with ice navigation experience. Marine insurers would need to calculate the proper level of risk premium for polar routes, which would require more detailed information about Arctic accidents and incidents in the past.

Regulation of Arctic Shipping

Due to the international nature of the shipping industry, maritime trading nations have adopted international treaties that establish standards for ocean carriers in terms of safety, pollution prevention, and security. These standards are agreed upon by shipping nations through the International Maritime Organization (IMO), a United Nations agency that first met in 1959.[56] Key conventions that the 168 IMO member nations have adopted include the Safety of Life at Sea Convention (SOLAS), which was originally adopted in response to the Titanic disaster in 1912 but has since been revised several times; the Prevention of Pollution from Ships (MARPOL), which was adopted in 1973 and modified in 1978; and the Standards for Training, Certification, and Watchkeeping for Seafarers (SCTW), which was adopted in 1978 and amended in 1995. It is up to ratifying nations to enforce these standards. The United States is a party to these conventions and the U.S. Coast Guard enforces these regulations when it boards and inspects ships and crews arriving at U.S. ports and the very few ships engaged in international trade that sail under the U.S. flag. Like the United States, most of the other major maritime trading nations lack the ability to enforce these regulations as a "flag state" because much of the world's merchant fleet is registered under so-called "flags of convenience." While most ship owners and operators are headquartered in developed countries, they often register their ships in Panama, Liberia, the Bahamas, the Marshall Islands, Malta, and Cyprus, among other "open registries," because these nations offer more attractive tax and employment regulatory regimes. Because of this development, most maritime trading nations enforce shipping regulations under a "port state control" regime—that is, they require compliance with these regulations as a condition of calling at their ports. The fragmented nature of ship ownership and operation can be a further hurdle to regulatory enforcement. It is common for cargo ships to be owned by one company, operated by a second company (which markets the ship's space), and managed by a third (which may supply the crew and other services a ship requires to sail), each of which could be headquartered in different countries.

Arctic Guidelines

While SOLAS and other IMO conventions include provisions regarding the operation of ships in ice-infested waters, they are not specific to the polar regions. To supplement existing requirements, in December 2002, the IMO approved guidelines for ships operating in Arctic ice-covered waters.[57] These are only recommendations for ships operating in the Arctic, not requirements. They apply to passenger and cargo ships of 500 gross tons or more engaged in international voyages. They do not apply to fishing vessels, military vessels, pleasure yachts, and

[55] Ice reporting that currently exists is intended for scientists not mariners.

[56] See http://www.imo.org/ for more information.

[57] See MSC/Circ. 1056/MEPC/Circ.399 at http://www.imo.org/.

smaller cargo ships. The guidelines are intended to improve safety and prevent pollution in the Arctic, and they include provisions on ship construction, ship equipment related to navigation, and crew training and ship operation. The guidelines recommend that ships carry fully enclosed lifeboats or carry tarpaulins to cover their lifeboats. They recommend that the crew include at least one ice navigator with documented evidence of having completed an ice navigation training program.

Nations can enforce additional requirements on ships arriving at their ports or sailing through their coastal waters. For instance, U.S. Coast Guard regulations largely follow IMO conventions but mandate additional requirements in some areas. U.S. coastal states can require ships calling at their ports to take additional safety and pollution prevention safeguards. Canada and Russia have additional pollution regulations for Arctic waters exceeding MARPOL. The U.S. Coast Guard is seeking agreement with Russia to establish a vessel traffic separation scheme for the strait between Alaska and Russia. The United States and Canada have set up a unique cooperative arrangement in governing the St. Lawrence Seaway System that some suggest could serve as a model for multinational regulation of Arctic shipping.

Regardless of whether it is trans-Arctic or destination shipping that increases in the region, protection of life and the environment is a concern. Among the issues for U.S. policymakers to consider are whether IMO guidelines for Arctic shipping should become mandatory, the appropriate roles of the U.S. federal government and the state of Alaska in regulating Arctic shipping, and how best to arrange a multinational framework for governing Arctic navigation.

Oil, Gas, and Mineral Exploration[58]

Changes to the Arctic brought about by warming temperatures resulting from climate change will likely allow more exploration for oil and gas offshore where the extent of summer sea ice is shrinking. Similarly, shrinking glaciers onshore could expose land containing economic deposits of gold, iron ore, or other minerals that were previously covered by glacial ice. Warming that causes permafrost to melt could also pose challenges to onshore exploration activities because ground structures, such as pipelines and other infrastructure that depend on footings sunk into the permafrost for support, could become unstable. Despite the warming temperatures, however, exploration and development in the Arctic would still be subject to harsh conditions, especially in winter, which makes it costly and challenging to develop infrastructure necessary to produce, store, and transport oil, gas, and minerals from newly discovered deposits.

Shrinking sea ice cover in the Arctic has also intensified interest in mapping the continental margins of countries with lands in the Arctic. Delineating the extent of the continental margins beyond the 200 nautical mile Exclusive Economic Zone (EEZ) under the terms of Article 76 of the U.N. Convention on the Law of the Sea (UNCLOS) could open up substantial amounts of submerged lands for development. Mapping projects are underway, by individual countries and in cooperative studies, that would be used to support national claims to submerged lands which may contain large amounts of oil, natural gas, methane hydrates, or minerals.

[58] This section prepared by Curry Hagerty, Specialist in Energy and Natural Resources Policy, Resources, Science, and Industry Division; Peter Folger, Specialist in Energy and Natural Resources Policy, Resources, Science, and Industry Division; and Marc Humphries, Analyst in Energy Policy, Resources, Science, and Industry Division.

Expiration of the annual congressional moratoria on September 30, 2008, coupled with other developments in offshore leasing activity, impacts federal policies on Arctic offshore development in a number of ways.[59] The expiration of leasing restrictions allows Outer Continental Shelf (OCS) areas where leasing has not been considered for many years to be considered for potential federal leasing activity. Other developments in offshore leasing activity include a presidential order to lift the executive restrictions on certain OCS areas to allow offshore drilling,[60] the emergence of new offshore operations (OCS renewable energy leasing in Arctic areas[61]), and the general emergence of new technologies related to OCS research and development. Diminished leasing restrictions impact OCS activity in a domestic and an international context and generally contribute to the larger debate over OCS drilling in the Arctic.

Oil and Gas

A primary driver for the increased interest in exploring for oil and gas offshore in the Arctic is the shrinking Arctic ice cap, or conversely, the growing amount of ice-free ocean in the summertime. Reduced sea ice in the summer means that ships towing seismic arrays[62] can explore previously inaccessible regions of the Arctic Ocean, Chukchi Sea, Beaufort Sea and other offshore regions for longer periods of time without risk of colliding with floating sea ice. Less sea ice over longer periods compared to previous decades also means that the seasonal window for offshore drilling in the Arctic remains open longer in the summer and increases the chances for making a discovery.

In addition to the improved access to larger portions of the Arctic afforded by shrinking sea ice, recent interest in Arctic oil and gas was fueled by a 2008 U.S. Geological Survey (USGS) appraisal of undiscovered oil and gas north of the Arctic Circle.[63] The USGS asserts that "The extensive Arctic continental shelves may constitute the geographically largest unexplored prospective area for petroleum remaining on Earth."[64] In the report, the USGS estimates that 90 billion barrels of oil, nearly 1,700 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids may remain to be discovered in the Arctic. Nearly all (84%) of the oil and gas is expected to occur offshore. The USGS estimate for total undiscovered oil and gas in the Arctic exceeds the total discovered amount of Arctic oil and oil-equivalent natural gas (240 billion

[59] The Continuing Appropriations Resolution 2009 (P.L. 110-329) did not extend the annual congressional moratorium on oil and gas leasing activities. On March 11, 2009, the Omnibus Appropriations Act, 2009 (P.L. 111-8) was enacted without moratoria provisions, confirming that the oil and gas development moratoria in the OCS along the Atlantic and Pacific Coasts, parts of Alaska, and the Gulf of Mexico that had been in place since 1982 had not been restored in 2009 appropriations measures. The combined effect of Presidential Directives from 1990 to 2008 also impacted moratoria constraints.

[60] On July 14, 2008, a Modification of the Presidential Withdrawal of areas of the United States Outer Continental Shelf from leasing disposition was announced by President Bush in the following statement, "Under the authority vested in me as President of the United States, including section 12(a) of the Outer Continental Shelf Lands Act, 43 U.S.C. 1341(a), I hereby modify the prior memoranda of withdrawals from disposition by leasing of the United States Outer Continental Shelf issued on August 4, 1992."

[61] Effective on June 29, 2009, the rule established two types of leases: (1) commercial leases for full development and power generation, and (2) limited leases for resource assessment and technology testing. See 73 Fed Reg 39376.

[62] A seismic array is typically a long string or streamer of geophones—acoustic devices used for recording seismic signals—towed behind a ship while the ship traverses a prospective oil and gas-bearing portion of the seafloor. The seismic signals are processed and interpreted to give a cross-section or three-dimensional image of the subsurface.

[63] See USGS Circum-Arctic Resource Appraisal website at http://energy.usgs.gov/arctic/.

[64] USGS Fact Sheet 2008-3049: Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle; at http://pubs.usgs.gov/fs/2008/3049/.

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barrels), which constitutes almost 10% of the world's known conventional petroleum resources.[65] An important caveat to the USGS assessment, however, is that it excludes economic considerations. The report only includes resources that would be technically recoverable with current technology; they may not necessarily be economically recoverable under prevailing oil and gas prices.

Despite the warming trend in the Arctic, a discovery of new oil and gas deposits far from existing storage, pipelines, and shipping facilities can not be developed until infrastructure is built to extract and transport the petroleum. For example, a Devon Energy spokesman noted in April 2008 that a 240 million barrel discovery in the Beaufort Sea won't be developed for at least 10 years because the company does not have the infrastructure to transport the oil.[66] Other areas with oil and gas potential, such as offshore east Greenland, may take even longer to develop because they are still covered by substantial summer sea ice that would hinder exploration and development unless more ice melts.[67]

Extent of the Continental Margin

Increased interest in developing offshore resources in the Arctic has sparked efforts by nations bordering the Arctic Ocean to map the extent of their continental margins beyond the 200-mile EEZ limit. Under UNCLOS, nations can submit a claim to submerged lands if they demonstrate that their continental margin extends beyond the 200-mile limit according to the definition in Article 76. Under Article 76, the extent of the continental margin beyond the 200-mile limit depends on the position of the foot of the continental slope, the thickness of sediments, and the depth of water. Also, the continental margin could include geologic features that extend from the continent out to sea, which may include undersea ridges continuing for hundreds of miles offshore.

As mentioned earlier—see "U.S. Activities As a Non-Party to UNCLOS"—the United States, as a non-party to UNCLOS, cannot participate as a member of the Commission on the Limits of the Continental Shelf; it cannot submit a claim under Article 76. Over the years, however, it has submitted observations on submissions made by other states, requesting that those observations be made available online and to the commission. In addition, since 2001, the United States has gathered and analyzed data to determine the outer limits of its extended continental shelf.

Arctic border countries have begun the complex investigations needed to support claims for an extended continental shelf in the Arctic. Claims have already been submitted by several countries, including the Russian Federation, which submitted its UNCLOS claim to a portion of the Arctic continental shelf in 2001.[68] Russia made claims to the Lomonosov Ridge, an undersea feature spanning the Arctic from Russia to Canada, as an extension of its continental margin. The submission demonstrated Russia's bid to extend activities in Arctic regions. The United States has

[65] USGS Fact Sheet 2008-3049: Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle; at http://pubs.usgs.gov/fs/2008/3049/.

[66] Hugo Miller, "BHP Billiton Leads Arctic Gold Hunt in Global Warming Bonanza," Bloomberg.com (April 16, 2008), at http://www.bloomberg.com/apps/news?pid=20601081&sid=ag.kQZln.mFg&refer=australia.

[67] The Associated Press, "Greenland Opens to Oil Firms; Melting Ice Unlocks Reserves," International Herald Tribune (January 14, 2008), at http://www.iht.com/articles/ap/2008/01/14/business/NA-FIN-US-Greenland-Oil-Companies.php.

[68] Tony Halpin, "President Medvedev Threatens Russian Arctic Annexation," Times Online (September 18, 2008), at http://www.timesonline.co.uk/tol/news/world/europe/article4773567.ece.

started to gather and analyze data through an initiative called the Extended Continental Shelf Project.[69] In this effort, the United States is working closely with Canada to prepare and present Canada's submission to the Commission on the Limits of the Continental Shelf.

Canada and the United States share overlapping regions of the seabed as part of the extended continental margin of both nations. Both countries have conducted research singly and jointly to map the extended continental shelf.[70] In August 2008, Canada's prime minister announced that Canada would spend $100 million (Canadian) over five years to map its total Arctic mineral and energy resources and bolster Canada's sovereignty over its northern resources.[71] On January 12, 2009, the Bush Administration issued a presidential directive addressing the extended continental shelf and boundary issues in the Arctic, among other issues, including national security and maritime transportation.[72] The directive acknowledges an unresolved boundary between the United States and Canada in the Beaufort Sea, and notes that Russia and the United States abide by a 1990 maritime boundary treaty pending its entry into force once it is ratified by the Russian Federation. According to the USGS, however, most of the potential oil and gas resources estimated for the Arctic are likely to occur within already agreed-upon territorial boundaries.[73] (For further discussion, see "Territorial Claims and Sovereignty Issues.")

Minerals

A warming Arctic means new opportunities and challenges for mineral exploration and development. Receding glaciers expose previously ice-covered land that could host economic mineral deposits that were previously undetectable and un-mineable below the ice. Longer summers would also extend exploration seasons even for areas not currently ice-covered but which are only accessible for ground surveys during the warmer months. In some parts of the Arctic, such as Baffin Island, Canada, less sea ice allows ships to transport heavy equipment to remote locations, and to convey ore from mines to the market further south. Some railway and mining operators are considering developing railroads and other infrastructure to transport ore year-round.[74] As with onshore oil and gas development, however, mining infrastructure that depends on footings sunk into permafrost could become unstable if the permafrost melts in response to warmer temperatures. Also, as with oil and gas development, mineral deposits that may be technically recoverable with current technology may not be economically profitable.

One important part of the current infrastructure in the Arctic that supports oil, gas, and mineral development is the construction and use of ice roads—built and used during the winter—but which are not passable during the warmer months. Warmer temperatures are shortening the ice

[69] The purpose of the U.S. Extended Continental Shelf Project is to establish the full extent of the continental shelf of the United States, consistent with international law. Involved in this mission are the U.S. Coast Guard (USCG), Department of State (DOS), and the University of New Hampshire (UNH). NOAA has the lead in collecting bathymetric data. The U.S. Geological Survey has the lead in collecting seismic data.

[70] See USGS, U.S. Extended Continental Shelf Project, at http://www.state.gov/g/oes/continentalshelf/.

[71] Press release, Office of the Prime Minister, Canada (August 26, 2008), at http://www.pm.gc.ca/eng/media.asp?category=1&id=2242.

[72] National Security Presidential Directive/NSPD-66 and Homeland Security Presidential Directive/HSPD-25, at http://www.whitehouse.gov/news/releases/2009/01/20090112-3.html.

[73] Don Gautier, Research Geologist, USGS, quoted in "Countries in Tug-of-War Over Arctic Resources," CNN.com (January 2, 2009), at http://www.cnn.com/2009/TECH/science/01/02/arctic.rights.dispute/index.html?iref=newssearch.

[74] Carolyn Fitzpatrick, "Heavy Haul in the High North," Railway Gazette International (July 24, 2008), at http://www.railwaygazette.com/news/single-view/view/10/heavy-haul-in-the-high-north.html.

road transport seasons and creating transportation challenges. For example, the opening date for tundra roads in northern Alaska has shifted from early November prior to 1991 to January in recent years.[75]

Environment and Economics

The warming Arctic has focused attention on threats to its wildlife and ecosystems, and it is expected that increased oil, gas, and mineral exploration and development activities may also invite increased scrutiny of possible harm to the fragile Arctic ecosystems. Federal offshore programs are often the subject of this type of scrutiny, as demonstrated by litigation largely focusing on environmental impacts. For example, plaintiffs in cases challenging government approval of OCS development activity in the Chukchi Sea generally are local communities and national environmental groups. The defendant in litigation over federal leasing in the Alaska program areas is the Secretary of the Interior. Typically litigation over federal offshore programs in Alaska takes place in two venues—the U.S. Court of Appeals for the Ninth Circuit, and/or the U.S. District Court of the District of Alaska. The schedule for litigation can be an issue because the schedule in one venue has some bearing on rulings related to litigation in the other venue. A new schedule for litigation regarding OCS development in the Chukchi Sea is currently under consideration. The outcome of court cases will likely impact future development activities.

The outcome of judicial action on environmental regulations is not yet known, but it is widely accepted that complying with current environmental laws and regulations in the Arctic adds to the comparatively high cost of doing business in the far north. In addition, the price and price stability of petroleum and mineral commodities will underlie industry decisions about whether to make large investments in multi-year exploration and development projects in the Arctic. Low or volatile prices could curtail any sustained development efforts north of the Arctic Circle, even if continued warming opens new territory to petroleum and mineral exploration. In addition to uncertainty regarding the price of oil, gas, and minerals, and the environmental considerations that accompany exploration and development, there is the uncertainty for the United States regarding its claims to submerged lands beyond the 200-mile EEZ.

Even if the commodity prices and environmental costs were favorable toward exploration and development, uncertainty over U.S. claims to the extended continental shelf—because the United States is a non-party to UNCLOS—may influence private sector decisions to invest in Arctic oil, gas, and mineral resource development.

Oil Pollution and Pollution Response[76]

Oil Pollution Implications of Arctic Change

Climate change impacts in the Arctic, particularly the decline of sea ice and retreating glaciers, have stimulated human activities in the region, many of which have the potential to create oil pollution. A primary concern is the threat of a large oil spill in the area. Although a major oil spill

[75] See National Oceanic and Atmospheric Administration, Arctic Change, at http://www.arctic.noaa.gov/detect/land-road.shtml?page=land.

[76] This section prepared by Jonathan L. Ramseur, Analyst in Environmental Policy, Resources, Science, and Industry Division.

has not occurred in the Arctic region,[77] recent economic activity, such as oil and gas exploration and tourism (cruise ships), increases the risk of oil pollution (and other kinds of pollution) in the Arctic. Significant spills in high northern latitudes (e.g., the 1989 *Exxon Valdez* spill in Alaska and spills in the North Sea) suggest that the "potential impacts of an Arctic spill are likely to be severe for Arctic species and ecosystems."[78]

Risk of Oil Pollution in the Arctic

A primary factor determining the risk of oil pollution in the Arctic is the level and type of human activity being conducted in the region. Although climate changes in the Arctic are expected to increase access to natural resources and shipping lanes, the region will continue to present logistical challenges that may hinder human activity in the region. For example (as discussed in another section of this report),[79] the unpredictable ice conditions may discourage trans-Arctic shipping. If trans-Arctic shipping were to occur on a frequent basis, it would represent a considerable portion of the overall risk of oil pollution in the region. In recent decades, many of the world's largest oil spills have been from oil tankers, which can carry millions of gallons of oil.[80]

Although the level of trans-Arctic shipping is uncertain, many expect oil exploration and extraction activities to intensify.[81] Historically, oil well blowouts from offshore oil extraction operations have been a source of major oil spills. The largest accidental oil spill in world history—the IXTOC I, estimated at 140 million gallons—was due to an oil well blowout in Mexican Gulf Coast waters in 1979.[82] A 1969 well blowout off the coast of Santa Barbara released approximately 4 million gallons into the environment and has been credited with catalyzing some of the landmark environmental legislation of the 1970s. However, in recent decades the spill record for offshore platforms in U.S. federal waters has improved.[83] Indeed, a 2003 National Research Council (NRC) study of oil and gas activities on Alaska's North Slope identified five loss-of-well-control events between 1977 and 2001, but none of these incidents led to oil spills. During this time period, approximately 5,000 wells were drilled or re-drilled, yielding an event frequency of 1 per 1,000. According to studies cited in the NRC report, this is comparable to frequencies in other regions, such as the Gulf of Mexico or the Pacific Coast. The NRC report stated "the conclusion of these analyses is that blowouts that result in large spills are unlikely."[84]

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[77] Arctic Monitoring and Assessment Programme (AMAP), Arctic Oil and Gas 2007 (2008).

[78] Arctic Monitoring and Assessment Programme (AMAP), Arctic Oil and Gas 2007 (2008).

[79] See this report's section "Implications for Sea Transportation" by John Fritelli.

[80] For example, the *Exxon Valdez* spilled approximately 10 million gallons of oil, but its carrying capacity was approximately 60 million gallons.

[81] See this report's section "Implication of Changes in the Arctic for Oil, Gas, and Mineral Exploration and Development," by Peter Folger and Marc Humphries.

[82] National Research Council (NRC) of the National Academies of Science, *Oil in the Sea III: Inputs, Fates, and Effects* (2003).

[83] See CRS Report RL33705, *Oil Spills in U.S. Coastal Waters: Background and Governance*, by Jonathan L. Ramseur

[84] National Research Council of the National Academies of Science, *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* (2003).

Although the 2003 NRC report stated (citing Minerals Management Service data) that there have been no spills over 39,000 gallons on the North Slope,[85] approximately 200,000 gallons of crude oil were released from a North Slope pipeline in 2006.[86] This spill drew intense attention from the public and Members of Congress.[87] Even under the most stringent control systems, some tanker spills, pipeline leaks, and other accidents are likely to occur from equipment leaks or human error.

Potential Impacts

No oil spill is entirely benign. Even a relatively minor spill, depending on the timing and location, can cause significant harm to individual organisms and entire populations. Regarding aquatic spills, marine mammals, birds, bottom-dwelling and intertidal species, and organisms in early developmental stages—eggs or larvae—are especially vulnerable. However, the effects of oil spills can vary greatly. Oil spills can cause impacts over a range of time scales, from only a few days to several years, or even decades in some cases.

Conditions in the Arctic may have implications for toxicological effects that are not yet understood. For example, oil spills on permafrost may persist in an ecosystem for relatively long periods of time, potentially harming plant life through their root systems. Moreover, little is known about the effects of oil spills on species that are unique to the Arctic, particularly, species' abilities to thrive in a cold environment and the effect temperature has on toxicity.[88]

The effects of oil spills in high latitude, cold ocean environments may last longer and cause greater damage than expected. Some recent studies have found that oil spills in lower latitudes have persisted for longer than initially expected, thus raising the concern that the persistence of oil in the Arctic may be understated. In terms of wildlife, population recovery may take longer in the Arctic because many of the species have longer life spans and reproduce at a slower rate.[89]

Response and Cleanup Challenges in the Arctic Region

Climate changes in the Arctic are expected to increase human activities in the region, many of which impose a risk of oil pollution, particularly from oil spills. Conditions in the Arctic region impose unique challenges for personnel charged with oil spill response—the process of getting people and equipment to the incident—and cleanup duties—either recovering the spilled oil or mitigating the contamination so that it poses less harm to the ecosystem. These challenges may play a role in the policy development for economic activities in the Arctic.

[85] Between 1977 and 2000, the 10 largest crude oil spills on the Alaskan North Slope ranged between 5,000 and 39,000 gallons. National Research Council of the National Academies of Science, *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* (2003).

[86] Alaska Department of Environmental Conservation, *Final Situation Report: GC-2 Oil Transit Line Release* (March 2008).

[87] See CRS Report RL33629, *BP Alaska North Slope Pipeline Shutdowns: Regulatory Policy Issues*, by Paul W. Parfomak.

[88] AMAP, Arctic *Oil and Gas 2007* (2008).

[89] AMAP, *Arctic Oil and Gas 2007* (2008).

Spill Response Challenges

Response time is a critical factor for oil spill recovery. With each hour, spilled oil becomes more difficult to track, contain, and recover, particularly in icy conditions, where oil can migrate under or mix with surrounding ice.[90] Most response techniques call for quick action, which may pose logistical challenges in areas without prior staging equipment or trained response professionals. Many stakeholders are concerned about a "response gap" for oil spills in the Arctic region. A response gap is a period of time in which oil spill response activities would be unsafe or infeasible. Although the response gap in the Arctic has not been quantified, a recent estimate of Prince William Sound (PWS) may be instructive. A 2007 study found a response gap for PWS of 38% for the time of the study period (65% during the winter season).[91] The response gap for the northern Arctic latitudes is likely to be higher due to its more extreme weather conditions. In addition, PWS has existing infrastructure for response, while the more remote Arctic areas do not. A recent NOAA report concluded that "there is a clear need for emergency response equipment for SAR [search and rescue] and pollution response throughout the Arctic."[92]

The history of oil spills and response in the Aleutian Islands raises concerns for potential spills in the Arctic region:

> The past 20 years of data on response to spills in the Aleutians has also shown that almost no oil has been recovered during events where attempts have been made by the responsible parties or government agencies, and that in many cases, weather and other conditions have prevented any response at all.[93]

Moreover, the commander of the Coast Guard's 17th District, which covers Alaska, noted in an online journal that "we are not prepared for a major oil spill [over 100,000 gallons] in the Arctic environment. The Coast Guard has no offshore response capability in Northern or Western Alaska and we only dimly understand the science of recovering oil in broken ice."[94]

Oil Spill Cleanup Challenges

The behavior of oil spills in cold and icy waters is not well understood.[95] Cleaning up oil spills in ice-covered waters will be more difficult than in other areas, primarily because effective strategies have yet to be developed. Natural oil seeps, which are a major source of oil in the arctic environment, may offer opportunities for studying the behavior of oil.[96]

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[90] World Wildlife Fund, *Oil Spill: Response Challenges in Arctic Waters* (2007).

[91] Nuka Research and Planning Group, LLC, *Response Gap Estimate for Two Operating Areas in Prince William Sound, Alaska* (2007), Report to Prince William Sound Regional Citizens' Advisory Council.

[92] Coastal Response Research Center, *Opening the Arctic Seas: Envisioning Disasters and Framing Solutions*, (2009), partnership between the National Oceanic and Atmospheric Administration and the University of New Hampshire.

[93] Transportation Research Board of the National Academy of Sciences, *Risk of Vessel Accidents and Spills in the Aleutian Islands: Designing a Comprehensive Risk Assessment* (2008), Special Report 293, National Academies Press. Washington, DC.

[94] Arthur Brooks (Commander, 17th Coast Guard District) Coast Guard Journal, Arctic Journal (April 7, 2008).

[95] Coastal Response Research Center, *Opening the Arctic Seas: Envisioning Disasters and Framing Solutions*, (2009), partnership between the National Oceanic and Atmospheric Administration and the University of New Hampshire. See also, U.S. Arctic Research Commission, (Draft) *White Paper: U.S. Arctic Research Commission Recommends Steps to Expanded U.S. Funding for Arctic/Subarctic Oil Spill Research* (February 24, 2010).

[96] Arctic Monitoring and Assessment Programme (AMAP), *Arctic Oil and Gas 2007* (2008).

The Arctic conditions present several hurdles to oil cleanup efforts. In colder water temperatures, there are fewer organisms to break down the oil through microbial degradation. Oil evaporates at a slower rate in colder water temperatures. Although slower evaporation may allow for more oil to be recovered, evaporation removes the lighter, more toxic hydrocarbons that are present in crude oil.[97] The longer the oil remains in an ecosystem, the more opportunity there is for exposure. Oil spills may get trapped in ice, evaporating only when the ice thaws. In some cases, oil could remain in the ice for years.

Icy conditions enhance emulsification—the process of forming different states of water in oil, often described as "mousse." Emulsification creates oil cleanup challenges by increasing (1) the volume of the oil/water mixture and (2) the mixture's viscosity (resistance to flow). The latter change creates particular problems for conventional removal and pumping cleanup methods.[98] Moreover, two of the major non-mechanical recovery methods—in-situ burning and dispersant application—may be limited (or "precluded") by the Arctic conditions and lack of logistical support: aircraft, vessels, and other infrastructure.[99]

Existing Policy Framework

Considering both the recent increase in human activity in the region (and expectation of further interest) and the response and recovery challenges that an oil spill would impose in Arctic waters, many would assert that the region warrants particular attention in terms of governance. However, the existing framework for international governance of maritime operations in the Arctic region lacks legally binding requirements. While the Safety of Life at Sea Convention (SOLAS) and other International Maritime Organization (IMO) conventions include provisions regarding ships in icy waters, the provisions are not specific to the polar regions. The IMO has "Guidelines for Ships Operating in Arctic," but these were considered inadequate by many participants in a recent workshop.[100] As stated in a recent NOAA report, the non-binding IMO provisions seem "inconsistent with the hazards of Arctic navigation and the potential for environmental damage from such an incident."[101]

Fisheries[102]

Large commercial fisheries exist in the Arctic, including in the Barents and Norwegian Seas north of Europe, the Central North Atlantic off of Greenland and Iceland, and the Newfoundland and Labrador Seas off of northeastern Canada.[103]

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[97] National Research Council, *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* (2003).

[98] Arturo A. Keller and Kristin Clark, *Oil Recovery with Novel Skimmer Surfaces under Cold Climate Conditions* (2007), prepared for the Minerals Management Service.

[99] World Wildlife Fund, *Oil Spill: Response Challenges in Arctic Waters* (2007). For further discussion of issues relating to oil spills, see CRS Report RL33705, *Oil Spills in U.S. Coastal Waters: Background and Governance*, by Jonathan L. Ramseur.

[100] Coastal Response Research Center, *Opening the Arctic Seas: Envisioning Disasters and Framing Solutions*, (2009), partnership between the National Oceanic and Atmospheric Administration and the University of New Hampshire.

[101] Coastal Response Research Center, *Opening the Arctic Seas: Envisioning Disasters and Framing Solutions*, (2009), partnership between the National Oceanic and Atmospheric Administration and the University of New Hampshire.

[102] This section prepared by Eugene Buck, Specialist in Natural Resources Policy, Resources, Science, and Industry Division.

In the 110th Congress, P.L. 110-243 stated that "the United States should initiate international discussions and take necessary steps with other Arctic nations to negotiate an agreement or agreements for managing migratory, transboundary, and straddling fish stocks in the Arctic Ocean and establishing a new international fisheries management organization or organizations for the region." In response to this, the United States participated in meetings with other Arctic nations at the March 2009 UN Food and Agriculture Organization Committee on Fisheries meetings in Rome. These international discussions are continuing.

On February 5, 2009, the North Pacific Fishery Management Council, acting under the authority of the Magnuson-Stevens Fishery Conservation and Management Act, unanimously approved the Council's draft Arctic Fisheries Management Plan and approved the preferred alternative, which would (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components; (2) determine the fishery management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues; and (3) implement an ecosystem-based management policy that recognizes the resources of the U.S. Arctic and the potential for fishery development that might affect those resources, particularly in the face of a changing climate.

On November 3, 2009, the National Marine Fisheries Service (Department of Commerce) issued a final rule that implemented the North Pacific Council's Fishery Management Plan for Fish Resources of the Arctic Management Area, as well as Amendment 29 to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs. This action followed the North Pacific Council's recommendations establishing a basis for sustainable management of commercial fishing in the Arctic Management Area and moving the northern boundary of the crab fishery south of the Arctic Management Area to Bering Strait.[104]

Protected Species[105]

Concern over development of the Arctic relates to how such development might affect threatened and endangered species. Under the Endangered Species Act (16 U.S.C. §§ 1531-1543), the polar bear was listed as threatened on May 15, 2008. In addition, a positive 90-day finding was made on a petition to list the ribbon seal on March 28, 2008. The failure by the U.S. Fish and Wildlife Service to make a 90-day finding on a 2008 petition to list Pacific walrus has led to submission of 60-days notice of a future citizen suit, and a petition to list ringed, bearded, and spotted seals was filed May 28, 2008.

In either terrestrial or marine environments, the extreme pace of change makes a biological response many times more difficult. For species with adaptations for a specific optimum temperature for egg development, or production of young timed to match the availability of a favored prey species, or seed dispersal in predictable fire regimes, etc., evolutionary responses may well not keep pace with the rate of change.[106] While species of plants and animals farther

(...continued)

[103] Erik J. Molenaar and Robert Corell, *Arctic Fisheries*, Arctic Transform, February 9, 2009; available at http://arctic-transform.org/download/FishBP.pdf.

[104] 74 *Federal Register* 56734-56746, November 3, 2009.

[105] Prepared by Lynne Corn and Eugene Buck, Specialists in Natural Resources Policy, Resources, Science, and Industry Division.

[106] Among biologists, it is traditionally said that a species faced with extreme change can respond in three basic ways: (continued...)

south might migrate, drift, or be transplanted from warming habitats to more northerly sites that may continue to be suitable,[107] once a terrestrial species reaches the Arctic Ocean, it is very literally at the end of the line. No more northern or colder habitat is available.

The Marine Mammal Protection Act (MMPA; 16 U.S.C. §§ 1361 et seq.) protects whales, seals, walruses, and polar bears. The MMPA established a moratorium on the "taking" of marine mammals in U.S. waters and by U.S. nationals on the high seas, including the Arctic. The MMPA protects marine mammals from "clubbing, mutilation, poisoning, capture in nets, and other human actions that lead to extinction." Under the MMPA, the Secretary of Commerce, acting through National Marine Fisheries Service (NMFS), is responsible for the conservation and management of whales and seals. The Secretary of the Interior, acting through the Fish and Wildlife Service (FWS), is responsible for walruses and polar bears.[108] Despite the MMPA's general moratorium on taking, the MMPA allows U.S. citizens to apply for and obtain authorization for taking small numbers of mammals incidental to activities other than commercial fishing (e.g., offshore oil and gas exploration and development) if the taking would have only a negligible impact on any marine mammal species or stock, provided that monitoring requirements and other conditions are met.

Indigenous People Living in the Arctic[109]

Background

Seven of the eight Arctic nations have indigenous peoples,[110] whose predecessors were present in parts of the Arctic over 10,000 years ago, well before the arrival of peoples with European backgrounds.[111] Current Arctic indigenous peoples comprise dozens of diverse cultures and speak dozens of languages from eight or more non-Indo-European language families.[112]

(...continued)

"migrate, mutate, or die." When change is rapid enough, mutation (accompanied by natural selection of individuals within the population more suited to the changed environment) may not be able to occur fast enough, leaving migration and death as the only options. The problem of response rate is more severe for species that reproduce slowly (e.g., polar bears) and less severe for species that reproduce rapidly (e.g. algae).

[107] The efficacy and the effect of this tactic is often questioned, since natural migration is unlikely to involve the entire suite of species in an ecosystem (e.g., host plants might not move north (or up) as fast as their moth herbivores, nor as fast as the birds that depend on the moths). Moreover, the southerners will not find a land of sterile bare dirt—the species that are already there may be threatened themselves by the competition from the new arrivals, perhaps tipping the balance and pushing still more species toward extinction.

[108] Under the MMPA, both NMFS and FWS have responsibility for additional marine mammal species (e.g., manatees, sea otters, dolphins) which are not currently found in the Arctic.

[109] This section prepared by Roger Walke, Specialist in American Indian Policy, Domestic Social Policy Division.

[110] *Arctic Human Development Report*, ed. Joan Nymand Larsen, et al. (Akureyri, Iceland: Stefansson Arctic Institute, 2004), p. 47; this report is subsequently cited in this section as *AHDR*. The seven countries are Canada, Denmark-Greenland, Finland, Norway, Russia, Sweden, and the United States.

[111] John F. Hoffecker, *A Prehistory of the North: Human Settlement of the Higher Latitudes* (New Brunswick, NJ: Rutgers University Press, 2005), pp. 8, 81, 112-115.

[112] *AHDR*, pp. 47, 53; David Crystal, *Cambridge Encyclopedia of Language*, 2nd ed. (Cambridge: Cambridge University Press, 1997), chap. 50; *Ethnologue: Languages of the World*, 16th ed., ed. M. Paul Lewis (Dallas: SIL International, 2009) available online at http://www.ethnologue.com/. The number of languages and language families varies not only with definitions of the Arctic but with definitions of languages and language families.

Before the arrival of Europeans, Arctic indigenous peoples lived in economies that were chiefly dependent, in varying proportions, on hunting land and marine mammals, catching salt- and fresh-water fish, herding reindeer (in Eurasia), and gathering, for their food, clothing, and other products.[113] Indigenous peoples' interaction with and knowledge of Arctic wildlife and environments has developed over millennia and is the foundation of their cultures.[114]

The length of time that Arctic indigenous peoples were in contact with Europeans varied across the Arctic. As recorded by Europeans, contact began as early as the 9th century CE, if not before, in Fennoscandia[115] and northwestern Russia, chiefly for reasons of commerce (especially furs); it progressed mostly west-to-east across northern Asia, reaching northeastern Arctic Asia by the 17th century.[116] North American Arctic indigenous peoples' contact with Europeans started in Labrador in the 16th century and in Alaska in the 18th century, and was not completed until the early 20th century.[117] Greenland's indigenous peoples first saw European-origin peoples in the late 10th century, but those Europeans died out during the 15th or 16th century and Europeans did not return permanently until the 18th century.[118]

Contact led to significant changes in Arctic indigenous economies, political structures, foods, cultures, and populations, starting especially in the 20th century. At present, for instance, most Arctic indigenous peoples are minorities in their countries' Arctic areas, except in Greenland and Canada (one source estimates that, around 2003, about 10% of an estimated 3.7 million people in the Arctic were indigenous).[119] While many Arctic indigenous communities remain heavily dependent on hunting, fishing, and herding and are more likely to depend on traditional foods than non-indigenous Arctic inhabitants,[120] there is much variation. Most Arctic indigenous people

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[113] Jim Berner, et al., *Arctic Climate Impact Assessment* (Cambridge: Cambridge University Press, 2005), chapter 12; this report is subsequently cited in this section as *ACIA*.

[114] *ACIA*, pp. 654-655.

[115] Fennoscandia refers to the Scandinavian Peninsula, Finland, the Kola Peninsula of Russia, and certain parts of Russia bordering on Finland.

[116] Janet Martin, *Treasure in the Land of Darkness: The Fur Trade and Its Significance for Medieval Russia* (Cambridge: Cambridge University Press, 1986), pp. 41-42; James Forsyth, *A History of the Peoples of Siberia: Russia's North Asian Colony, 1581-1990* (Cambridge: Cambridge University Press, 1992), pp. 69-83, 102; Lassi K. Heininen, "Different Images of the Arctic and the Circumpolar North in World Politics," in *Knowledge and Power in the Arctic*, Proceedings at a Conference in Rovaniemi, April 16-18, 2007, Arctic Centre Reports 48, ed. Paula Kankaanpaa, et al. (Rovaniemi, Finland: University of Lapland, Arctic Centre, 2007), p. 125.

[117] James W. VanStone, "Exploration and Contact History of Western Alaska," and David Damas, "Copper Eskimo," and J. Garth Taylor, "Historical Ethnography of the Labrador Coast," in *Handbook of North American Indian: Vol. 5, Arctic,* vol. ed. David Damas, gen. ed. William C. Sturtevant (Washington: Smithsonian, 1984), pp. 149-155, 408, 509-510.

[118] Inge Kleivan, "History of Norse Greenland," in *Handbook, Vol. 5, Arctic, op. cit.,*, pp. 549-555; Finn Gad, "Danish Greenland Policies," in *Handbook of North American Indians: Vol. 4, History of Indian-White Relations*, vol. ed. Wilcomb E. Washburn, gen. ed. William C. Sturtevant (Washington: Smithsonian, 1988), p. 110.

[119] *AHDR*, pp. 19, 29. Estimates of Arctic indigenous populations are complicated by varying definitions not only of the Arctic but also of indigenous peoples; for instance, Russia does not count some non-European Arctic ethnic groups, such as the Yakut, as "indigenous minorities" (see "Peoples of the Arctic: Characteristics of Human Populations Relevant to Pollution Issues," in *AMAP Assessment Report: Arctic Pollution Issues*, ed. Simon J. Wilson et al. (Oslo: Arctic Monitoring and Assessment Programme, 1998), pp. 167-169; this report is subsequently cited in this section as *AMAP 1998*.

[120] *AMAP 1998*, chapter 5; see also Birger Poppel et al., *SLiCA Results*, Survey of Living Conditions in the Arctic (Anchorage: Institute of Social and Economic Research, University of Alaska Anchorage, 2007), pp. 4-7, http://www.arcticlivingconditions.org.

may no longer consume traditional foods as their chief sources of energy and nutrition.[121] Major economic change is also relatively recent but ongoing.[122] Many Arctic indigenous communities have developed a mixture of traditional economic activities and wage employment.[123] Subsistence and economics will be key factors in the effects of climate change on Arctic indigenous peoples, and on their reaction to Arctic climate change.

Arctic indigenous peoples' current political structures vary, as do their relationships with their national governments. Some indigenous groups govern their own unique land areas within the national structure, as in the United States and Canada; others have special representative bodies, such as the Saami parliaments in Norway, Finland, and Sweden;[124] a few areas have general governments with indigenous majorities, such as Greenland (a member country of Denmark), Nunavut territory in Canada, and the North Slope and Northwest Arctic boroughs in Alaska.[125] Control of land, through claims and ownership, also varies among Arctic indigenous peoples, as do rights to fishing, hunting, and resources.[126] Arctic indigenous peoples' political relationships to their national and local governments, and their ownership or claims regarding land, are also significant factors in the responses to Arctic climate change by the indigenous peoples and by Arctic nations' governments.

Effects of Climate Change

Arctic climate change is expected to affect the economies, subsistence, health, population, societies, and cultures of Arctic indigenous peoples. Changes in sea ice and sea level, permafrost, tundra, and tree and vegetation distribution, and increased commercial shipping, will affect the distribution of land and sea mammals, of freshwater and marine fish, and of forage for reindeer, and this will in turn affect traditional subsistence activities and related indigenous lifestyles.[127] Arctic indigenous peoples' harvesting of animals is likely to become riskier and less predictable, which may increase food insecurity, change diets, and increase dependency on outside, non-traditional foods.[128] Sea and permafrost changes have damaged infrastructure and increased coastal erosion, especially in Alaska, where the Government Accountability Office (GAO) found that "coastal villages are becoming more susceptible to flooding and erosion caused in part by rising temperatures."[129]

Oil, gas, and mineral exploration and development are expected to increase, as are other economic activities, such as forestry and tourism, and these are expected to increase economic

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[121] Annika E. Nilson and Henry P. Huntington, *Arctic Pollution 2009* (Oslo: Arctic Monitoring and Assessment Programme, 2009), p. 39-41; this report is subsequently cited in this section as *AMAP 2009*.

[122] *ACIA*, p. 1000.

[123] *SLiCA Results, op.cit.*, pp. v, 4-8.

[124] *AHDR*, p. 232.

[125] *AHDR*, chapter 4, and pp. 232-233.

[126] *AHDR*, chapters 6-7, and pp. 232-233.

[127] *ACIA*, pp. 1000-1001, 1004.

[128] *ACIA*, pp. 1000-1001, 1004.

[129] U.S. Government Accountability Office, *Alaska Native Villages: Villages Affected by Flooding and Erosion Have Difficulty Qualifying for Federal Assistance*, GAO-04-895T, June 29, 2004, p. i, http://www.gao.gov/new.items/d04895t.pdf. See also, GAO, *Alaska Native Villages: Most Are Affected by Flooding and Erosion, but Few Qualify for Federal Assistance*, GAO-04-142, December 12, 2003, http://www.gao.gov/new.items/d04142.pdf.

opportunities for all Arctic residents, including indigenous peoples.[130] Pressures to increase participation in the wage economy, however, may speed up changes in indigenous cultures. Increased economic opportunities may also lead to a rise in the non-indigenous population, which may further change the circumstances of indigenous cultures.

Health problems may increase with Arctic climate change. Economic development may exacerbate Arctic pollution problems, including food contamination, and warmer temperatures may increase insect- and wildlife-borne diseases.[131] Climate change may lead to damage to water and sanitation systems, reducing protection against waterborne diseases.[132] Changes in Arctic indigenous cultures may increase mental stress and behavioral problems.[133]

The response to climate change by Arctic indigenous peoples has included international activities by Arctic indigenous organizations and advocacy before their national governments. As one report noted, "the rise of solidarity among indigenous peoples organizations in the region is surely a development to be reckoned with by all those interested in policy issues in the Arctic."[134] Six national or international indigenous organizations are permanent participants of the Arctic Council, the regional intergovernmental forum.[135] In April 2009, the Inuit Circumpolar Council (an organization of Inuit in the Arctic regions of Alaska, Canada, Greenland, and Russia) hosted in Alaska the worldwide "Indigenous Peoples Global Summit on Climate Change."[136] The conference report, forwarded to the Copenhagen Conference of the Parties of the U.N. Framework Convention on Climate Change (December 2009), noted "accelerating" climate change caused by "unsustainable development" and, among several recommendations, called for a greater indigenous role in national and international decisions on climate change, including a greater role for indigenous knowledge in climate change research, monitoring, and mitigation.[137] In Alaska, the Alaska Federation of Natives has asked Congress to mitigate flooding and erosion in Alaska Native villages and to fund relocation of villages where necessary.[138]

[130] *ACIA*, pp. 1001, 1004.

[131] *AMAP Assessment 2009: Human Health in the Arctic*, ed. Simon J. Wilson and Carolyn Symon (Oslo: Arctic Monitoring and Assessment Programme, 2009), pp. 4-6, 143.

[132] John Warren, "Climate change could affect human health," *Mukluk Telegraph*, January/February 2005, pp. 5-6.

[133] John Warren, "Climate change could affect human health," *Mukluk Telegraph*, January/February 2005, pp. 5-6.

[134] *AHDR*, p. 235.

[135] See http://www.arctic-council.org/. The six organizations are the Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit Circumpolar Council, RAIPON (Russian Association of Indigenous Peoples of the North), and Saami Council.

[136] See http://www.indigenoussummit.com/servlet/content/home.html.

[137] K. Galloway-McLean et al., *Report of the Indigenous Peoples' Global Summit on Climate Change: 20-24 April 2009, Anchorage, Alaska* (Darwin, Australia: United Nations University—Traditional Knowledge Initiative, 2009), pp. 5-7; available at http://www.indigenoussummit.com/servlet/content/home.html.

[138] Alaska Federation of Natives, Human Resources Committee, *2010 Federal Priorities* (Anchorage: Alaska Federation of Natives, 2010), pp. 22-23; available at http://www.nativefederation.org/documents/2010_AFN_Federal_Priorities.pdf. See also, GAO, *Alaska Native Villages: Limited Progress Has Been Made on Relocating Villages Threatened by Flooding and Erosion*, GAO-09-551, June 3, 2009, http://www.gao.gov/new.items/d09551.pdf.

Polar Icebreaking[139]

The Coast Guard's three polar icebreakers perform a variety of missions supporting U.S. interests in the Arctic, including the following:

- conducting and supporting U.S. scientific research in the Arctic;[140]
- defending U.S. sovereignty in the Arctic by helping to maintain a presence in the region;
- defending other U.S. interests in polar regions, including economic interests relating to the U.S. exclusive economic zone (EEZ) north of Alaska;
- monitoring sea traffic in the Arctic, including ships bound for the United States; and
- conducting other typical Coast Guard missions (such as search and rescue, law enforcement, and protection of marine resources) in Arctic waters, including U.S. territorial waters north of Alaska.

The Coast Guard's two heavy polar icebreakers—*Polar Star* and *Polar Sea*—have exceeded their intended 30-year service lives. The *Polar Star* is not operational and has been in caretaker status since July 1, 2006.[141] Congress in FY2009 and FY2010 provided funding to repair *Polar Star* and return it to service for 7 to 10 years; the Coast Guard expects the reactivation project to be completed in 2013.[142] On June 25, 2010, the Coast Guard announced that *Polar Sea* had suffered an unexpected engine casualty and consequently will likely be unavailable for operation until at least January 2011.[143] The United States currently has no operational heavy polar icebreakers.

The Coast Guard's third polar icebreaker—*Healy*—entered service in 2000. Compared to *Polar Star* and *Polar Sea*, *Healy* has less icebreaking capability (it is considered a medium polar icebreaker), but more capability for supporting scientific research. The ship is used primarily for supporting scientific research in the Arctic.

A 2007 report from the National Research Council (NRC) on the U.S. polar icebreaking fleet states that "U.S. [polar] icebreaking capability is now at risk of being unable to support national interests in the north and the south." On July 16, 2008, Admiral Thad Allen, the Commandant of the Coast Guard, testified that: "Today, our nation is at a crossroads with Coast Guard domestic and international icebreaking capabilities. We have important decisions to make. And I believe we must address our icebreaking needs now."

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[139] This section prepared by Ronald O'Rourke, Specialist in Naval Affairs, Foreign Affairs, Defense, and Trade Division. It is adapted from CRS Report RL34391, *Coast Guard Polar Icebreaker Modernization: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

[140] The Coast Guard's polar icebreakers also support U.S. scientific research in the Antarctic.

[141] Source for July 1, 2006, date: U.S. Coast Guard email to CRS on February 22, 2008.

[142] "Icebreaker POLAR SEA Sidelined By Engine Troubles," *Coast Guard Compass (Official Blog of the U.S. Coast Guard)*, June 25, 2010. An FY2011 budget justification document—Department of Homeland Security, *Congressional Budget Justification FY 2011*, p. USCG-9 (pdf page 2176 of 3985)—states that the repairs to *Polar Star* are to be completed in FY2012.

[143] "Icebreaker POLAR SEA Sidelined By Engine Troubles," *Coast Guard Compass (Official Blog of the U.S. Coast Guard)*, June 25, 2010.

The Coast Guard since 2008 has been studying how many polar icebreakers, with what capabilities, should be procured as replacements for *Polar Star* and *Polar Sea*.[144] Following a decision to design and build one or more new polar icebreakers, the first replacement polar icebreaker might enter service in 8 to 10 years, by which time *Polar Star* and *Polar Sea* could be more than 40 years old. The Coast Guard estimated in February 2008 that new replacement polar icebreakers might cost $800 million to $925 million each in 2008 dollars, and that the alternative of extending the service lives of *Polar Sea* and *Polar Star* for 25 years might cost about $400 million per ship.

Potential policy issues for Congress regarding Coast Guard polar icebreaker modernization include the potential impact on U.S. polar missions of the United States having no operational heavy polar icebreakers; numbers and capabilities of polar icebreakers the Coast Guard will need in the future; whether to provide these icebreakers through construction of new ships or service life extensions of *Polar Star* and/or *Polar Sea*; whether to accelerate the Coast Guard's current schedule for acquiring replacement ships; whether new ships should be nuclear powered; and whether new ships should be funded entirely in the Coast Guard budget, or partly or entirely in some other part of the federal budget, such as the Department of Defense (DOD) budget, the National Science Foundation (NSF) budget, or both.

Search and Rescue[145]

The possibility of increased sea traffic through Arctic waters has increased concerns regarding Arctic-area search and rescue capabilities. Given the location of current U.S. Coast Guard operating bases, it could take Coast Guard aircraft several hours, and Coast Guard cutters a few or several days, to reach a ship in distress in Arctic waters. In addition, the harsh climate complicates search and rescue operations in the region.

Particular concern has been expressed about cruise ships that may experience problems and need assistance; there have already been two incidents of this kind in recent years in waters off Antarctica. One option for mitigating the risks associated with cruise ship operations in the Arctic would be to require the vessels to sail in pairs, so that if one ship experiences a problem, the other one could quickly come to its aid.

Increasing U.S. Coast Guard search and rescue capabilities for the Arctic could require one or more of the following: enhancing or creating new Coast Guard operating bases in the region, procuring additional Arctic-capable aircraft, cutters, and rescue boats for the Coast Guard, and

[144] The eight Arctic countries have differing requirements for polar icebreakers, depending on the nature and extent of their activities in Arctic (and Antarctic) waters. According to one source, as of January 2009, Russia had a fleet of 25 polar icebreakers (including six active heavy icebreakers, two heavy icebreakers in caretaker status, 15 other icebreakers, and two additional icebreakers leased from the Netherlands); Finland and Sweden each had seven; Canada had six; and the United States had three (including one active heavy icebreaker (Polar Sea), one heavy icebreaker in caretaker status (Polar Star), and one additional icebreaker (Healy)). (Source: Slide entitled "Icebreaker Force Laydown," in "The Accessible Arctic, A Quick Overview," a presentation given at a seminar entitled "The Changing Strategic Landscape for Sea-Based Missile Defense," Center for Technology and National Security, National Defense University, Fort Lesley J. McNair, Washington, DC, December 2-3, 2009. The slide defined a heavy icebreaker as one with a propulsion plant rated at more than 45,000 break horsepower (BHP).) Russia's heavy icebreakers are nuclear-powered.

[145] This section prepared by Ronald O'Rourke, Specialist in Naval Affairs, Foreign Affairs, Defense, and Trade Division.

adding systems to improve Arctic maritime communications, navigation, and domain awareness.[146] It may also entail enhanced forms of cooperation with navies and coast guards of other Arctic countries.

U.S. Relations with Other Arctic Countries[147]

Of the other Arctic coastal nations, the United States enjoys strong political and commercial ties with Canada, Norway, and Denmark; all four countries are members of NATO. Although the United States views Russia as an important partner in developing policies to cope with changing conditions in the Arctic, relations with Moscow have been somewhat problematic in recent years, particularly in the wake of Russia's August 2008 incursion into South Ossetia and Georgia, and its cutoff of natural gas to Ukraine and Europe.[148] The two nations have also been at odds over Washington's plans to install in Europe missile defense facilities intended to guard against missiles launched from Iran. In February 2009, Vice President Joseph Biden stated the Obama Administration's intention "to press the reset button and to revisit the many areas where we can and should work together."[149] Washington has sought to engage Russian cooperation in negotiations with North Korea. Also, in support of UN sanctions, Moscow has cancelled the proposed sale of its S-300 anti-aircraft missiles to Iran. In addition, Russia is permitting non-lethal supplies to be transported across its territory to NATO forces in Afghanistan. Finally, in April 2010 the two countries signed the New Start Treaty, currently pending Senate ratification.

As noted elsewhere in this report (see "Territorial Claims and Sovereignty Issues"), in late May 2008, ministerial representatives of the Arctic littoral states (the United States, Denmark, Norway, Russia, and Canada) attended a meeting convened by Denmark in Ilulissat, Greenland. Danish Foreign Minister Stig Møller implied that the meeting was intended to develop interim measures for Arctic governance: "We must continue to fulfill our obligations in the Arctic area until the U.N. decides who will have the right to the sea and the resources in the region. We must agree on the rules and what to do if climate changes make more shipping possible."[150] Attendees discussed a variety of issues, including the environment, transportation, resources, and security. The Danish Foreign Ministry stated that the resulting Ilulissat Declaration

> sent a clear political signal to the local inhabitants and the rest of the world that we will act responsibly when addressing the development in the Arctic Ocean. We have committed ourselves politically to solve any disagreements through negotiation. Thus, hopefully, we have eradicated all the myths about a 'race for the North Pole.' The legal framework is in place and the five States have now declared that they will abide by it.[151]

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[146] For a report assessing certain emergency scenarios in the Arctic, including search and rescue scenarios, see *Opening the Arctic Seas, Envisioning Disasters and Framing Solutions*, Coastal Response and Research Center, University of New Hampshire, report of January 2009, based on conference held March 18-20, 2008, at Durham, New Hampshire.

[147] This section prepared by Carl Ek, Specialist in International Relations, Foreign Affairs, Defense, and Trade Division.

[148] "US To Seek New Cooperation In Thawing Arctic," *Reuters News,* April 28, 2009. "The Transformation of US-Russia Relations," by Samuel Charap, *Current History*, October, 2010.

[149] Speech at the 45th Munich Security Conference, U.S. Vice President Joseph Biden, February 7, 2009, http://www.securityconference.de/konferenzen/rede.php?menu_2009=&menu_konferenzen=&sprache=en&id=238&.

[150] Conference on the Arctic Ocean, May 26, 2008, Arctic Council website: http://arctic-council.org/article/2008/5/conference_on_the_arctic_ocean.

[151] Conference In Ilulissat, Greenland: Landmark Political Declaration on the Future of the Arctic, Edited December 11, 2008, website of the Danish Foreign Ministry, http://www.um.dk/en.

The Arctic has increasingly become a subject of discussions in bilateral meetings among leaders of the nations in the region. The main international forum for cooperation in the high north, however, is the eight-nation Arctic Council, of which the United States is an active member. The chief topics addressed by the six working groups of the Council, which was formed in 1996, are sustainable development, environmental protection, and the social well-being of the indigenous communities. The United States reportedly vetoed security as an issue of consideration for the Council. The Council holds ministerial-level meetings biennially, while the working groups meet more frequently; the most recent ministerial was held in Tromsø, Norway, in April 2009. Denmark currently holds the revolving chairmanship. Russia has taken the lead within the Council for developing a plan for international cooperation in search-and-rescue activities in the region.[152]

Although the establishment of sovereignty through the demarcation of boundaries in the region is being conducted peacefully under the auspices of the U.N. Convention on the Law of the Sea (UNCLOS), the Arctic is also increasingly being viewed by some as a potential emerging security issue. Canadian academic Rob Huebert pointed out that in August 2010 the United States, Canada, and Denmark conducted in the Canadian Arctic their annual joint naval exercises involving several advanced and powerful warships. Huebert observed that "while defence officials are quick to point out they see no military threat to the region, it's still interesting to see these three Arctic friends coming together to improve their naval combat capability in the Far North...."[153] The Russian government has stated that, although it deplores the notion of an arms race in the region and does not foresee a conflict there, it intends to protect its Arctic interests.[154] In varying degrees, the Arctic coastal states have indicated a willingness to establish and maintain a military presence in the high north.[155] Although some have argued that terrorism and hijacking may constitute security concerns in the region, others maintain that such threats are chimerical, given the challenges of distance and geography, and the difficulty of navigating in a polar environment.

China has also evinced a growing interest in the Arctic region, based mainly upon its interest in the possibility of shorter sea routes and in the eventual development of energy-related natural resources. China's economy is strongly dependent upon exports; one analyst has reported an estimate that one-half of China's GDP is reliant upon shipping. The opening of Arctic Ocean corridors north of Russia and/or Canada would drastically reduce both sailing times and transportation costs. China has also been active in conducting research on the Arctic; it acquired a large icebreaker in 1993 and is planning to construct domestically a state-of-the-art polar capable research vessel.

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[152] The Council members are the "Arctic 5" coastal States plus Sweden, Finland, and Iceland. Six indigenous Arctic peoples organizations are permanent participants. Several other countries, including Spain, China, and the UK, have observer status. "Document On Cooperation In Arctic Search and Rescue Efforts Could Be Ready In April 2011," *Interfax: Russia & CIS Military Newswire*, February 26, 2010. Also see the Arctic Council's website: http://arctic-council.org/

[153] "Welcome To a New Era of Arctic Security," Rob Huebert, Canadian Defense and Foreign Affairs Institute, August, 2010.

[154] "Russia Will Protect Interests In Arctic: Official," *Agence France Presse,* June 10, 2009. "Russia Opposes Arms Race In Arctic Region—Diplomat," *ITAR-TASS World Service,* July 21, 2009.

[155] See, for example, "Canada Vows 'Firm' Defence of Arctic Border," *Canwest News Service,* November 24, 2009. "Danes With Dogs To Join Military Sovereignty Patrol Of Canadian Arctic," *The Canadian Press,* March 3, 2010. "Norway Plans One New Arctic Base, Perhaps More," *Defense News,* March 8, 2010.

Some Chinese leaders have voiced concern over perceived emerging security issues in the Arctic. In early March 2010, a Chinese Admiral stated that "the current scramble for the sovereignty of the Arctic among some nations has encroached on many other countries' interests," and he added that China had to "make short and long term ocean strategic development plans to exploit the Arctic because it will become a future mission for the navy." Some analysts, however, believe that China's general approach toward the Arctic will remain decidedly low-key: "To date China has adopted a wait-and-see approach to Arctic developments, wary that active overtures would cause alarm in other countries due to China's size and status as a rising global power." China is believed to be keen on resolving through diplomacy the national interests of both littoral and non-Arctic states in the high north. Toward that end, it has sought permanent observer status on the Arctic Council.[156]

The Arctic has also become a region of interest for NATO. Speaking in Reykjavík in January 2009, former NATO Secretary General Jaap de Hoop Scheffer urged that member states not allow the Arctic to become a divisive issue. He also recommended that the alliance and Russia cooperate through building upon their shared experience in search-and-rescue operations. Former Danish Prime Minister Anders Fogh Rasmussen, who became secretary general of the alliance in August 2009, has also addressed security in the high north. Citing the "potentially huge security implications" of Arctic climate change, Rasmussen in October 2009 stated that "I think it is within the natural scope of work for NATO to be the forum for consultation and discussion on [selected Arctic] issues." In March 2009, however, Russia's NATO ambassador stated that Moscow would not cooperate with the alliance on Arctic matters. And in September 2010, President Medvedev reportedly observed that "the Arctic can do fine without NATO," and that his government "views [possible NATO] activity with quite serious tension, because it is after all a zone of peaceful cooperation, economic cooperation, and of course the military factor always—at a minimum—creates additional questions."[157]

As noted earlier (see "January 2009 Presidential Arctic Policy Directive" in "Background"), the Bush Administration in early January 2009 issued a presidential directive outlining its policy on the Arctic region; the last such directive had been issued in 1994. The Obama Administration is currently operating under the Bush Administration's policy directive.[158]

U.S. Military Forces and Operations[159]

During the cold war, the Arctic was an arena of military competition between the United States and the Soviet Union, with both countries, for example, operating nuclear-powered submarines, long-range bombers, and tactical aircraft in the region. The end of the cold war and the collapse

[156] "China Prepares For An Ice-free Arctic," Linda Jakobson, *SIPRI Insights On Peace and Security*, No. 2010/2, March 2010. "Admiral Urges Government To Stake Claim In the Arctic," *South China Morning Post*, March 6, 2010.

[157] "Russia, Norway Sign Border Deal For Arctic Energy," *Reuters*, September 15, 2010. "NATO Chief Cautions Against Division Over Arctic," *Canwest News Service*, January 29, 2009. "NATO Proposes Arctic Cooperation With Russia," Reuters, January 29, 2009. Speech by NATO Secretary General Jaap de Hoop Scheffer On Security Prospects In the High North, January 29, 2009, http://www.nato.int/docu/speech/2009/s090129a.html. "NATO Chief Wars Of Climate Change Security Risks," *Agence France Presse*, October 1, 2009. "Rogozin Says He Won't Discuss Cooperation In Arctic With NATO," *Interfax: Russia & CIS General Newswire,* March 27, 2009.

[158] CRS communication with State Department official, October 8, 2010.

[159] This section prepared by Ronald O'Rourke, Specialist in Naval Affairs, Foreign Affairs, Defense, and Trade Division.

of most elements of the Russian military establishment following the dissolution of the Soviet Union in December 1991 greatly reduced this competition and led to a reduced emphasis on the Arctic in U.S. military planning.

The diminishment of Arctic sea ice is now leading U.S. military forces to pay increased attention to the Arctic. This is particularly true in the case of the Navy and Coast Guard, because the diminishment of Arctic sea ice is opening up potential new operating areas for their surface ships. Defense officials in the United States and other countries view issues such as sovereignty, freedom of navigation, and energy exploration as creating a potential in the Arctic for military cooperation, competition, or conflict, depending on how these issues are handled.[160]

2010 Quadrennial Defense Review

The Department of Defense's (DOD's) report on the 2010 Quadrennial Defense Review (QDR), submitted to Congress in February 2010, states:

> The effect of changing climate on the Department's operating environment is evident in the maritime commons of the Arctic. The opening of the Arctic waters in the decades ahead[,] which will permit seasonal commerce and transit[,] presents a unique opportunity to work collaboratively in multilateral forums to promote a balanced approach to improving human and environmental security in the region. In that effort, DoD must work with the Coast Guard and the Department of Homeland Security to address gaps in Arctic communications, domain awareness, search and rescue, and environmental observation and forecasting capabilities to support both current and future planning and operations. To support cooperative engagement in the Arctic, DoD strongly supports accession to the United Nations Convention on the Law of the Sea.[161]

The report also states:

> The Department of Defense and its interagency partners must be able to more comprehensively monitor the air, land, maritime, space, and cyber domains for potential direct threats to the United States. Such monitoring provides the U.S. homeland with an extended, layered in depth defense. This effort includes enhanced coordination with Canada for the defense of North America as well as assisting Mexico and Caribbean partners in developing air and maritime domain awareness capacities. Special attention is required to develop domain awareness tools for the Arctic approaches as well. In coordination with domestic and international partners, DoD will explore technologies that have the potential to detect, track, and identify threats in these spheres to ensure that capabilities can be deployed to counter them in a timely fashion.[162]

The report further states:

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[160] See, for example, John Vandiver, "NATO Commander Sees Arctic Seabed As Cooperative Zone," *Mideast Stars and Stripes*, October 10, 2009; Tom Coghlan, "Nato Commander Warns Of Conflict With Russia In Arctic Circle," *London Times*, October 3, 2009; Gerard O'Dwyer, "Danish Report: Conflicts Coming Over Arctic," *Defense News*, September 28, 2009: 18; Gerard O'Dwyer, "Russia Warns Denmark Over Arctic Arms Race," *Defense News*, August 3, 2009: 13; Gerrard Cowen, "Russia and NATO Look to Co-operation In Arctic," *Jane's Defence Weekly*, April 8, 2009: 12; David Scutro, "Thawing Arctic Seas May Bring Security Risk," *NavyTimes.com*, January 29, 2009.

[161] Department of Defense, *Quadrennial Defense Review Report*, February 2010, p. 86.

[162] Department of Defense, *Quadrennial Defense Review Report*, February 2010, p. 19.

> Central to the security of the United States is a strong transatlantic partnership, which is underpinned by the bilateral relationships between the United States and the governments of Europe. We will continue to work with this community of like-minded nations, whether by engaging with allies still shaping their democracies after decades of living in the shadow of the Soviet Union, building on the benefits of French reintegration into NATO's military structure, or addressing new security issues such as those arising in the Arctic region.[163]

The report states: "We will seek out opportunities to work with Moscow on emerging issues, such as the future of the Arctic" and that DOD "will also enhance defense relationships and continue to work with Canada in the context of regional security, increased interaction in the Arctic, and combat operations in Afghanistan."[164]

Navy and Coast Guard

The Navy and Coast Guard are exploring the potential implications that increased surface ship and aircraft operations in the Arctic may have for required numbers of ships and aircraft, ship and aircraft characteristics, new or enlarged Arctic bases, and supporting systems, such as navigation and communication systems. The Navy and Coast Guard have sponsored or participated in studies and conferences to explore these implications, the Coast Guard has deployed boats and aircraft into the region to better understand the implications of operating such units there,[165] and Navy sailors in 2009 rode on Canadian Navy ships deploying to Arctic waters for similar reasons.[166] The Coast Guard is coordinating with the North Atlantic and North Pacific Coast Guard forums to plan exercises in the Arctic in the summer of 2010.[167]

These U.S. Navy and Coast Guard activities are taking place as other countries, such as Canada and Russia, are examining the potential implications for their military forces of diminished Arctic sea ice, and taking or contemplating steps to increase their own navy and coast guard presence and operations in the region.[168]

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[163] Department of Defense, *Quadrennial Defense Review Report*, February 2010, p. 57.

[164] Department of Defense, *Quadrennial Defense Review Report*, February 2010, p. 62.

[165] See Susan Gvozdas, "U.S. Coast Guard Preps For Open Arctic Waters," *Defense News*, September 7, 2009: 40; John C. Marcario, "Return to the Arctic," Seapower, August 2009: 26-27; John C. Marcario, "Coming Into Focus," Seapower, March 2009: 42, 44; John C. Marcario, "Arctic Presence," Seapower, August 2008: 32-33; Emelie Rutherford, "Coast Guard To Test How Ships and Aircraft Operate in Arctic," *Inside the Navy*, January 21, 2008; Philip Ewiing, "Allen: CG Expedition To Assess Arctic Waters," *NavyTimes.com*, January 17, 2009; Patricia Kime, "North Pole Flyover A First For Coast Guard," *NavyTimes.com*, October 25, 2007.

[166] Andrew Scutro, "Navy Preps For Uncharted Arctic Waters," *NavyTimes.com*, November 24, 2009.

[167] Cid Standifer, "Allen: National Discussion On Polar Policy Set To Begin Next Year," *Inside the Navy*, November 19, 2009.

[168] See, for example, David Pugliese, "[Canadian] Senators: Arm [Canadian] Coast Guard Patrols in Canada's Arctic," *Defense News*, January 18, 2010: 12; David Pugliese, "Arctic Operations Pose Challenge For Canadian Navy, Admiral Says," *Defense News*, September 7, 2009: 28; Randy Boswell, "Russia's Plans To Drop Troopers At North Pole Raise Eyebrows," *Ottawa Citizen*, July 30, 2009: 4; "Russia Will Protect Interests in Arctic: Official," *NavyTimes.com (Agence France-Presse)*, June 10, 2009; David Pugliese and Gerard O'Dwyer, "Canada, Russia Build Arctic Forces," *Defense News*, April 6, 2009: 1, 8; Vladimir Isachenkov, "Russia Plans Military Force For Arctic," *Boston Globe*, March 28, 2009; Sharon Hobson and Casandra Newell, "Shrinking Ice Cover Creates Opportunities and Threats," Jane's navy International, January/February 2009: 16-18, 20-21; Zachary M. Peterson, "As Ice Melts, Canadian Forces Ramp Up Presence In The Far North," *Inside the Navy*, December 8, 2008; Edward Lucas and Jon Rosamond, "Arctic Countries Vying For a Piece of the Ice Seek to Strengthen Regional Presence," *Jane's Navy International*, September 2008: 12-14; "Russian Navy Boosts Combat Presence in Arctic," *Defense News (Agence France-Presse)*, July 14, 2008; Adrian Blomfield, "Russia Plans Arctic Military Build-Up," *London Daily Telegraph*, June 12, 2008; David (continued...)

Points or themes that have emerged in studies and conferences regarding the potential implications for the U.S. Navy and Coast Guard of diminished Arctic sea ice include but are not limited to the following:

- The diminishment of Arctic ice is creating potential new operating areas in the Arctic for Navy surface ships and Coast Guard cutters.
- U.S. national security interests in the Arctic include "such matters as missile defense and early warning; deployment of sea and air systems for strategic sealift, strategic deterrence, maritime presence, and maritime security operations; and ensuring freedom of navigation and overflight."[169]
- A mission of potential particular interest for expanded surface ship operations in the Arctic would be defending the U.S. (and European Union) claim that the Northern Sea Route running along Russia's north coast and the Northwest Passage running through Canada's northern archipelago constitute international straits which allow right of innocent passage.
- Search and rescue in the Arctic is a mission of increasing importance, particularly for the Coast Guard, and one that poses potentially significant operational challenges (see "Search and Rescue" above).
- More complete and detailed information on the Arctic is needed to more properly support expanded Navy and Coast Guard ship and aircraft operations in the Arctic.
- The Navy and the Coast Guard currently have limited infrastructure in place in the Arctic to support expanded ship and aircraft operations in the Arctic.[170]

(...continued)

Pugliese, "Wakeup Call?" *Seapower*, October 2007: 19-20, 22; Iam Austen, "Canada Announces Plans For 2 New Bases In Its Far North," *New York Times*, August 11, 2007; "Canada To Strengthen Arctic Claim," BBC News, August 10, 2007.

[169] NSPD 66/HSPD 25, Section III B.

[170] Regarding infrastructure in the Arctic, an October 2009 press report stated:

> A big challenge will be logistics support since the only [U.S.] supply base currently available is the town of Barrow, Alaska. [Rear Admiral Dave] Titley [the Oceanographer of the Navy] explained that the Arctic region is roughly the size of the United States. By way of illustration Titley said: "Think of trying to conduct operations through the entire U.S., and your one logistics base is the size of San Clemente Island [an island off the coast of Southern California]. That is roughly the size of Barrow."

(Bob Freeman, "Conference Addresses Navy's Role in a Changing Arctic," Navy New Service, October 4, 2009. See also Zachary M. Peterson, "As A Result of Melting Ice, Navy Study Need For Base in Far North," *Inside the Navy*, December 29, 2009; Patricia Kime, "CG Boss Calls For Forward Bases In The Arctic," *NavyTimes.com*, September 28, 2007.)

- Expanded ship and aircraft operations in the Arctic may require altering ship and aircraft designs and operating methods.[171]
- Cooperation with other Arctic countries will be valuable in achieving defense and homeland security goals.

The National Ice Center (a multi-agency operational center operated by the U.S. Navy, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard) and USARC sponsored a 2007 symposium on the impact of an ice-diminished Arctic on naval and maritime operations. The summary report on the symposium stated, among other things, that: "While an ice-diminished Arctic will increase the scope of naval and maritime operations, the U.S. has little capacity to expand and little ability to operate in the Arctic environment."[172] During discussions at the symposium, the following points, among others, were made:

- Mechanisms for joint (i.e., integrated multi-service) operations in the Arctic do not currently exist.
- A lack of infrastructure will be an issue for the Navy.
- It is important to develop interoperability between the U.S. and Canadian navies, and among circumpolar nations.[173]

In October 2007, the Navy, Marine Corps, and Coast Guard released a joint document on maritime strategy, which states in part:

> Climate change is gradually opening up the waters of the Arctic, not only to new resource development, but also to new shipping routes that may reshape the global transport system. While these developments offer opportunities for growth, they are potential sources of competition and conflict for access and natural resources.[174]

In a February 2009 journal article, the Oceanographer of the Navy stated:

> Competing claims dealing with the Arctic are often political in nature and have important implications. For example, in the summer of 2008 Canada announced that it would increase its military presence in the region, begin construction of a deep-water port on Baffin Island, establish a cold weather training base at Resolute Bay, and build six new ice-hardened ships to patrol the Northwest Passage. During the same period, Russia conducted strategic bomber flights over the area for the first time since the end of the Cold War....
>
> Preserving freedom of navigation in the region is an important tenet of U.S. policy. The NSR [Northern Sea Route], however, is a contested waterway, with Russian claims of sovereignty

[171] For articles discussing potential changes to ship and aircraft designs, see Dan Taylor, "Roughead: Navy Will Have To Design Ships To Better Handle Arctic," *Inside the Navy*, November 26, 2009; Rebekah Gordon, "Coast Guard OPC [Offshore Patrol Cutter] Modifications For Varied Environments A Possibility," *Inside the Navy*, August 24, 2009; Andrew Scutro, "Arctic Forces Fleet to Look North," *NavyTimes.com*, February 23, 2009; Amy McCullough, "Stronger Hulls Could Help Fill Icebreaker Gap," *NavyTimes.com*, February 22, 2009; Rebekah Gordon, "Coast Guard Evaluating Effects of Increased Arctic Operations on Fleet," Inside the Navy, February 9, 2009.

[172] Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations, Summary Report, July 10-12, 2007, p. 10, http://www.star.nesdis.noaa.gov/star/documents/2007IceSymp/Summary_Report_2007.pdf.

[173] Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations, Summary Report, July 10-12, 2007, pp. 15 and 50-51, http://www.star.nesdis.noaa.gov/star/documents/2007IceSymp/Summary_Report_2007.pdf.

[174] *A Cooperative Strategy for 21st Century Seapower*, Washington, 2007, p. 3 (Section entitled "Challenges of a New Era"), http://www.navy.mil/maritime/MaritimeStrategy.pdf.

competing against U.S. and European Union insistence that it is an international strait available to all nations, subject to mutually recognized terms. Another potential [Arctic] transoceanic shipping route may be the Northwest Passage, which extends from the Atlantic through Baffin Bay and the Canadian Archipelago and into the Pacific by way of the Bering Strait. Canada claims sovereignty over the waters of the Canadian Archipelago, although the United States and the European Union claim that the Northwest Passage also constitutes an international strait which allows right of innocent passage....

Aside from access and right of passage, the Navy and Coast Guard, in particular, must also be concerned with strategic choke points such as the Bering Strait, Canada's Queen Elizabeth Islands in the Northwest Passage, and Russia's Severnaya Zemlya and New Siberian Islands in the Northern Sea Route. These narrow passages offer some protection from persistent ice blockage, but they are also vulnerable to control or blockade by adversaries that would significantly disrupt potential commercial shipping and oil transport....

U.S. naval interests will face new challenges in an increasingly ice-free Arctic with a strategic objective to understand potential threats to the United States from the maritime domain. As throughout the global commons, the U.S. Navy must be aware of activities that could be harmful to national security interests in a region that will, no doubt, see fewer barriers to access by potential adversaries in the future. National and homeland security interests pertinent to the U.S. Navy in the region would include early warning/missile defense; maritime presence and security; and freedom of navigation and over-flight....

The region is primarily a maritime domain and the U.S. Navy of the future must be prepared to protect sea lines of communication supporting maritime commerce and other national interests—including national security—there. In addition to thinking through how we adjust our shipbuilding emphasis to support such operations, the Navy should also be thinking strategically about building the necessary infrastructure to provide logistic support for Arctic patrols, search and rescue capabilities, and shore-based support activities.

To ensure complete maritime domain awareness in the region, and to provide our forces a competitive advantage, it will be necessary to have comprehensive knowledge of the physical environment. Data must be obtained by a suite of remote sensors (satellites, radars), autonomous sensors (data buoys, unmanned vehicles), and manned sensors (shipboard, coastal observing stations). Computer-based ocean and atmospheric models must be adjusted to the geophysical peculiarities of high latitudes. Communication lines for data exchange and reach-back processing at high-performance computing production centers must be robust and reliable. To ensure safety of navigation, we will also need to conduct more high-resolution bottom surveys and increase the scrutiny we place on sea ice conditions.

The Navy relies on its international and interagency partners for assistance to ensure success of maritime domain awareness and maritime security missions. To meet the demands of national security in the changing northern environment, strengthening mechanisms for cooperation among the regional nations and U.S. agencies must remain a high priority. Like everywhere else in the world, sound national security in the Arctic will require strategic access, military mobility, safe navigation, unimpeded maritime transportation, improved homeland security, and responsible, sustainable use of ocean and coastal resources. International and interagency agreements and partnerships are vital to incorporating these essential elements into a viable national security policy and will be critical for resolving future naval challenges of a changing Arctic.[175]

[175] David Grove, "Arctic Melt: Reopening a Naval Frontier?" *U.S. Naval Institute Proceedings*, February 2009: 16-21.

In a spring 2010 journal article, the Oceanographer of the Navy (the successor to the officer who authored the above journal article) and a coauthor stated that "Navy surface vessels are able to operate up to the marginal ice zone but will require ice-strengthening to operate in higher ice conditions; Navy aircraft are capable of operating in the Arctic, but the lack of divert fields limits their duration and range."[176] The article also stated:

> While the Navy has a rich history in the Arctic, several challenges must be met to ensure successful operations in the future. These include the lack of support infrastructure and logistics support, environmental hazards such as drifting sea ice and icing on exposed surfaces, and communications difficulties. Antiquated nautical charts, drifting ice, low visibility, and the paucity of electronic and visual navigation aids hinder safety of navigation. A lack of coastal installations also contributes to the difficulty of search and rescue (SAR) operations. The only American-owned deepwater port near the Arctic basin is Dutch Harbor, in the Aleutian Islands.[177]

A March 2010 press report stated that

> a sustained [Navy] presence [in the Arctic] requires a lot of answers and training in the near future. Specifically, the harsh environment will require significant modifications in ship and satellite architecture.
>
> "Where do we keep our fuel?" [Admiral Gary Roughead] the CNO [Chief of Naval Operations] said. "The way that we design our heating and ventilation systems are just not designed to keep up with ambient temperatures that are as cold as it gets up there. You have difficulties sometimes in how the more traditional outside equipment is maintained, and when you have freezing rain and things like that, how do you keep it clear? There are a lot of ship designs and ship alterations aspects. ... What sort of communication architectures do we have to have? I really believe now is the time to start thinking about that because it means changes to ship design, which means we have to start laying in. It means perhaps some new overhead satellite architectures, and those are extraordinarily costly."[178]

The Navy examined issues and concerns relating to climate change at a May 15, 2009, meeting of the Chief of Naval Operations (CNO) Executive Board. Following this meeting, the Navy decided to establish a Navy group led by the Oceanographer of the Navy called Task Force Climate Change (TFCC), and to develop Navy roadmaps first for the Arctic, and later for more general responses to global climate change.

The Navy issued its Arctic roadmap on November 10, 2009.[179] The document, which is dated October 2009 and co-sponsored by TFCC and the Oceanographer of the Navy,[180] is intended to guide the service's activities regarding the Arctic for the period FY2010-FY2014. The November 10 cover memo states that the document is to remain in effect until the completion of the report

[176] David W. Titley and Courtney C. St. John, "Arctic Security Considerations and the U.S. Navy's Roadmap for the Arctic," *Naval War College Review*, Spring 2010: 41.

[177] David W. Titley and Courtney C. St. John, "Arctic Security Considerations and the U.S. Navy's Roadmap for the Arctic," *Naval War College Review*, Spring 2010: 42.

[178] Lance M. Bacon, "Ice Breaker," *Armed Forces Journal*, March 2010: 16-19, 34-35.

[179] Memorandum for Distribution dated November 10, 2009, from Admiral J. W. Greenert, Vice Chief of Naval Operations, on the subject of the Navy Arctic Roadmap. The document was posted on *InsideDefense.com* (subscription required).

[180] U.S. Navy, U.S. Navy Arctic Roadmap, Washington, 2009, 29 pp. (October 2009, sponsored by Task Force Climate Change [and] Oceanographer of the Navy.) The document was posted on *InsideDefense.com* (subscription required).

on the FY2014 Quadrennial Defense Review (QDR), at which time it will be reviewed and revised to incorporate guidance from that QDR.

The roadmap states that "significant action items" for FY2010 for the Navy include the following:

- Conduct assessments of fleet readiness and mission requirements in the Arctic region.
- Develop Navy strategic objectives in the Arctic region.
- Continue partnership-building activities with stakeholders in the region and conduct a limited objective experiment (or LOE—a kind of exercise) for the Arctic.
- Continue monitoring the Air Force's Polar Military Satellite Communications (MILSTACOM) program.
- Advocate for U.S. accession to the U.N. Convention on the Law of the Sea.
- Develop a Navy position regarding combatant commander authorities and responsibilities for the Arctic.
- Conduct research and development on a next-generation environmental prediction capability that is applicable to the Arctic.

The roadmap states that "significant action items" for FY2011-FY2012 for the Navy include the following:

- Initiate assessments of required Navy Arctic capabilities.
- Develop recommendations to address Arctic requirements for program proposals in the Navy's Program Objective Memorandum (or POM—a document that guides the development of a Navy budget) for FY2014 (POM-14).
- Continue biennial Navy participation in Arctic exercises, including ICEX-11, ICEX-13, Arctic Edge, and Arctic Care.
- Formalize new cooperative relationships that increase Navy experience and competency in search and rescue (SAR), maritime domain awareness (MDA), and humanitarian assistance and disaster response (HADR) in the Arctic, and defense support of civil authorities (DSCA) in Alaska.

The roadmap states that "significant action items" for FY2013-FY2014 for the Navy include the following:

- Execute Navy POM-14 budget initiatives that address Arctic requirements.
- Initiate combined (i.e., multi-lateral) and bilateral activities which support safety, security, and stability in the region.[181]

A March 2010 report stated the following regarding the roadmap:

[181] For additional discussion of the roadmap, see David W. Titley and Courtney C. St. John, "Arctic Security Considerations and the U.S. Navy's Roadmap for the Arctic," *Naval War College Review*, Spring 2010: 35-48.

> Capabilities-based assessments and preparation for major funding requests will follow in fiscal 2011-12. A priority will be an increase in hydrographic and bottom-mapping surveys, as less than 5 percent of the region is mapped to current standards. Simultaneously, training to increase experience and competency in search and rescue, maritime domain awareness, humanitarian assistance and disaster response will expand. The first major investments for major training and ship preparation will be sought in fiscal 2014.[182]

The report also stated that

> one option the Coast Guard is considering is a modified version of its Offshore Patrol Cutter [OPC], the third large ship it plans as part of its modernization program. The Coast Guard could build a "Flight II" OPC, he said, built specifically to withstand the punishing seas and drifting ice. All the ships in that special class would likely be stationed in Kodiak, Alaska.[183]

In December 2009, it was reported that "U.S. and Canadian defense officials are studying emerging gaps in their awareness of Arctic activities, seeking to boost North American Aerospace Defense [NORAD] Command's maritime-warning mission and crafting a new threat assessment for the region." The effort would reportedly involve both NORAD and a Canadian-American advisory board called the Permanent Joint Board on Defense.[184]

In May 2010, it was reported that "American and Canadian defense officials are bolstering collaboration on military exercises, investment plans and technology development related to the Arctic." The report stated that "U.S. and Canadian intelligence officials have created a classified joint "utilization" assessment for the Arctic looking out to 2020, which will be continuously updated." It also stated that "American and Canadian defense officials have just started implementing a new five-year work plan that contains specific initiatives and requires concrete deliverables, Stockton said, noting the Arctic received special attention in the plan. The plan also covers defense critical infrastructure protection, defense support to civil agencies and defense cooperation in the Americas."[185]

A September 2010 GAO report on the Coast Guard's efforts to identify Arctic requirements in general stated:

> The Coast Guard has taken specific action to identify Arctic requirements and gaps while also collecting relevant information from routine operations. The High Latitude Study is the centerpiece of the agency's efforts to determine its Arctic requirements. The Coast Guard has also established temporary operating locations in the Arctic and conducted biweekly Arctic overflights to obtain more information on the Arctic operating environment. In addition, information gathered during the Coast Guard's routine missions—ice breaking, search and rescue, and others—also informs requirements. The agency's preliminary efforts to identify its Arctic requirements generally align with key practices for agencies defining missions and desired outcomes.

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[182] Lance M. Bacon, "Ice Breaker," *Armed Forces Journal*, March 2010: 16-19, 34-35.

[183] Lance M. Bacon, "Ice Breaker," *Armed Forces Journal*, March 2010: 16-19, 34-35. For more on the OPC, see CRS Report RL33753, *Coast Guard Deepwater Acquisition Programs: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke.

[184] Christopher J. Castelli, "DOD, Canada Aim TO Develop Arctic Policy Options By Early 2010," *Inside the Navy*, December 7, 2009.

[185] Christopher J. Castelli, "American, Canadian Defense Officials Tighten Ties On Arctic Issues," *Inside the Navy*, May 3, 2010.

> The Coast Guard faces Arctic challenges including limited information, minimal assets and infrastructure, personnel issues, and difficult planning and funding decisions, but is taking initial steps to address these challenges. Specifically, the Coast Guard does not currently have Arctic maritime domain awareness—a full understanding of variables that could affect the security, safety, economy, or environment in the Arctic—but is acquiring additional Arctic vessel tracking data, among other things, to address this issue. In addition, the Coast Guard's Arctic assets and infrastructure are limited and not suitable for the harsh environment, but the agency is testing equipment and using alternative options to mitigate gaps. Finally, the Coast Guard faces uncertainty over the timing of predicted environmental changes in the Arctic, as well as over future funding streams. To address these challenges the Coast Guard obtains scientific data on Arctic climate change and is studying its Arctic resource requirements to support potential future funding needs.[186]

January 2009 Arctic Policy Directive

As noted earlier (see "January 2009 Presidential Arctic Policy Directive" in "Background" and also "U.S. Relations with Other Arctic Countries"), the Obama Administration is currently operating under the January 2009 Arctic region policy directive (NSPD 66/HSPD 25) issued by the George W. Bush Administration.[187] Potential oversight questions include but not are limited to the following:

- Is NSPD 66/HSPD 25 a suitable statement of U.S. policy for the Arctic region?[188]
- Although the Obama Administration is currently operating under NSPD 66/HSPD 25, does the Obama Administration fully agree with all parts of it? If not, with which parts does it not fully agree?
- Is the Obama Administration planning to conduct a review of NSDP 66/HSPD 25? If so, what is the Administration's schedule for conducting and releasing the results of that review?

CRS Reports On Specific Arctic-Related Issues

CRS Report RL34266, *Climate Change: Science Highlights*, by Jane A. Leggett

CRS Report RS21890, *The U.N. Law of the Sea Convention and the United States: Developments Since October 2003*, by Marjorie Ann Browne

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[186] Government Accountability Office, *Coast Guard[:]Efforts to Identify Arctic Requirements Are Ongoing, but More Communication about Agency Planning Efforts Would Be Beneficial*, GAO-10-870, September 2010, summary page.

[187] CRS communication with State Department official, October 8, 2010.

[188] On this question, a January 19, 2009, press article about the new directive stated:

> The new policy directive covers several key areas, including national security, energy exploration and the environment, but it does not specify whether any should take precedence over others.
>
> That led Jeremy Rabkin, a professor at George Mason University Law School, to comment: "It's really a list of all the things we're concerned about; that's not policy. I don't see anything here that helps you decide what gets priority."
>
> (Juliet Eilperin and Spencer S. Hsu, "White House Directive Guides Policy On Arctic," *Washington Post*, January 19, 2009: 2.)

CRS Report RL32838, *Arctic National Wildlife Refuge (ANWR): Votes and Legislative Actions, 95th Congress through 110th Congress*, by M. Lynne Corn and Beth A. Roberts

CRS Report RL34547, *Possible Federal Revenue from Oil Development of ANWR and Nearby Areas*, by Salvatore Lazzari

CRS Report RL33705, *Oil Spills in U.S. Coastal Waters: Background and Governance*, by Jonathan L. Ramseur

CRS Report RL33941, *Polar Bears: Listing Under the Endangered Species Act*, by Eugene H. Buck, M. Lynne Corn, and Kristina Alexander

CRS Report RL34573, *Does the Endangered Species Act Listing Provide More Protection of the Polar Bear?*, by Kristina Alexander

CRS Report RS22906, *Use of the Polar Bear Listing to Force Reduction of Greenhouse Gas Emissions: The Legal Arguments*, by Robert Meltz

CRS Report RL34391, *Coast Guard Polar Icebreaker Modernization: Background, Issues, and Options for Congress*, by Ronald O'Rourke

CRS Report RL34342, *Homeland Security: Roles and Missions for United States Northern Command*, by William Knight

Appendix A. Arctic Research and Policy Act of 1984 (Title I of P.L. 98-373)

The text of the Arctic Research and Policy Act of 1984 (Title I of P.L. 98-373 of July 31, 1984[189]) is as follows:

TITLE I – ARCTIC RESEARCH AND POLICY

SHORT TITLE

SEC. 101. This title may be cited as the "Arctic Research and Policy Act of 1984".

FINDINGS AND PURPOSES

SEC. 102. (a) The Congress finds and declares that-

(1) the Arctic, onshore and offshore, contains vital energy resources that can reduce the Nation's dependence on foreign oil and improve the national balance of payments;

(2) as the Nation's only common border with the Soviet Union, the Arctic is critical to national defense;

(3) the renewable resources of the Arctic, specifically fish and other seafood, represent one of the Nation's greatest commercial assets;

(4) Arctic conditions directly affect global weather patterns and must be understood in order to promote better agricultural management throughout the United States;

(5) industrial pollution not originating in the Arctic region collects in the polar air mass, has the potential to disrupt global weather patterns, and must be controlled through international cooperation and consultation;

(6) the Arctic is a natural laboratory for research into human health and adaptation, physical and psychological, to climates of extreme cold and isolation and may provide information crucial for future defense needs;

(7) atmospheric conditions peculiar to the Arctic make the Arctic a unique testing ground for research into high latitude communications, which is likely to be crucial for future defense needs;

(8) Arctic marine technology is critical to cost-effective recovery and transportation of energy resources and to the national defense;

(9) the United States has important security, economic, and environmental interests in developing and maintaining a fleet of icebreaking vessels capable of operating effectively in the heavy ice regions of the Arctic;

[189] Title II of P.L. 98-373 is the National Critical Materials Act of 1984.

(10) most Arctic-rim countries, particularly the Soviet Union, possess Arctic technologies far more advanced than those currently available in the United States;

(11) Federal Arctic research is fragmented and uncoordinated at the present time, leading to the neglect of certain areas of research and to unnecessary duplication of effort in other areas of research;

(12) improved logistical coordination and support for Arctic research and better dissemination of research data and information is necessary to increase the efficiency and utility of national Arctic research efforts;

(13) a comprehensive national policy and program plan to organize and fund currently neglected scientific research with respect to the Arctic is necessary to fulfill national objectives in Arctic research;

(14) the Federal Government, in cooperation with State and local governments, should focus its efforts on the collection and characterization of basic data related to biological, materials, geophysical, social, and behavioral phenomena in the Arctic;

(15) research into the long-range health, environmental, and social effects of development in the Arctic is necessary to mitigate the adverse consequences of that development to the land and its residents;

(16) Arctic research expands knowledge of the Arctic, which can enhance the lives of Arctic residents, increase opportunities for international cooperation among Arctic-rim countries, and facilitate the formulation of national policy for the Arctic; and

(17) the Alaskan Arctic provides an essential habitat for marine mammals, migratory waterfowl, and other forms of wildlife which are important to the Nation and which are essential to Arctic residents.

(b) The purposes of this title are-

(1) to establish national policy, priorities, and goals and to provide a Federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences;

(2) to establish an Arctic Research Commission to promote Arctic research and to recommend Arctic research policy;

(3) to designate the National Science Foundation as the lead agency responsible for implementing Arctic research policy; and

(4) to establish an Interagency Arctic Research Policy Committee to develop a national Arctic research policy and a five year plan to implement that policy.

ARCTIC RESEARCH COMMISSION

SEC. 103. (a) The President shall establish an Arctic Research Commission (hereafter referred to as the "Commission").

(b)(1) The Commission shall be composed of five members appointed by the President, with the Director of the National Science Foundation serving as a nonvoting, ex officio member. The members appointed by the President shall include-

(A) three members appointed from among individuals from academic or other research institutions with expertise in areas of research relating to the Arctic, including the physical, biological, health, environmental, social, and behavioral sciences;

(B) one member appointed from among indigenous residents of the Arctic who are representative of the needs and interests of Arctic residents and who live in areas directly affected by Arctic resource development; and

(C) one member appointed from among individuals familiar with the Arctic and representative of the needs and interests of private industry undertaking resource development in the Arctic.

(2) The President shall designate one of the appointed members of the Commission to be chairperson of the Commission.

(c)(1) Except as provided in paragraph (2) of this subsection, the term of office of each member of the Commission appointed under subsection (b)(1) shall be four years.

(2) Of the members of the Commission originally appointed under subsection (b)(1)-

(A) one shall be appointed for a term of two years;

(B) two shall be appointed for a term of three years; and

(C) two shall be appointed for a term of four years.

(3) Any vacancy occurring in the membership of the Commission shall be filled, after notice of the vacancy is published in the Federal Register, in the manner provided by the preceding provisions of this section, for the remainder of the unexpired term.

(4) A member may serve after the expiration of the member's term of office until the President appoints a successor.

(5) A member may serve consecutive terms beyond the member's original appointment.

(d)(1) Members of the Commission may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. A member of the Commission not presently employed for compensation shall be compensated at a rate equal to the daily equivalent of the rate for GS-16 of the General Schedule under section 5332 of title 5, United States Code, for each day the member is engaged in the actual performance of his duties as a member of the Commission, not to exceed 90 days of service each year. Except for the purposes of chapter 81 of title 5 (relating to compensation for work injuries) and chapter 171 of title 28 (relating to tort claims), a member of the Commission shall not be considered an employee of the United States for any purpose.

(2) The Commission shall meet at the call of its Chairman or a majority of its members.

(3) Each Federal agency referred to in section 107(b) may designate a representative to participate as an observer with the Commission.

These representatives shall report to and advise the Commission on the activities relating to Arctic research of their agencies.

(4) The Commission shall conduct at least one public meeting in the State of Alaska annually.

DUTIES OF COMMISSION

SEC. 104. (a) The Commission shall-

(1) develop and recommend an integrated national Arctic research policy;

(2) in cooperation with the Interagency Arctic Research Policy Committee established under section 107, assist in establishing a national Arctic research program plan to implement the Arctic research policy;

(3) facilitate cooperation between the Federal Government and State and local governments with respect to Arctic research;

(4) review Federal research programs in the Arctic and suggest improvements in coordination among programs;

(5) recommend methods to improve logistical planning and support for Arctic research as may be appropriate and in accordance with the findings and purposes of this title;

(6) suggest methods for improving efficient sharing and dissemination of data and information on the Arctic among interested public and private institutions;

(7) offer other recommendations and advice to the Interagency Committee established under section 107 as it may find appropriate; and

(8) cooperate with the Governor of the State of Alaska and with agencies and organizations of that State which the Governor may designate with respect to the formulation of Arctic research policy.

(b) Not later than January 31 of each year, the Commission shall-

(1) publish a statement of goals and objectives with respect to Arctic research to guide the Interagency Committee established under section 107 in the performance of its duties; and

(2) submit to the President and to the Congress a report describing the activities and accomplishments of the Commission during the immediately preceding fiscal year.

COOPERATION WITH THE COMMISSION

SEC. 105. (a)(1) The Commission may acquire from the head of any Federal agency unclassified data, reports, and other nonproprietary information with respect to Arctic research in the possession of the agency which the Commission considers useful in the discharge of its duties.

(2) Each agency shall cooperate with the Commission and furnish all data, reports, and other information requested by the Commission to the extent permitted by law; except that no agency need furnish any information which it is permitted to withhold under section 552 of title 5, United States Code.

(b) With the consent of the appropriate agency head, the Commission may utilize the facilities and services of any Federal agency to the extent that the facilities and services are needed for the establishment and development of an Arctic research policy, upon reimbursement to be agreed upon by the Commission and the agency head and taking every feasible step to avoid duplication of effort.

(c) All Federal agencies shall consult with the Commission before undertaking major Federal actions relating to Arctic research.

ADMINISTRATION OF THE COMMISSION

SEC. 106. The Commission may-

(1) in accordance with the civil service laws and subchapter III of chapter 53 of title 5, United States Code, appoint and fix the compensation of an Executive Director and necessary additional staff personnel, but not to exceed a total of seven compensated personnel;

(2) procure temporary and intermittent services as authorized by section 3109 of title 5, United States Code;

(3) enter into contracts and procure supplies, services, and personal property; and

(4) enter into agreements with the General Services Administration for the procurement of necessary financial and administrative services, for which payment shall be made by reimbursement from funds of the Commission in amounts to be agreed upon by the Commission and the Administrator of the General Services Administration.

LEAD AGENCY AND INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE

SEC. 107. (a) The National Science Foundation is designated as the lead agency responsible for implementing Arctic research policy, and the Director of the National Science Foundation shall insure that the requirements of section 108 are fulfilled.

(b)(1) The President shall establish an Interagency Arctic Research Policy Committee (hereinafter referred to as the "Interagency Committee").

(2) The Interagency Committee shall be composed of representatives of the following Federal agencies or offices:

(A) the National Science Foundation;

(B) the Department of Commerce;

(C) the Department of Defense;

(D) the Department of Energy;

(E) the Department of the Interior;

(F) the Department of State;

(G) the Department of Transportation;

(H) the Department of Health and Human Services;

(I) the National Aeronautics and Space Administration;

(J) the Environmental Protection Agency; and

(K) any other agency or office deemed appropriate.

(3) The representative of the National Science Foundation shall serve as the Chairperson of the Interagency Committee.

DUTIES OF THE INTERAGENCY COMMITTEE

SEC. 108. (a) The Interagency Committee shall-

(1) survey Arctic research conducted by Federal, State, and local agencies, universities, and other public and private institutions to help determine priorities for future Arctic research, including natural resources and materials, physical and biological sciences, and social and behavioral sciences;

(2) work with the Commission to develop and establish an integrated national Arctic research policy that will guide Federal agencies in developing and implementing their research programs in the Arctic;

(3) consult with the Commission on-

(A) the development of the national Arctic research policy and the 5-year plan implementing the policy;

(B) Arctic research programs of Federal agencies;

(C) recommendations of the Commission on future Arctic research; and

(D) guidelines for Federal agencies for awarding and administering Arctic research grants;

(4) develop a 5-year plan to implement the national policy, as provided for in section 109;

(5) provide the necessary coordination, data, and assistance for the preparation of a single integrated, coherent, and multiagency budget request for Arctic research as provided for in section 110;

(6) facilitate cooperation between the Federal Government and State and local governments in Arctic research, and recommend the undertaking of neglected areas of research in accordance with the findings and purposes of this title;

(7) coordinate and promote cooperative Arctic scientific research programs with other nations, subject to the foreign policy guidance of the Secretary of State;

(8) cooperate with the Governor of the State of Alaska in fulfilling its responsibilities under this title;

(9) promote Federal interagency coordination of all Arctic research activities, including-

(A) logistical planning and coordination; and

(B) the sharing of data and information associated with Arctic research, subject to section 552 of title 5, United States Code; and

(10) provide public notice of its meetings and an opportunity for the public to participate in the development and implementation of national Arctic research policy.

(b) Not later than January 31, 1986, and biennially thereafter, the Interagency Committee shall submit to the Congress through the President, a brief, concise report containing-

(1) a statement of the activities and accomplishments of the Interagency Committee since its last report; and

(2) a description of the activities of the Commission, detailing with particularity the recommendations of the Commission with respect to Federal activities in Arctic research.

5-YEAR ARCTIC RESEARCH PLAN

SEC. 109. (a) The Interagency Committee, in consultation with the Commission, the Governor of the State of Alaska, the residents of the Arctic, the private sector, and public interest groups, shall prepare a comprehensive 5-year program plan (hereinafter referred to as the "Plan") for the overall Federal effort in Arctic research. The Plan shall be prepared and submitted to the President for transmittal to the Congress within one year after the enactment of this Act and shall be revised biennially thereafter.

(b) The Plan shall contain but need not be limited to the following elements:

(1) an assessment of national needs and problems regarding the Arctic and the research necessary to address those needs or problems;

(2) a statement of the goals and objectives of the Interagency Committee for national Arctic research;

(3) a detailed listing of all existing Federal programs relating to Arctic research, including the existing goals, funding levels for each of the 5 following fiscal years, and the funds currently being expended to conduct the programs;

(4) recommendations for necessary program changes and other proposals to meet the requirements of the policy and goals as set forth by the Commission and in the Plan as currently in effect; and

(5) a description of the actions taken by the Interagency Committee to coordinate the budget review process in order to ensure interagency coordination and cooperation in (A) carrying out Federal Arctic research programs, and (B) eliminating unnecessary duplication of effort among these programs.

COORDINATION AND REVIEW OF BUDGET REQUESTS

SEC. 110. (a) The Office of Science and Technology Policy shall-

(1) review all agency and department budget requests related to the Arctic transmitted pursuant to section 108(a)(5), in accordance with the national Arctic research policy and the 5-year program under section 108(a)(2) and section 109, respectively; and

(2) consult closely with the Interagency Committee and the Commission to guide the Office of Science and Technology Policy's efforts.

(b)(1) The Office of Management and Budget shall consider all Federal agency requests for research related to the Arctic as one integrated, coherent, and multiagency request which shall be reviewed by the Office of Management and Budget prior to submission of the President's annual budget request for its adherence to the Plan. The Commission shall, after submission of the President's annual budget request, review the request and report to Congress on adherence to the Plan.

(2) The Office of Management and Budget shall seek to facilitate planning for the design, procurement, maintenance, deployment, and operations of icebreakers needed to provide a platform for Arctic research by allocating all funds necessary to support icebreaking operations, except for recurring incremental costs associated with specific projects, to the Coast Guard.

AUTHORIZATION OF APPROPRIATIONS; NEW SPENDING AUTHORITY

SEC. 111. (a) There are authorized to be appropriated such sums as may be necessary for carrying out this title.

(b) Any new spending authority (within the meaning of section 401 of the Congressional Budget Act of 1974) which is provided under this title shall be effective for any fiscal year only to such extent or in such amounts as may be provided in appropriation Acts.

DEFINITION

SEC. 112. As used in this title, the term "Arctic" means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain.

Appendix B. P.L. 101-609 of 1990, Amending Arctic Research and Policy Act of 1984

The Arctic Research and Policy Act of 1984 (see **Appendix A**) was amended by P.L. 101-609 of November 16, 1990. The text of P.L. 101-609 is as follows:

> SECTION 1. Except as specifically provided in this Act, whenever in this Act an amendment or repeal is expressed as an amendment to, or repeal of a provision, the reference shall be deemed to be made to the Arctic Research and Policy Act of 1984.
>
> SEC. 2. Section 103(b)(1) (15 U.S.C. 4102(b)(1)) is amended—
>
> (1) in the text above clause (A), by striking out `five' and inserting in lieu thereof `seven';
>
> (2) in clause (A), by striking out `three' and inserting in lieu thereof `four'; and
>
> (3) in clause (C), by striking out `one member' and inserting in lieu thereof `two members'.
>
> SEC. 3. Section 103(d)(1) (15 U.S.C. 4102(d)(1)) is amended by striking out `GS-16' and inserting in lieu thereof `GS-18'.
>
> SEC. 4. (a) Section 104(a) (15 U.S.C. 4102(a)) is amended—
>
> (1) in paragraph (4), by striking out `suggest' and inserting in lieu thereof `recommend';
>
> (2) in paragraph (6), by striking out `suggest' and inserting in lieu thereof `recommend';
>
> (3) in paragraph (7), by striking out `and' at the end thereof;
>
> (4) in paragraph (8), by striking out the period and inserting in lieu thereof a semicolon; and
>
> (5) by adding at the end thereof the following new paragraphs:
>
> `(9) recommend to the Interagency Committee the means for developing international scientific cooperation in the Arctic; and
>
> `(10) not later than January 31, 1991, and every 2 years thereafter, publish a statement of goals and objectives with respect to Arctic research to guide the Interagency Committee established under section 107 in the performance of its duties.'.
>
> (b) Section 104(b) is amended to read as follows:
>
> `(b) Not later than January 31 of each year, the Commission shall submit to the President and to the Congress a report describing the activities and accomplishments of the Commission during the immediately preceding fiscal year.'.
>
> SEC. 5. Section 106 (15 U.S.C. 4105) is amended—
>
> (1) in paragraph (3), by striking out `and' at the end thereof;

(2) in paragraph (4), by striking out the period at the end thereof and inserting in lieu thereof `; and'; and

(3) by adding at the end thereof the following new paragraph:

`(5) appoint, and accept without compensation the services of, scientists and engineering specialists to be advisors to the Commission. Each advisor may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. Except for the purposes of chapter 81 of title 5 (relating to compensation for work injuries) and chapter 171 of title 28 (relating to tort claims) of the United States Code, an advisor appointed under this paragraph shall not be considered an employee of the United States for any purpose.'.

SEC. 6. Subsection (b)(2) of section 108 (15 U.S.C. 4107(b)(2)) is amended to read as follows:

`(2) a statement detailing with particularity the recommendations of the Commission with respect to Federal interagency activities in Arctic research and the disposition and responses to those recommendations.'.

Appendix C. January 2009 Presidential Arctic Policy Directive

On January 12, 2009, the George W. Bush Administration released a presidential directive establishing a new U.S. policy for the Arctic region. The directive, dated January 9, 2009, was issued as National Security Presidential Directive 66/Homeland Security Presidential Directive 25 (NSPD 66/HSPD 25). The text of NSPD 66/HSPD 25 is as follows:

SUBJECT: Arctic Region Policy

I. PURPOSE

A. This directive establishes the policy of the United States with respect to the Arctic region and directs related implementation actions. This directive supersedes Presidential Decision Directive/NSC-26 (PDD-26; issued 1994) with respect to Arctic policy but not Antarctic policy; PDD-26 remains in effect for Antarctic policy only.

B. This directive shall be implemented in a manner consistent with the Constitution and laws of the United States, with the obligations of the United States under the treaties and other international agreements to which the United States is a party, and with customary international law as recognized by the United States, including with respect to the law of the sea.

II. BACKGROUND

A. The United States is an Arctic nation, with varied and compelling interests in that region. This directive takes into account several developments, including, among others:

1. Altered national policies on homeland security and defense;

2. The effects of climate change and increasing human activity in the Arctic region;

3. The establishment and ongoing work of the Arctic Council; and

4. A growing awareness that the Arctic region is both fragile and rich in resources.

III. POLICY

A. It is the policy of the United States to:

1. Meet national security and homeland security needs relevant to the Arctic region;

2. Protect the Arctic environment and conserve its biological resources;

3. Ensure that natural resource management and economic development in the region are environmentally sustainable;

4. Strengthen institutions for cooperation among the eight Arctic nations (the United States, Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, and Sweden);

5. Involve the Arctic's indigenous communities in decisions that affect them; and

6. Enhance scientific monitoring and research into local, regional, and global environmental issues.

B. National Security and Homeland Security Interests in the Arctic

1. The United States has broad and fundamental national security interests in the Arctic region and is prepared to operate either independently or in conjunction with other states to safeguard these interests. These interests include such matters as missile defense and early warning; deployment of sea and air systems for strategic sealift, strategic deterrence, maritime presence, and maritime security operations; and ensuring freedom of navigation and overflight.

2. The United States also has fundamental homeland security interests in preventing terrorist attacks and mitigating those criminal or hostile acts that could increase the United States vulnerability to terrorism in the Arctic region.

3. The Arctic region is primarily a maritime domain; as such, existing policies and authorities relating to maritime areas continue to apply, including those relating to law enforcement.[1] Human activity in the Arctic region is increasing and is projected to increase further in coming years. This requires the United States to assert a more active and influential national presence to protect its Arctic interests and to project sea power throughout the region.

4. The United States exercises authority in accordance with lawful claims of United States sovereignty, sovereign rights, and jurisdiction in the Arctic region, including sovereignty within the territorial sea, sovereign rights and jurisdiction within the United States exclusive economic zone and on the continental shelf, and appropriate control in the United States contiguous zone.

5. Freedom of the seas is a top national priority. The Northwest Passage is a strait used for international navigation, and the Northern Sea Route includes straits used for international navigation; the regime of transit passage applies to passage through those straits. Preserving the rights and duties relating to navigation and overflight in the Arctic region supports our ability to exercise these rights throughout the world, including through strategic straits.

6. Implementation: In carrying out this policy as it relates to national security and homeland security interests in the Arctic, the Secretaries of State, Defense, and Homeland Security, in coordination with heads of other relevant executive departments and agencies, shall:

a. Develop greater capabilities and capacity, as necessary, to protect United States air, land, and sea borders in the Arctic region;

b. Increase Arctic maritime domain awareness in order to protect maritime commerce, critical infrastructure, and key resources;

c. Preserve the global mobility of United States military and civilian vessels and aircraft throughout the Arctic region;

d. Project a sovereign United States maritime presence in the Arctic in support of essential United States interests; and

e. Encourage the peaceful resolution of disputes in the Arctic region.

C. International Governance

1. The United States participates in a variety of fora, international organizations, and bilateral contacts that promote United States interests in the Arctic. These include the Arctic Council, the International Maritime Organization (IMO), wildlife conservation and management agreements, and many other mechanisms. As the Arctic changes and human activity in the region increases, the United States and other governments should consider, as appropriate, new international arrangements or enhancements to existing arrangements.

2. The Arctic Council has produced positive results for the United States by working within its limited mandate of environmental protection and sustainable development. Its subsidiary bodies, with help from many United States agencies, have developed and undertaken projects on a wide range of topics. The Council also provides a beneficial venue for interaction with indigenous groups. It is the position of the United States that the Arctic Council should remain a high-level forum devoted to issues within its current mandate and not be transformed into a formal international organization, particularly one with assessed contributions. The United States is nevertheless open to updating the structure of the Council, including consolidation of, or making operational changes to, its subsidiary bodies, to the extent such changes can clearly improve the Council's work and are consistent with the general mandate of the Council.

3. The geopolitical circumstances of the Arctic region differ sufficiently from those of the Antarctic region such that an "Arctic Treaty" of broad scope—along the lines of the Antarctic Treaty—is not appropriate or necessary.

4. The Senate should act favorably on U.S. accession to the U.N. Convention on the Law of the Sea promptly, to protect and advance U.S. interests, including with respect to the Arctic. Joining will serve the national security interests of the United States, including the maritime mobility of our Armed Forces worldwide. It will secure U.S. sovereign rights over extensive marine areas, including the valuable natural resources they contain. Accession will promote U.S. interests in the environmental health of the oceans. And it will give the United States a seat at the table when the rights that are vital to our interests are debated and interpreted.

5. Implementation: In carrying out this policy as it relates to international governance, the Secretary of State, in coordination with heads of other relevant executive departments and agencies, shall:

a. Continue to cooperate with other countries on Arctic issues through the United Nations (U.N.) and its specialized agencies, as well as through treaties such as the U.N. Framework Convention on Climate Change, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention on Long Range Transboundary Air Pollution and its protocols, and the Montreal Protocol on Substances that Deplete the Ozone Layer;

b. Consider, as appropriate, new or enhanced international arrangements for the Arctic to address issues likely to arise from expected increases in human activity in that region, including shipping, local development and subsistence, exploitation of living marine resources, development of energy and other resources, and tourism;

c. Review Arctic Council policy recommendations developed within the ambit of the Council's scientific reviews and ensure the policy recommendations are subject to review by Arctic governments; and

d. Continue to seek advice and consent of the United States Senate to accede to the 1982 Law of the Sea Convention.

D. Extended Continental Shelf and Boundary Issues

1. Defining with certainty the area of the Arctic seabed and subsoil in which the United States may exercise its sovereign rights over natural resources such as oil, natural gas, methane hydrates, minerals, and living marine species is critical to our national interests in energy security, resource management, and environmental protection. The most effective way to achieve international recognition and legal certainty for our extended continental shelf is through the procedure available to States Parties to the U.N. Convention on the Law of the Sea.

2. The United States and Canada have an unresolved boundary in the Beaufort Sea. United States policy recognizes a boundary in this area based on equidistance. The United States recognizes that the boundary area may contain oil, natural gas, and other resources.

3. The United States and Russia are abiding by the terms of a maritime boundary treaty concluded in 1990, pending its entry into force. The United States is prepared to enter the agreement into force once ratified by the Russian Federation.

4. Implementation: In carrying out this policy as it relates to extended continental shelf and boundary issues, the Secretary of State, in coordination with heads of other relevant executive departments and agencies, shall:

a. Take all actions necessary to establish the outer limit of the continental shelf appertaining to the United States, in the Arctic and in other regions, to the fullest extent permitted under international law;

b. Consider the conservation and management of natural resources during the process of delimiting the extended continental shelf; and

c. Continue to urge the Russian Federation to ratify the 1990 United States-Russia maritime boundary agreement.

E. Promoting International Scientific Cooperation

1. Scientific research is vital for the promotion of United States interests in the Arctic region. Successful conduct of U.S. research in the Arctic region requires access throughout the Arctic Ocean and to terrestrial sites, as well as viable international mechanisms for sharing access to research platforms and timely exchange of samples, data, and analyses. Better coordination with the Russian Federation, facilitating access to its domain, is particularly important.

2. The United States promotes the sharing of Arctic research platforms with other countries in support of collaborative research that advances fundamental understanding of the Arctic region in general and potential Arctic change in particular. This could include collaboration with bodies such as the Nordic Council and the European Polar Consortium, as well as with individual nations.

3. Accurate prediction of future environmental and climate change on a regional basis, and the delivery of near real-time information to end-users, requires obtaining, analyzing, and disseminating accurate data from the entire Arctic region, including both paleoclimatic data and observational data. The United States has made significant investments in the infrastructure needed to collect environmental data in the Arctic region, including the establishment of portions of an Arctic circumpolar observing network through a partnership among United States agencies, academic collaborators, and Arctic residents. The United States promotes active involvement of all Arctic nations in these efforts in order to advance

scientific understanding that could provide the basis for assessing future impacts and proposed response strategies.

4. United States platforms capable of supporting forefront research in the Arctic Ocean, including portions expected to be ice-covered for the foreseeable future, as well as seasonally ice-free regions, should work with those of other nations through the establishment of an Arctic circumpolar observing network. All Arctic nations are members of the Group on Earth Observations partnership, which provides a framework for organizing an international approach to environmental observations in the region. In addition, the United States recognizes that academic and research institutions are vital partners in promoting and conducting Arctic research.

5. Implementation: In carrying out this policy as it relates to promoting scientific international cooperation, the Secretaries of State, the Interior, and Commerce and the Director of the National Science Foundation, in coordination with heads of other relevant executive departments and agencies, shall:

a. Continue to play a leadership role in research throughout the Arctic region;

b. Actively promote full and appropriate access by scientists to Arctic research sites through bilateral and multilateral measures and by other means;

c. Lead the effort to establish an effective Arctic circumpolar observing network with broad partnership from other relevant nations;

d. Promote regular meetings of Arctic science ministers or research council heads to share information concerning scientific research opportunities and to improve coordination of international Arctic research programs;

e. Work with the Interagency Arctic Research Policy Committee (IARPC) to promote research that is strategically linked to U.S. policies articulated in this directive, with input from the Arctic Research Commission; and

f. Strengthen partnerships with academic and research institutions and build upon the relationships these institutions have with their counterparts in other nations.

F. Maritime Transportation in the Arctic Region

1. The United States priorities for maritime transportation in the Arctic region are:

a. To facilitate safe, secure, and reliable navigation;

b. To protect maritime commerce; and

c. To protect the environment.

2. Safe, secure, and environmentally sound maritime commerce in the Arctic region depends on infrastructure to support shipping activity, search and rescue capabilities, short- and long-range aids to navigation, high-risk area vessel-traffic management, iceberg warnings and other sea ice information, effective shipping standards, and measures to protect the marine environment. In addition, effective search and rescue in the Arctic will require local, State, Federal, tribal, commercial, volunteer, scientific, and multinational cooperation.

3. Working through the International Maritime Organization (IMO), the United States promotes strengthening existing measures and, as necessary, developing new measures to improve the safety and security of maritime transportation, as well as to protect the marine environment in the Arctic region. These measures may include ship routing and reporting systems, such as traffic separation and vessel traffic management schemes in Arctic chokepoints; updating and strengthening of the Guidelines for Ships Operating in Arctic Ice-Covered Waters; underwater noise standards for commercial shipping; a review of shipping insurance issues; oil and other hazardous material pollution response agreements; and environmental standards.

4. Implementation: In carrying out this policy as it relates to maritime transportation in the Arctic region, the Secretaries of State, Defense, Transportation, Commerce, and Homeland Security, in coordination with heads of other relevant executive departments and agencies, shall:

a. Develop additional measures, in cooperation with other nations, to address issues that are likely to arise from expected increases in shipping into, out of, and through the Arctic region;

b. Commensurate with the level of human activity in the region, establish a risk-based capability to address hazards in the Arctic environment. Such efforts shall advance work on pollution prevention and response standards; determine basing and logistics support requirements, including necessary airlift and icebreaking capabilities; and improve plans and cooperative agreements for search and rescue;

c. Develop Arctic waterways management regimes in accordance with accepted international standards, including vessel traffic-monitoring and routing; safe navigation standards; accurate and standardized charts; and accurate and timely environmental and navigational information; and

d. Evaluate the feasibility of using access through the Arctic for strategic sealift and humanitarian aid and disaster relief.

G. Economic Issues, Including Energy

1. Sustainable development in the Arctic region poses particular challenges. Stakeholder input will inform key decisions as the United States seeks to promote economic and energy security. Climate change and other factors are significantly affecting the lives of Arctic inhabitants, particularly indigenous communities. The United States affirms the importance to Arctic communities of adapting to climate change, given their particular vulnerabilities.

2. Energy development in the Arctic region will play an important role in meeting growing global energy demand as the area is thought to contain a substantial portion of the world's undiscovered energy resources. The United States seeks to ensure that energy development throughout the Arctic occurs in an environmentally sound manner, taking into account the interests of indigenous and local communities, as well as open and transparent market principles. The United States seeks to balance access to, and development of, energy and other natural resources with the protection of the Arctic environment by ensuring that continental shelf resources are managed in a responsible manner and by continuing to work closely with other Arctic nations.

3. The United States recognizes the value and effectiveness of existing fora, such as the Arctic Council, the International Regulators Forum, and the International Standards Organization.

4. Implementation: In carrying out this policy as it relates to economic issues, including energy, the Secretaries of State, the Interior, Commerce, and Energy, in coordination with heads of other relevant executive departments and agencies, shall:

a. Seek to increase efforts, including those in the Arctic Council, to study changing climate conditions, with a view to preserving and enhancing economic opportunity in the Arctic region. Such efforts shall include inventories and assessments of villages, indigenous communities, subsistence opportunities, public facilities, infrastructure, oil and gas development projects, alternative energy development opportunities, forestry, cultural and other sites, living marine resources, and other elements of the Arctic's socioeconomic composition;

b. Work with other Arctic nations to ensure that hydrocarbon and other development in the Arctic region is carried out in accordance with accepted best practices and internationally recognized standards and the 2006 Group of Eight (G-8) Global Energy Security Principles;

c. Consult with other Arctic nations to discuss issues related to exploration, production, environmental and socioeconomic impacts, including drilling conduct, facility sharing, the sharing of environmental data, impact assessments, compatible monitoring programs, and reservoir management in areas with potentially shared resources;

d. Protect United States interests with respect to hydrocarbon reservoirs that may overlap boundaries to mitigate adverse environmental and economic consequences related to their development;

e. Identify opportunities for international cooperation on methane hydrate issues, North Slope hydrology, and other matters;

f. Explore whether there is a need for additional fora for informing decisions on hydrocarbon leasing, exploration, development, production, and transportation, as well as shared support activities, including infrastructure projects; and

g. Continue to emphasize cooperative mechanisms with nations operating in the region to address shared concerns, recognizing that most known Arctic oil and gas resources are located outside of United States jurisdiction.

H. Environmental Protection and Conservation of Natural Resources

1. The Arctic environment is unique and changing. Increased human activity is expected to bring additional stressors to the Arctic environment, with potentially serious consequences for Arctic communities and ecosystems.

2. Despite a growing body of research, the Arctic environment remains poorly understood. Sea ice and glaciers are in retreat. Permafrost is thawing and coasts are eroding. Pollutants from within and outside the Arctic are contaminating the region. Basic data are lacking in many fields. High levels of uncertainty remain concerning the effects of climate change and increased human activity in the Arctic. Given the need for decisions to be based on sound scientific and socioeconomic information, Arctic environmental research, monitoring, and vulnerability assessments are top priorities. For example, an understanding of the probable consequences of global climate variability and change on Arctic ecosystems is essential to guide the effective long-term management of Arctic natural resources and to address socioeconomic impacts of changing patterns in the use of natural resources.

3. Taking into account the limitations in existing data, United States efforts to protect the Arctic environment and to conserve its natural resources must be risk-based and proceed on the basis of the best available information.

4. The United States supports the application in the Arctic region of the general principles of international fisheries management outlined in the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of December 10, 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks and similar instruments. The United States endorses the protection of vulnerable marine ecosystems in the Arctic from destructive fishing practices and seeks to ensure an adequate enforcement presence to safeguard Arctic living marine resources.

5. With temperature increases in the Arctic region, contaminants currently locked in the ice and soils will be released into the air, water, and land. This trend, along with increased human activity within and below the Arctic, will result in increased introduction of contaminants into the Arctic, including both persistent pollutants (e.g., persistent organic pollutants and mercury) and airborne pollutants (e.g., soot).

6. Implementation: In carrying out this policy as it relates to environmental protection and conservation of natural resources, the Secretaries of State, the Interior, Commerce, and Homeland Security and the Administrator of the Environmental Protection Agency, in coordination with heads of other relevant executive departments and agencies, shall:

a. In cooperation with other nations, respond effectively to increased pollutants and other environmental challenges;

b. Continue to identify ways to conserve, protect, and sustainably manage Arctic species and ensure adequate enforcement presence to safeguard living marine resources, taking account of the changing ranges or distribution of some species in the Arctic. For species whose range includes areas both within and beyond United States jurisdiction, the United States shall continue to collaborate with other governments to ensure effective conservation and management;

c. Seek to develop ways to address changing and expanding commercial fisheries in the Arctic, including through consideration of international agreements or organizations to govern future Arctic fisheries;

d. Pursue marine ecosystem-based management in the Arctic; and

e. Intensify efforts to develop scientific information on the adverse effects of pollutants on human health and the environment and work with other nations to reduce the introduction of key pollutants into the Arctic.

IV. Resources and Assets

A. Implementing a number of the policy elements directed above will require appropriate resources and assets. These elements shall be implemented consistent with applicable law and authorities of agencies, or heads of agencies, vested by law, and subject to the availability of appropriations. The heads of executive departments and agencies with responsibilities relating to the Arctic region shall work to identify future budget, administrative, personnel, or legislative proposal requirements to implement the elements of this directive.

[1] These policies and authorities include Freedom of Navigation (PDD/NSC-32), the U.S. Policy on Protecting the Ocean Environment (PDD/NSC-36), Maritime Security Policy (NSPD-41/HSPD-13), and the National Strategy for Maritime Security (NSMS).[190]

Author Contact Information

Ronald O'Rourke, Coordinator
Specialist in Naval Affairs
rorourke@crs.loc.gov, 7-7610

Marjorie Ann Browne
Specialist in International Relations
mbrowne@crs.loc.gov, 7-7695

Eugene H. Buck
Specialist in Natural Resources Policy
gbuck@crs.loc.gov, 7-7262

M. Lynne Corn
Specialist in Natural Resources Policy
lcorn@crs.loc.gov, 7-7267

Carl Ek
Specialist in International Relations
cek@crs.loc.gov, 7-7286

Peter Folger
Specialist in Energy and Natural Resources Policy
pfolger@crs.loc.gov, 7-1517

John Frittelli
Specialist in Transportation Policy
jfrittelli@crs.loc.gov, 7-7033

Curry L. Hagerty
Specialist in Energy and Natural Resources Policy
chagerty@crs.loc.gov, 7-7738

Marc Humphries
Analyst in Energy Policy
mhumphries@crs.loc.gov, 7-7264

Jane A. Leggett
Specialist in Energy and Environmental Policy
jaleggett@crs.loc.gov, 7-9525

Jonathan L. Ramseur
Specialist in Environmental Policy
jramseur@crs.loc.gov, 7-7919

Roger Walke
Specialist in American Indian Policy
rwalke@crs.loc.gov, 7-8641

[190] Source for text: http://fas.org/irp/offdocs/nspd/nspd-66.htm. The text is also available online at http://www.nsf.gov/od/opp/opp_advisory/briefings/may2009/nspd66_hspd25.pdf.

RESOURCE review

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Shell outlines oil spill response plan for the Arctic OCS

In a briefing open to the press with Senator Lisa Murkowski, Shell emphasized its experience in harsh, remote Arctic environments and the lengths and expense it is willing to go to safely explore, develop and produce oil and gas resources in the Chukchi and Beaufort seas.

"We do work in a lot of areas worldwide where there are weather conditions that are more challenging than what we see in the Beaufort and the Chukchi," said Shell Alaska Vice President Pete Slaiby. "For instance, we've been operating in the North Sea since the mid-1960s where we have higher winds and seas. The Gulf of Mexico can have dramatically higher wind. What we get in the Beaufort and Chukchi is multi-year ice. The currents you see right out the window here in Cook Inlet are probably two to three times the current you see in the Chukchi, and Shell put the first two platforms in Cook Inlet in the early 1960s."

Shell oil spill response equipment on deck at Dutch Harbor.

The Chukchi Sea is an important future source of U.S. energy supply with up to 29 billion barrels of oil and 209 trillion cubic feet of natural gas potentially in place. The Chukchi is considered the most prospective unexplored offshore basin in the country.

Shell has been slammed with repeated permitting and litigation delays and has spent in excess of $3.5 billion over the past several years to acquire leases and prepare for drilling. The company is seeking approval for a 2012 exploration plan that would allow it to drill several wells in both the Chukchi and Beaufort, reinforced by a flotilla of support ships, barges, tugs, recovery vessels, back-up drill rigs, and a double-hulled icebreaking tanker with a capacity of 513,000 barrels.

Shell was planning to mobilize its fleet in 2010, but the Deepwater Horizon spill in the Gulf of Mexico led to a de facto moratorium on Arctic drilling. The company's 2011 program was scuttled after its final air permit was revoked by the Environmental Protection Agency's (EPA) appeals board.

Shell is now looking for a positive record of decision on a supplemental environmental impact statement by October 3. If that decision isn't positive, the 2012 program would also be derailed.

In an encouraging sign, the EPA has issued draft air quality permits for Shell and ConocoPhillips exploratory drilling operations in the Chukchi and Beaufort seas beginning in 2012. The draft permits are subject to a 30-day public review, and it is likely that environmental groups will also appeal the most recent drafts. Shell has spent over $60 million over the past four years to secure its air permits.

"We believe the work we have done to further modify and reduce our air emissions to meet new standards meets the goal of having no measurable impact on the environment or coastal villages," said Shell's spokesperson Curtis Smith.

At a July briefing in Anchorage, Shell highlighted its comprehensive spill prevention and response plans to Murkowski and the press. The company assured Murkowski it has the capability to respond quickly and effectively to a spill without the support of onshore infrastructure, which is currently quite limited in the Arctic.

Shell noted that drilling in the Arctic offers distinct differences and advantages over deepwater exploration and development in

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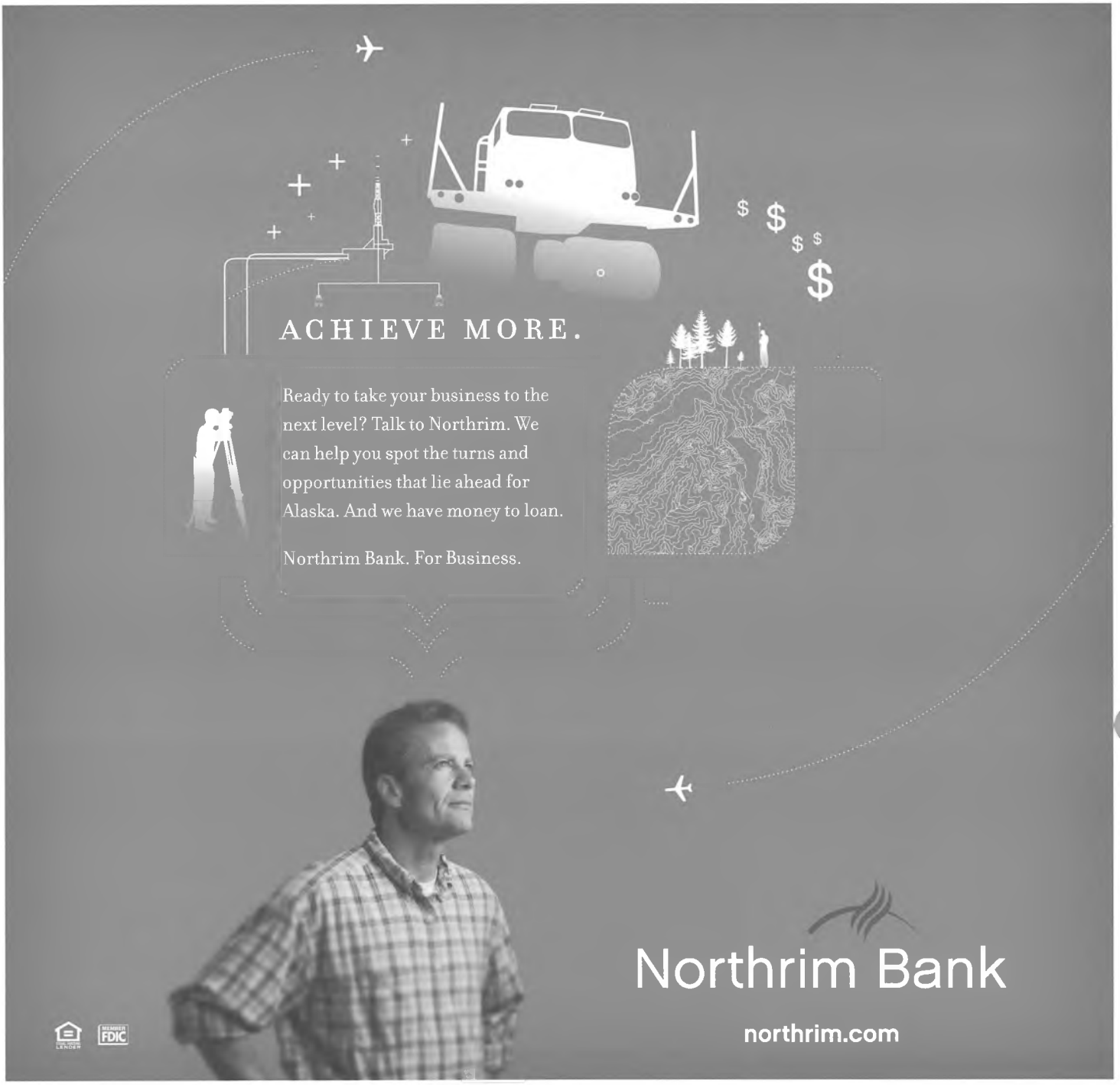

Resource Development Council

121 W. Fireweed, Suite 250
Anchorage, AK 99503

(907) 276-0700
e-mail: resources@akrdc.org
www.akrdc.org

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The Resource Review is the official periodic publication of the Resource Development Council (RDC), Alaska's largest privately funded nonprofit economic development organization working to develop Alaska's natural resources in a responsible manner and to create a broad-based, diversified economy.

Past issues of the Resource Review (1978-2011) are available at akrdc.org.

Jason Brune accepts new position at Anglo American

RDC Executive Director Jason Brune has been appointed Public Affairs and Government Relations Manager for Anglo American US. Brune's resignation from RDC became effective June 1.

Anglo American is one of two partners pursuing development of the Pebble copper and gold prospect in Southwest Alaska. Brune will be based at the company's Anchorage office.

"Through the RDC, I have had the privilege of working with Jason for the last three years and besides his energy, integrity, and commitment to the responsible development of Alaska's resources, I have been very impressed with his efforts to build consensus and engage constructively on even the most challenging issues," said Paul Henry, Chief Operating Officer of Anglo American US. "I am therefore delighted to welcome Jason into the Anglo American family and I know he will make a great addition to our team."

Brune first came to RDC in August 2000 and served six years as Projects Coordinator and led the Alaska Mineral and Energy Resource Education Fund, now Alaska Resource Education, as its Executive Director. He was appointed RDC Executive Director in November 2006.

At the Annual Meeting Luncheon June 28, RDC President Tom Maloney presented Jason Brune with one of RDC's limited edition First Barrel of Oil plaques in appreciation for his 11 years of service to the statewide business organization. Brune served as Executive Director for over four years.

During his tenure at RDC, Brune built on RDC's successes, working closely with state and federal governments and the Alaska Legislature on key resource development initiatives and issues. He also worked to expand RDC's membership base and grow the organization's special events. He was a key player in building public opposition to several ballot initiatives which would have been detrimental to the responsible development of Alaska's oil and gas and mineral resources.

The RDC Board of Directors has initiated a search for a new Executive Director.

Alaskans turn out in force to support OCS drilling

Pro-drilling OCS energy advocates heavily dominated a public hearing in Anchorage June 29 on Lease Sale 193.

Approximately 100 Alaskans attended the hearing and of those who testified, 32 spoke in favor of Lease Sale 193 while 11 urged the federal government to dismiss it. Pro-drilling advocates included private citizens and representatives from virtually every Alaska industry and sector of the economy, including mining, timber, tourism and organized labor.

Speaking against exploration were representatives of a number of international and national environmental activist groups, including the Pew Environmental Group, Sierra Club, Wilderness Society, and Ocean Conservancy, along with several private citizens.

The federal Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) recently released a new Draft Supplemental Environmental Impact Statement (SEIS) for the 2008 Chukchi Sea lease sale in which Shell, ConocoPhillips, Statoil, and others had purchased leases for oil and gas exploration. In July 2010, the U.S. District Court in Alaska, in response to an appeal against the lease sale, ordered BOEM to rework some technical aspects of the original Environmental Impact Statement for the sale, and the court banned lease related activities in the Chukchi Sea until BOEMRE prepared a new SEIS to the court's satisfaction.

The federal agency initially released a draft SEIS in October, but after reviewing public comments on the draft, BOEMRE chose to add an analysis of a very large oil spill in the Chukchi. The scenario of 2.2 million barrels spilled from a blowout lasting 74 days is considered a theoretical "worst case" for drilling across the large lease sale area. That analysis has now been completed and is included in the new draft SEIS.

A Final SEIS will provide the Secretary of the Interior with sufficient information and analyses to make an informed decision on whether to affirm, modify, or cancel Lease Sale 193. No drilling can take place until the final EIS is issued and Sale 193 is affirmed.

In its comments, RDC urged BOEMRE to affirm the lease sale as held.

OCS oil and gas development is absolutely critical to Alaska's future economy. With the Trans-Alaska Pipeline System now running at one-third capacity, exploration blocked

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Shell confident it can respond to Arctic spill

(Continued from page 1)

the Gulf of Mexico. The pressure encountered in deepwater drilling is multiple times greater than in Alaska where wells would be in much shallower water. The much lower reservoir pressure in the Alaska OCS means a significantly lower blowout risk compared to deepwater drilling in the Gulf. There are also major differences in well designs, as well as fundamental differences in the geology of the regions.

As it does with hurricanes in the Gulf of Mexico, Shell also has the ability to quickly move rigs out of harms way if ice moves in during its summer open-water drilling season.

Shell pointed out that the cold water of the Arctic and the depth of drilling offer some advantages that work in the company's favor. For example, the Deepwater Horizon spill in the Gulf of Mexico last summer occurred in 5,000 feet of water. In the Chukchi, Shell proposes to drill in water up to 150 feet deep. In deepwater drilling in the Gulf of Mexico, down-hole pressure is three to five times greater than what would be encountered in the Arctic, making a well much more difficult to cap in the Gulf. With the much shallower waters of the Alaska Arctic, an initial oil slick – should an accident occur – would be between 150-250 feet wide.

Oil would reach the surface in less than 10 seconds if a blowout occurred in Alaska, while oil from last summer's Gulf spill took more than an hour to surface and by then the slick was a mile wide.

Because oil would not emulsify as quickly in cold water, Shell would have a longer window of opportunity to use dispersants in the Arctic without losing their effectiveness.

At the core of Shell's contingency plan is to have oil spill response equipment on site at drilling locations and staged at strategic points, ready for deployment in the unlikely event of a spill. The self-contained response capability would also include trained personnel and supplies.

The company already has extensive experience operating in remote Arctic regions with little or no infrastructure. Shell will use equipment specifically designed for deployment in icy conditions, even though the company would be drilling during a 105-day open-water season.

Shell emphasized its top priority and focus is the prevention of spills through effective well planning and the use of remote oversight and monitoring of drilling operations.

Given the difficulty encountered in stemming the flow of oil from the deep water spill in the Gulf of Mexico, Shell is developing two new well capping and containment devices for use in the Arctic. If there were a blowout in the Arctic and if the well's blowout preventer recessed into the sea floor were to fail, Shell's first response would be to cap the well to stop the escape of oil into the ocean. That could be done by lowering a capping system onto the well bore and then it would be clamped into place. This system would include conduit to send oil to storage vessels at the surface. This system would give drillers the capability to kill the well by re-entering the well or by injecting fluids.

A second device that could be deployed is a containment dome designed to be lowered over the top of the well to gather oil escaping from the well and direct it through piping to surface vessels.

Shell's plan for the recovery of oil includes three tiers: recovery near the well site, recovery near to shore, and recovery onshore and along the shoreline.

Shell's drilling operations will have a purpose built, ice-capable spill response vessel on site to support any well site oil recovery operation. The Nanuq is already in operation while a second vessel is under construction. The Arctic Endeavor, an ice-strengthened barge, would support nearshore response.

The vessels would be fully equipped with boom, skimmers, and other spill response equipment. An ice-class, double-hulled tanker would be used to store recovered oil.

For the shoreline and onshore areas, Shell has pre-staged equipment at strategic sites and has a contract with the spill response cooperative Alaska Clean Seas for onshore operations. Plans include the protection of high priority, environmentally-sensitive onshore sites.

Shell says it has enough equipment to respond independently to the largest foreseeable spill at any of its drilling operations in the Arctic. Should it prove necessary, the company also has access to caches of spill response equipment worldwide. Much of the equipment could be flown in through Barrow or the village of Wainwright. Much of the equipment is packaged so it can be transported quickly.

RDC touts benefits of tapping Alaska OCS

(Continued from page 3)

in ANWR, and non-development activists working toward Wilderness designations in the National Petroleum Reserve, nothing less than Alaska's future economy is at stake.

Development of potentially immense oil and gas deposits in the Chukchi Sea would significantly boost the economy for a generation and extend the life of the oil pipeline. Without new oil production, TAPS could be uneconomic to operate at some point in the next decade.

"If there is no oil and gas development in ANWR and the OCS, and the best prospects in NPR-A are taken off the table, the federal government must then accept the consequences, including heavier reliance on foreign oil, soaring trade deficits, a weaker national economy, and compromised national security," said RDC Deputy Director Carl Portman. "For Alaskans, our future will be bleak with the state losing much of its economic base."

OCS production could provide an annual average of 54,700 jobs nationwide with an estimated cumulative payroll of $145 billion over the next 50 years. Moreover, revenues generated from OCS development in the Arctic could amount to hundreds of billions of dollars in revenues to federal, state and local governments over a 50-year period.

The potential recoverable reserves offshore Alaska is more than all the current total proven U.S. oil reserves of approximately 21 billion barrels.

Please see RDC's comments at akrdc.org.

Alaska ranks low in two recent surveys measuring business climate

Despite a pro-business governor, a treasure-trove of natural resources and a budget surplus, Alaska ranks near the bottom in two recent surveys of places to do business. We know how great it is to work, live and play here, so we find such rankings frustrating. However, objective observers are telling us that our economic house is not in order, and they are telling us what needs improvement.

The annual CNBC survey of "America's Top States for Business" puts Alaska in 49th place. Last year we were 50th, and this year our huge oil tax surplus helped move us ahead of Rhode Island.

The study looked at the basic indicators of economic health and growth, including fiscal health, which was calculated by examining projected budget gaps (or surpluses) for the coming fiscal year. Even this bright spot was somewhat dimmed by learning that North Dakota and Wyoming beat us in this category – both with oil taxes orders of magnitude lower than Alaska's.

We flunked most of the other categories: 49th in cost of doing business, 48th in workforce, 43rd in technology and innovation, 41st in education, 49th in cost of living. We got slightly better grades in access to capital, 35th, and business friendliness, 34th. The one category where we usually think we don't stack up – what I call the "cold and dark" measure - we proved ourselves competitive in the middle of the pack at 21st.

But wait, there's more!

A recent report issued by the Fraser Institute, a well-respected Canadian research organization, ranked locations in terms of their favorability to oil and gas development. Alaska's scores went from bad last year to dismal this year, falling behind 21 oil regions.

While Alaska only ranked in the third quintile, other U.S. states dominated the top quintile, with eight of the top 10 spots going to U.S. states: Mississippi, Ohio and Kansas taking the top three spots.

> **"A recent report issued by the Fraser Institute, a well-respected Canadian research organization, ranked locations in terms of their favorability to oil and gas development. Alaska's scores went from bad last year to dismal this year, falling behind 21 oil regions."**
>
> **– Rachael Petro**

Meantime, Alaska offshore plunged from 57th to 78th and Alaska onshore fell from 68th to 83rd. Ouch!

So why is a state with a world-class resource ranked with Uzbekistan and Uganda? In the case of offshore, the report says: "investors continue to be turned off by environmental regulations and related uncertainties in these areas."

Onshore, the report says, Alaska dropped 15 places "due to poorer scores on a number of issues, including fiscal terms, environmental regulation, the cost of regulatory compliance, uncertainties about protected areas and Native land claims."

Maybe that explains why a single exploratory well was drilled on the North Slope last year – and a single well this year, despite record high oil prices. No more waiting to reform our oil tax!

But wait, there's more! The operator of the trans-Alaska pipeline – the economic engine that pays for 90 percent of state government – just issued a report warning that we need to act now to increase flow through the pipeline.

"The study findings make it clear that the technical challenges compound and increase as throughput declines," said Alyeska Service Company President Tom Barrett. "The simplest, most direct and cost-effective path to dealing with these challenges is to stop the decline by adding more oil."

Our own Senator Lisa Murkowski quickly called for action on the federal level. And Senator Begich is aggressively pushing the federal government as well, calling the pipeline a national asset that delivers about 12 percent of U.S. oil production.

Here at home, Governor Sean Parnell outlined the "Secure Our Future" strategy, a five-point program to increase pipeline throughput to one million barrels a day:

- Boosting Alaska's competitiveness and investment climate.
- Structuring the permitting processes to improve resource development decision-making.
- Facilitating and incentivizing the next phases of North Slope development.
- Forging national partnerships to increase investment, while protecting the state's interest.
- Promoting domestic oil production and Alaska's role.

We know how to improve our business rankings, but our policy makers must agree and take action – as soon as possible.

Calling all champions for Alaska's future. Let's work together to improve Alaska's business climate!

Plan to participate in the Alaska State Chamber of Commerce's 52nd Annual Conference, where fellow champions will gather to discuss and plan Alaska's future success. The conference will be in Talkeetna, Alaska from September 19-21. Register today at www.alaskachamber.com.

Rachael Petro is the President and CEO of the Alaska State Chamber of Commerce.

America is funding its own demise

In a keynote address before 950 Alaskans attending RDC's 36th Annual Meeting Luncheon in Anchorage June 28, Wyoming attorney Karen Budd-Falen reported that environmental groups are collecting tens of millions of dollars in attorney fees from the federal government in lawsuits aimed at systematically stopping development in oil, mining, timber, and other industries.

At issue is the Judgment Fund and the Equal Access to Justice Act (EAJA) which requires the federal government to pay attorney fees when it loses cases under statutes that do not specifically call for such fees to be paid by the government.

Budd-Falen and a growing block of Republicans in Congress argue that environmental groups have taken advantage of a lack of oversight on such payments and file lawsuits they know they can win on procedural grounds. Frequent litigants include the Sierra Club Legal Defense Fund, the Center for Biological Diversity, and Earthjustice.

Budd-Falen noted the Judgment Fund is reauthorized every year by Congress, but with no specified amount. The fund pays for litigation under the Clean Water Act, the Clean Air Act, and the Endangered Species Act (ESA). The Equal Access to Judgment Act applies in cases involving the National Environmental Policy Act (NEPA).

The Wyoming attorney and rancher reported that the Sierra Club alone has collected at least $56 million from the federal government for attorney fees. She said in one case, the government agreed to pay Earthjustice an hourly rate of $750 in attorney fees.

In that case, the environmental law firm collected $500,000. She said that in many cases the federal government would not disclose fees paid to environmental groups. In at least 10 percent of the cases nationwide, there is no information available as to how much in U.S. tax dollars were paid in attorney fees to environmental groups.

Budd-Falen pointed out that although federal law requires the awarding of fees be limited to the winning party in a lawsuit, in 21 percent of the cases, the government paid fees before the outcome of the case was determined.

Budd-Falen emphasized that in most cases, the groups sue on process, not substance. She said that despite best intentions, the federal agencies cannot fulfill all NEPA and ESA requirements in an entirely perfect manner, given compliance is too complex. This opens the door for environmentalists to sue on process issues, not on the impacts of a project itself.

For instance, under the ESA, the government has 90 days to respond to a petition to list a species for special protection. If the government does not respond to the petition within that time period, it is vulnerable to a process-driven lawsuit where the environmental group gets its fees paid, even for writing the petition in the first place, Budd-Falen warned.

The Center for Biological Diversity last year alone filed 1,000 petitions with the federal government to list species under the ESA.

The litigation climate in Alaska and elsewhere is driving investment away from America, Budd-Falen warned. "We're funding our own demise."

In research she conducted, Budd-Falen discovered that between 2000 and 2009, in 19 states 14 environmental groups filed 3,000 lawsuits in federal district courts, collecting $37 million in attorney fees. In addition, they collected an additional $4 million from private companies. No fees were disclosed in at least 10 percent of the cases.

Karen Budd-Falen spoke at RDC's 36th Annual Meeting Luncheon June 28, addressing the topic of environmental litigation and a strategy to restore fairness to industry and consumers. Budd-Falen warned that environmental groups are collecting tens of millions of dollars in attorney fees from the federal government in lawsuits that are brought largely on procedural grounds. These lawsuits have delayed or derailed projects in the oil and gas, mining, and timber industries that are important to national and local economies.

Moreover, court documents revealed that the federal government and private companies were forced to make $555,000 in donations to environmental groups, Budd-Falen said.

She noted that twice as many cases have been filed during the Obama administration, suggesting green groups may be emboldened by favorable decisions from a Democratic U.S. Justice Department. The most heavily litigated industry is the oil and gas sector.

According to a separate academic study outside of Budd-Falen's research, the Forest Service itself paid $6.1 million in legal fees to groups that sued it over a six-year period. The payments cover the period spanning 1999-2005.

Budd-Falen said there are efforts underway in Congress to accomplish litigation reform to curb what she called abuses of the system. A Republican-backed bill, H.R. 1996, would reform the law to restrict reimbursements for each entity to no more than three in a calendar year and would prevent payments to any group that has a net worth of more than $7 million. Attorney fees would be capped at $175 an hour and maximum payment for each case would be $200,000. Accountability of every dollar paid out in attorney fees would be required.

With regard to NEPA cases, Budd-Falen said the impacts of delays stemming from litigation should be calculated into the cost of a project. She said that in all NEPA compliant projects, the federal government should be required to equally consider the economic benefits of a project to local communities. She said the NEPA process needs to consider local economic stability in the permitting process. These recommendations are being worked into federal legislation. A video of Budd-Falen's presentation is available at akrdc.org.

Emerging ocean policy draws concern from Alaskans

By Marleanna Hall

Recent listening sessions, public workshops, and review of the nine Strategic Action Plan outlines issued by the National Ocean Council (NOC) have offered little more to further explain the future of national ocean policy.

There is growing concern that the new ocean policy, especially coastal and marine spatial planning (also widely called ocean zoning), could cause unnecessary harm to economies across the United States. In Alaska, industries such as fishing, transportation, mining, tourism, forestry, oil and gas, and support sectors could all be impacted. These impacts will likely cause a larger burden on Alaskans than the rest of the nation.

Given Alaska has more coastline than the continental U.S. combined, a national ocean policy will have a greater impact on the state, further hampering the already slow processes with little or no added benefit to the environment. Alaskan stakeholders are discouraging a one-size-fits-all ocean policy.

Given Alaska has more coastline than the continental U.S. combined, the state's economy could be disproportionately impacted by the emerging federal ocean policy. Industries potentially impacted include fishing, oil and gas, mining, timber, tourism, and transportation. At right is the Red Dog Mine's port facilities on the Chukchi Sea.

RDC and member concerns

Although their own documents state that effective implementation will require regulations where appropriate, the NOC continues to state that the nine strategic action plans are not regulatory, and they will not replace other regulatory mechanisms. Even so, RDC continues to remind the NOC of the existing array of measures in place to protect the nation's waters. These plans may lead to increased litigation on responsible resource development projects, with no added benefit to the environment. These projects create jobs in communities where few other jobs are available.

In Anchorage on June 10, members of the NOC received public comments from Alaskan stakeholders on the SAP outlines. Stakeholders also questioned the authority of the program, and where funding might come from. While the NOC came under fire for these important issues, RDC continued to support improving existing coordination of protection measures, instead of the addition of another layer of bureaucracy.

Doug Vincent-Lang, Acting Deputy Commissioner of the Department of Fish and Game for the State of Alaska, spoke to the importance of natural resources to Alaska's economy. Vincent-Lang noted Alaska's large Outer Continental Shelf boasts up to 29 billion barrels of oil and 209 trillion cubic feet of natural gas.

"Alaska's interest in our managing coastal and marine resources cannot be overstated," Vincent-Lang asserted.

Coastal and Marine Spatial Planning

Alaska accounts for one of the nine regional planning areas to be assigned a regional planning body (RPB), though the members of the RPB have not yet been announced. RDC has urged the NOC to involve stakeholders early, and to coordinate with existing measures and groups to define members of the RPBs.

June 21st marked a national gathering in Washington, D.C., with hundreds of online participants across the country. The focus of the three-day workshop was on National Coastal and Marine Spatial Planning (CMSP), with the first day dedicated to presentations and public testimony. The NOC has committed to future regional workshops, but has yet to propose the dates.

Presenters at the workshop, including Dr. Jane Lubchenco, Undersecretary of Commerce for Oceans and Atmosphere and Administrator of NOAA, spoke about CMSP being a "common vision." But participants asked, whose vision?

Brent Greenfield of the National Ocean Policy Coalition testified to the NOC, urging that CMSP first be tested in a pilot project and "must rely on neutral government funding to ensure that Coastal and Marine Spatial Plans are not seen as being paid for by advocates."

Additionally, there must be focus placed on using the best available science, and the amount of science used must be sufficient. RDC has advocated for further studies and research, and supports ocean access and safety through increased infrastructure and Coast Guard presence.

RDC's ongoing efforts

RDC submitted comments addressing concerns on the nine SAP outlines. These and earlier comments can be found online at akrdc.org. RDC members are encouraged to get involved and to watch for action alerts regarding the next steps.

While RDC staff continues to monitor the advancement of ocean policy, RDC has joined the National Ocean Policy Coalition. The NOPC is a national group with 10 principles that support the development and implementation of a sound, balanced ocean policy. For more information on these guiding principles, and to view NOPC members and comment letters, please visit oceanpolicy.com.

State challenges Roadless Rule, delegation seeks repeal

Governor Sean Parnell and Attorney General John Burns have directed the Department of Law to file a legal challenge to the Roadless Rule adopted in 2001 by the United States Forest Service (USFS). The Roadless Rule prohibited local and regional control over decisions about road construction, reconstruction and timber harvest on roughly 58.5 million acres of national forest lands.

As the latest step in a complex history of litigation, a March 2011 Federal District Court ruling set aside a Tongass National Forest exemption and reinstated the application of the Roadless Rule in the Alaska Forest. A 2003 administrative ruling had previously blocked the rule's implementation in the Tongass.

"Applying the Roadless Rule to national forest lands in Alaska diminishes jobs and hurts families, and removes local and regional management of the forests from the state, communities, residents, and foresters," Governor Parnell said. "This is the wrong time for the Forest Service to further restrict timber supply, new mining jobs and development, and impose higher energy costs on communities. Our forests are best managed for multiple uses including mining or logging, which require construction of roads. A one-size-fits-all forest mandate from Washington, D.C. is the wrong approach."

If allowed to stand, the Roadless Rule will increase costs for developing hydroelectric projects by prohibiting roads along transmission line routes for construction and maintenance. Those increased costs would be passed along to consumers.

"As Federal District Court Judge Brimmer already found in the roadless case in Wyoming, procedure counts," Attorney General Burns said. "The Roadless Rule and the rushed manner in which it was adopted violates several federal statutes, including the Administrative Procedure Act (APA), the National Environmental Policy Act, and other federal statutes. It creates de facto wilderness without the approval of Congress."

The State of Alaska also filed a notice of appeal of the Federal District Court decision that the Tongass exemption was invalid. Judge Sedwick ruled that the Forest Service violated the APA by changing the status of the Tongass from not exempt to exempt without providing adequate reasons.

The state maintains that the Forest Service provided a substantial examination during the Tongass exemption decision. The record shows extensive discussion about the settlement with the state, the direction provided to the USFS by Congress in the Alaska National Interest Lands Conservation Act (ANILCA) and the Tongass Timber Reform Act.

ANILCA provides that administration agencies may not withdraw more Alaska land for wilderness without the approval of Congress. The Tongass Timber Reform Act mandates that the Forest Service must seek to meet timber demand from the Tongass, while the Roadless Rule makes that impossible.

Meanwhile, Senator Mark Begich and Congressman Don Young recently introduced legislation to repeal the Roadless Rule in Alaska's national forests. Senator Lisa Murkowski co-sponsored the Senate measure.

"This cookie-cutter rule is a bad fit for Alaska," Begich said. "With high unemployment and high energy costs in Southeast Alaska, the Forest Service needs greater flexibility to address these issues. Repealing the rule will help keep the few existing mills alive and allow for the development of hydro projects throughout the region as well as two promising mining projects on Prince of Wales Island. Instead of adding options, the roadless rule takes them away."

> **"The roadless rule never made sense for Alaska since 96 percent of the Tongass and 99 percent of the Chugach are already protected by ANILCA and forest management plans. Exempting the Tongass from the roadless rule will help make certain that what little remains of the timber industry in Southeast can survive long enough for the Forest Service to implement its second-growth harvest."**
>
> **– Senator Lisa Murkowski**

"As we have seen time and time again, the one-size-fits-all approach rarely ever applies to Alaska," said Congressman Don Young. "The economic well-being and way of life for many Alaskans relies on responsible resource development and this legislation will ensure that this rule doesn't harm Alaska more than it already has. Over the last few decades I have watched the timber industry go from thousands of jobs to nothing; we cannot allow the government to decimate this area more than they already have. This legislation is an economic necessity so that Alaskans may start to responsibly develop our resources in these areas again."

"The roadless rule never made sense for Alaska since 96 percent of the Tongass and 99 percent of the Chugach are already protected by ANILCA and forest management plans," Murkowski said. "Exempting the Tongass from the roadless rule will help make certain that what little remains of the timber industry in Southeast can survive long enough for the Forest Service to implement its second-growth harvest policy. The exemption will also ensure that hydropower and other affordable energy projects in Southeast can move forward."

As implemented, the rule prohibits new roads in inventoried roadless areas and prohibits most timber harvest in these areas. The March court decision reinstating the rule effectively places 300,000 acres of inventoried roadless area in which logging would have been allowed under the Tongass Land Management Plan off limits to development.

The legislation introduced last month would prevent use of the rule in planning and decision making for Alaska's Chugach and Tongass National Forests.

Alaska's two national forests are the nation's largest. The Tongass is 17 million acres, covering an area the size of West Virginia. The Chugach National Forest is 5.4 million acres.

RDC staff attends Emerging Leaders Dialogue in Kotzebue

By Natasha Shively, RDC Intern

Kotzebue hosted the 2011 Emerging Leaders Dialogue, led by the Institute of the North, in early June. Attending from RDC were staff members Deantha Crockett, Marleanna Hall, and summer intern Natasha Shively.

The first Emerging Leaders Dialogue was first held in 2007 in Girdwood and is now held each spring in communities around the state. The theme of this Dialogue was "Livable Communities and the Human Condition." Most of the focus was on small group discussions. Topics ranged from getting youth involved in making community decisions and focusing on economic opportunities to preventing domestic abuse and addressing racism. The Dialogue featured a full slate of speakers, including Representative Reggie Joule, and Kotzebue Mayor Martha Siikauraq Whiting.

The Dialogue also included a tour of Red Dog Mine and a trip to Noatak. Featured in the Red Dog tour was a safety orientation, as well as a walk-through of the mill, mine, and fish weir. Visitors learned of the economic impact of Red Dog and the $145.9 million in royalties paid to NANA Regional Corporation in 2010. Studies have shown that most of rural Alaska's population is diminishing because people are moving into urban areas, which offer better economic opportunities. However, this isn't the case for the NANA Region, mainly because of the Red Dog Mine.

Noatak rolled out the welcome mat for the group by serving traditional native foods like caribou, sheefish, and dryfish. Many attendees participated in the Walk for Life; a walk through the village to recognize how devastating the suicide rate is for Alaska Natives in small villages. The group was also given a tour of the new high school and had a chance to visit with the locals.

RDC very much appreciated the opportunity to participate in this Dialogue, as well as the hospitality in Kotzebue, Noatak, and Red Dog.

Pictured in Kotzebue from left to right are Marleanna Hall, Natasha Shively, and Deantha Crockett.

Parnell details new Alaska energy policy

Governor Sean Parnell and Natural Resources Commissioner Dan Sullivan met with national reporters to share the state's plan to offer additional lands and offshore waters for oil and gas exploration.

The briefing with national media is part of the Parnell administration's wide-ranging efforts to generate national awareness and support for the state's goal to boost the flow of oil through the Trans Alaska Pipeline to one million barrels of oil within a decade.

"By reaching this goal we will strengthen Alaska's contribution to U.S. energy security and we will create tens of thousands of new jobs and billions of dollars in payroll," Parnell said after the briefing.

Calling President Obama's decision to release 30 million barrels of oil from the nation's Strategic Petroleum Reserve "bad policy," Parnell said "the real Strategic Petroleum Reserve is Alaska, which has the potential to provide more than 30 *billion* barrels of oil over three decades." He said developing Alaska's vast hydrocarbon resources will supply the nation with billions of barrels of domestic crude, provide tens of thousands of high paying jobs and generate hundreds of billions of dollars in revenue for the federal government.

Parnell also described his efforts in recent months to reach out to Obama, members of Congress, and other governors to encourage broad cooperation on boosting domestic energy production.

Commissioner Sullivan laid out the state's plan to boost development on its land and in state waters. He also discussed the stringent environmental protection measures in place that protect the sensitive tundra and the North Slope's wildlife populations.

The Central North Slope undeveloped acreage still holds three to six billion barrels of oil and 24 to 45 trillion cubic feet of natural gas, according to federal estimates of the region's undiscovered, technically-recoverable resources. The undiscovered resources on state land include dozens of pools of conventional oil that range in size from 50 to 150 million barrels, tens of billions of barrels of heavy and viscous oil, and potentially enormous shale oil deposits.

These estimates do not include the more than five billion barrels of conventional oil reserves that lie under producing fields or fields that are close to being placed into production.

Importantly, some of the known oil and gas plays on state land straddle highly prospective federal lands, including the National Petroleum Reserve-Alaska (NPR-A) and the 1002 Area of the Arctic National Wildlife Refuge (ANWR). By drilling on state land and waters adjacent to NPR-A and ANWR, developers may end up drawing untapped oil that lies beneath these federal lands.

"I applaud Governor Parnell and Commissioner Sullivan for stepping up to the plate to help deliver American energy that we so clearly need," said Karen Harbert, president and CEO of the U.S. Chamber's Institute for 21st Century Energy. "Alaska is acting to address our supply problems because the federal government has not. I hope that policymakers in Washington will take notice of the example set by Alaska's leaders by allowing more access to our oil and gas resources which will create jobs and improve our energy security."

RDC elects new statewide board, Maloney continues as president

Pictured above are members of the 2011-2012 RDC statewide Board of Directors who attended the 36th Annual Meeting at the Dena'ina Convention Center in Anchorage June 28. Pictured in the front row are Treasurer Eric Fjelstad, Vice President Len Horst, President Tom Maloney and Immediate Past President Wendy Lindskoog. At top right, Governor Sean Parnell was one of two speakers addressing a luncheon crowd of 950. At bottom right, Governor Parnell presents the Interstate Mining Compact Commission's 2011 National Minerals Education Award to Alaska Resource Education (ARE). Receiving the award are Nick Enos, Vice President of ARE and Michelle Brunner, Executive Director. (Photos by Judy Patrick)

Tom Maloney was re-elected to a second term as the President of the Resource Development Council Board of Directors. RDC's statewide board met for its 36th Annual Meeting in Anchorage June 28.

A 22-year Alaska resident, Maloney is Alaska Area Manager for CH2M HILL. He has worked as a senior project controller, corporate business manager, and president of two operating companies. He has also headed up business development, external affairs, and government relations. At RDC, Maloney has been a long-time member of the Executive Committee and had served as Treasurer before being elected to his first term as president in July 2010.

Phil Cochrane, Vice President of External Affairs at BP Exploration (Alaska), Inc., was re-elected Senior Vice President while Len Horst, Senior Vice President and Commercial Loan Manager at Northrim Bank, was re-elected Vice President. Ralph Samuels, Vice President of Government and Community Relations at Holland America Line, was elected Secretary while Eric Fjelstad, an attorney at Perkins Coie, was re-elected Treasurer.

Newly-elected to the RDC Executive Committee were Lisa Parker, Parker Horn Company, Scott Jepsen, ConocoPhillips Alaska, Inc., and Ralph Samuels.

New incoming board members were Dave Cruz, Cruz Companies, Palmer; Tim Gallagher, HDR Engineering, Anchorage; Ricky Gease, Kenai River Sportfishing Association, Soldotna; Larry Houle, RIM Architects, Anchorage; Jim Laiti, Pipefitters Local 375, Fairbanks; Thomas Mack, Aleut Corporation, Anchorage; Sam Mazzeo, Wells Fargo, Anchorage; Mike Satre, Council of Alaska Producers and Hecla Mining, Juneau, and Lorali Simon, Usibelli Coal Mine, Palmer.

Karen Budd-Falen, an attorney from Cheyenne, Wyoming, was the keynote speaker at the RDC Annual Meeting Luncheon. Budd-Falen addressed the topic of environmental litigation and a strategy to restore fairness to industry and consumers. See a recap of her presentation on page 6. A video is also available at akrdc.org.

Portman Achieves 30 Years at RDC

On April 1, 2011, Carl Portman celebrated his 30th Anniversary at RDC. Carl celebrated by not discussing the occasion with anyone he knew and crossing his fingers that nothing was planned to recognize him. His hopes were dashed upon arriving at the Petroleum Club of Anchorage for what he thought was a business meeting, only to be greeted by a huge group of colleagues, friends, and family.

Carl began his amazing career at RDC as a Community Relations Coordinator and worked in various capacities over the years, including Interim Executive Director several times. His current title is Deputy Director, but expanded titles include Mentor, Resident Genius and Oracle of all things Resource Development.

Former Executive Directors Applaud Portman

Paula Easley, Executive Director 1979-1987
You don't become a change-agent to get rich. You do it because you care about people and believe your work can improve peoples' lives. That's really what RDC has always been about - changing policies and systems so we all can live and work in this great state. Carl is that change-agent; he thrives on the daily challenges and if he gets discouraged, you'd never know it. His tenacity, passion and integrity are unmatched, as is the quality of his work. He's grown a lot and given a lot in the last three decades. Alaskans owe him a huge "thank you" for his contributions.

Becky Gay, Executive Director 1987-1998
Since we met in 1984, I think of Carl synonymous with the Resource Review. It epitomizes Carl's decades of dedicated work. In the early years, it absorbed him as photojournalist and researcher. Over the decades, as editor, writer and publisher, his words helped shape public views of Alaska resource development for policy, education, and debates nationwide. Carl clearly has staying power, creating his own destiny at RDC. Funny, he so resists change, but Carl has been at the forefront of change in Alaska. Now with his RDC career span of 30 years, Carl is a force to be reckoned with, a determined constant. I could always count on Carl as my "compass" on all things RDC.

Debbie Reinwand, Executive Director 1998
Everyone who works with Carl knows what an incredible resource he is for historic and current information about Alaska. From resource development, to oversight laws and regulations, to weather patterns for the past 30 years, Carl is our "go-to" guy. As a reporter in the 80s, I would call him for information and he always had it. Now at Bradley Reid, when discussing resource projects, we often say "Carl will know that - let's call him!" He is a unique Alaska treasure. I'm honored to have worked with him and that he allows me to continue to rely on him as a credible source of information.

Ken Freeman, Executive Director 1998-2001
Carl is one of the finest, most genuine and sincere persons I have ever known. Carl taught me a lot about RDC during my early days as an intern, projects coordinator, and most of all when I had the opportunity to serve as Executive Director. RDC is one of the most dynamic and important organizations in support of Alaska's economy, and the continuity Carl has provided over the many years of tireless service have helped make it one of the most prominent organizations in the state.

Tadd Owens, Executive Director 2001-2006
It is a great privilege to have the opportunity to contribute something in honor of Carl and his 30 years of service to RDC. Readers of this newsletter know Carl through his outstanding writing, public policy analysis, and advocacy for the responsible development of Alaska's natural resources. Others have gotten to know Carl over the years at RDC events and public hearings, and they have invariably come away impressed with Carl's intelligence, passion and tireless work ethic.
By employing these qualities and characteristics over the course of a 30-year career at RDC, Carl has left an indelible mark on the organization. RDC would not be what it is today without Carl. In many respects the organization IS Carl Portman.

Carl, back row, third from right, poses for a photo with several former and current board members in attendance at a reception honoring him April 1.

Jason Brune, Executive Director 2006-2011
"Nobody knows more about resource development in Alaska than Carl Portman." That is a phrase I've repeated over and over again in my time at RDC, often to Carl's blushing, waving of hands, and denial. As humble and embarrassed as Carl may be, it's true. Across all resource sectors, Carl is a wealth of knowledge. Each Executive Director RDC has ever had has had the privilege of working with Carl. He has made the organization what it is today. I learned so much from Carl and I will always value his mentorship and sincere caring nature. Alaskans owe a sincere debt of gratitude to Carl Portman.

Compiled by Jason Brune, Deantha Crockett, and Marleanna Hall

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Training Mariners for Ice Navigation with Ship Simulator Exercises

White Paper - Alaska Maritime Training Center - AVTEC, Seward, Alaska

18 May 2011

Orson P. Smith, PE, Ph.D.[1], Capt. Robert Thomas[2], and Capt. Scott Hamilton[3]

Introduction

The Alaska Maritime Training Center at AVTEC, Seward, Alaska, is currently engaged in development of ice navigation curricula (Smith et al 2010) that comply with requirements of the International Maritime Organization (IMO 2009) and with related standards of Det Norske Veritas (DNV 2008) for training ship officers for service in ice-covered waters. These training guidelines follow long-negotiated international standards for safe operation of ships in polar waters, the so-called "Polar Code" (IMO 2010 and Jensen 2007). The Polar Code calls for ice navigators, generally defined as watch-keeping officers and crew aboard ships in polar seas, to have documentary evidence of completing an approved training program providing knowledge necessary for prudent operation of a ship in ice-covered waters. The AVTEC ice navigation curriculum is designed to provide this training and an associated certificate of competency on completion of a comprehensive course with intensive ship simulator exercises. The opportunity to safely and affordably apply sophisticated information in realistic simulations assures a high level of understanding and skill in applying ice navigation knowledge in a broad range of challenging circumstances (Smith et al 2010 and Jensen 2006).

Realistic exercises in the AVTEC ship simulator are a safe alternative to extensive real-world exposure to the remote and inhospitable Arctic marine environment that is otherwise required for deep appreciation of ambient hazards and of technology and skills applied in their detection with modern instruments and telemetry. AVTEC's three full-sized ship simulator bridges can realistically enact impacts of natural hazards to the progress and safety of a variety of vessel types including ice breakers, tankers, cruise ships, tug boats, oil spill response ships, and military vessels. Many years at sea would be required to encounter the variety of dangerous situations that can be enacted in a ship simulator in a few days. Real-world experience is usually superior, but even time at sea may not involve an individual in the decisions at the level of intensity possible in a modern well-equipped ship simulator such as operated at AVTEC. Furthermore, the AVTEC ice navigation curriculum emphasizes timely constructive review by expert mentors of actions in simulations for the purpose of education and skill enhancement.

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[1] Civil Engineering Professor at the University of Alaska Anchorage

[2] Senior Instructor, Ice Curriculum Coordinator, Alaska Maritime Training Center, AVTEC; LCDR US Coast Guard (Ret)

[3] Department Head, Alaska Maritime Training Center, AVTEC; Master, Any Gross Tonnage; Oceans; First Class Federal Pilot with over 20 years' experience sailing Alaskan waters

AVTEC Ship Simulator

AVTEC's ship simulator was developed by Kongsberg Norcontrol IT of Horten, Norway and consists of 3 full-mission ship bridges, a fourth bridge currently under development, a Navigation Lab with six 3-monitor desktop computer stations, and a comprehensive instructor station. The instructor station provides for creation and control of multiple simultaneous simulator scenarios, graphical displays for monitoring progress of exercises, and closed-circuit television to observe human interactions in the simulated bridge environment.

One of the 3 full-scale ship's bridges at AVTEC projects a 240° horizon meeting the Det Norske Veritas (DNV) visual standard for a Class A bridge simulator. The other two operational bridges each have five 1.25-meter synchronized monitors for visuals to meet DNV Class B bridge simulator standards. All 3 operational bridges include a helm station, two radar/ARPA units, and a navigational table, along with a complete set of navigational instrumentation, including DGPS, steering and auto pilot control, VHF, sound signals, alarms, thruster control, tachometer, rudder angle and command indicators, log, echo sounder, Doppler log, gyro, anemometer, and magnetic compass. A fourth bridge under construction at AVTEC will have a 270° horizontal view that will enhance scenarios involving multiple ships and geographical constraints. All four bridges are suitable for training ice navigators, though each has advantages for simulating the bridges of certain types of ships. The Navigation Lab allows for running the Kongsberg Norcontrol simulation software on six individual computer stations that are fully interactive with each other and can replicate scenarios configured for the four full-scale ship bridges. The system is presently configured with 16 geographical databases covering large areas of Alaska's navigable waters and 30 ship models from which to choose for a simulator exercise. Software upgrades on order will expand these capabilities, particularly in the realm of sea ice and polar ocean conditions.

AVTEC Ice Navigation Comprehensive Course

The AVTEC Ice Navigation curriculum includes a comprehensive master course from which selected topics may be offered in shorter formats. The comprehensive course involves 9 intensive days of classroom presentations and discussion, reading assignments and written exercises, table-top exercises, and realistic ship simulator exercises. Classroom presentation and discussion topics are listed in Table 1. Table-top exercises are conducted on ice report interpretation, on voyage planning, and on ship and crew preparations. Ship simulator topics are listed in Table 2. Each table-top and ship simulator exercise is followed with critical review by participants and mentors. These activities are supplemented by reading assignments and study questions that are reviewed at the start of each new day in the course.

All of these course activities convey knowledge and skills that satisfy the full list of competencies called for my IMO (2009) and DNV (2008).The AVTEC Ice Navigation curriculum targets a range of learning levels, as defined by Bloom's Taxonomy of educational goals (Bloom et al 1956 and Anderson et al 2001), by application of course resources, including use of the ship simulator. DNV (2008) specifies learning levels on this scale. Table 3 describes the AVTEC strategy for achieving these varying levels of learning by students in the ice navigation course.

Table 1. AVTEC Ice Navigation Comprehensive Course – Classroom Presentations and Discussions	
L1.	Regulations and Guidelines of IMO/STCW, USCG, State of Alaska, Canada, and others
L2.	Ice Physics – Part 1 (water, ice, salinity, sea ice formation, growth, and decay)
L3.	Ice Physics – Part 2 (Ice response to wind and currents, ice forces)
L4.	Ice Classification and Reporting (sea ice, glacier ice, lake ice, river ice, VOS reports…)
L5.	Obtaining and Interpreting Ice Reports
L6.	Polar Weather
L7.	Sea Spray Icing
L8.	Ice regimes of the world
L9.	Navigating in High Latitudes
L10.	Ice route planning
L11.	Ice-class Ships
L12.	Navigating in Ice – Ship handling and ice management
L13.	Preparing the Ship for Ice
L14.	Preparing the Crew for Ice
L15.	Navigating in Ice – Watchkeeping and Bridge Resource Management
L16.	Navigating in Ice – Entering ice
L17.	Navigating in Ice – Getting beset; Anchoring in and Mooring to Ice
L18.	Navigating in Ice – Working with Icebreakers and Convoys
L19.	Navigating in Ice – Pilot Transfer and Working with Tugs
L20.	Navigating in Ice –Berthing, Unberthing, and Port Security
L21.	Emergencies in Ice
L22.	Oil Spills

Table 2. AVTEC Ice Navigation Comprehensive Course– Ship Simulator Exercises	
S1.	Navigation Lab exercises (instruments and controls, ARPA, ...)
S2.	Introductory exercise in Simulator Bridge
S3.	Navigation Practice in Simulator Bridge (no ice)
S4.	Ice and Polar Weather Observing and reporting (in Navigation Lab)
S5.	Navigating in Ice (polar weather, sea spray icing,)
S6.	Navigating in Ice (route finding)
S7.	Navigating in Ice (ship handling and ice management)
S8.	Navigating in Ice (entering the ice)
S9.	Navigating in Ice (getting beset)
S10.	Navigating in Ice (overtaking and passing other vessels)
S11.	Navigating in Ice (anchoring and mooring to ice edge)
S12.	Navigating in Ice (pilot transfer)
S13.	Navigating in Ice (docking, undocking, and port security)
S14.	Navigating in Ice (working with icebreakers)
S15.	Navigating in Ice (working with convoys)
S16.	Navigating in Ice (oil spills and emergency operations)

Academic Oversight

The Alaska Maritime Training Center is guided by an Advisory Board of senior Alaska mariners, maritime industry leaders, and academicians, who meet regularly to review all of AVTEC maritime education programs, including the ice navigation curriculum. The Advisory Board helps the Center design curriculum and assures that real needs of the State of Alaska and maritime industry are met by AVTEC investments in educational resources of the Alaska Maritime Training Center. Board member are particularly attuned to emerging issues and growing concerns surrounding the opening of the Arctic Ocean to increased waterborne commerce, tourism, oil and gas exploration, commercial fishing, and subsistence and recreational boating. These issues and concerns are addressed by the AVTEC Ice Navigation Curriculum with approval of the Advisory Board.

Table 3. AVTEC Ice Navigation Learning Level Achievement Strategy	
Learning Level	**AVTEC Course Resources Applied**
Level 1 (Knowledge)	classroom presentation, discussion, and written exercises
Level 2 (Understanding)	classroom presentation, discussion, and written exercises involving more complex questions than Level 1 topics
Level 3 (Application)	classroom presentation, discussion, written exercises, and table-top or simulator exercises with critiques
Level 4 (Integration)	classroom presentation, discussion, written exercises, and table-top or simulator exercises with critiques involving open-ended situational challenges more complex than Level 3

Ongoing Refinements

The Alaska Maritime Training Center, in collaboration with the School of Engineering of the University of Alaska Anchorage, is investigating recent marine accidents and near-misses in Arctic settings to develop related scenarios for ship simulator exercises. These exercises will be designed for incorporation in the ice navigation curriculum. They may also be applied in a proposed new "Alaska Arctic Marine Domain Awareness" course for maritime industry and government managers intended to impress participants with the extent of natural hazards to ships in the Arctic, with the variety of instrumentation available on well-equipped modern ship bridges for detection of hazards, with reports available via radio and satellite transmissions, and with the impact of combined hazards on progress of a voyage and safety of passengers, crew, and cargo. AVTEC is continually expanding its geographical databases and ship model capabilities as resources become available, with a view toward keeping its place as Alaska's premier maritime training institute.

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USGS
science for a changing world

An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska

Background

On March 31, 2010, Secretary of the Interior Ken Salazar announced a national strategy for Outer Continental Shelf (OCS) oil and gas development. In that announcement, the Administration outlined a three-pronged approach (U.S. Department of the Interior, 2010a):

Development: "...expand development and production throughout the Gulf of Mexico, including resource-rich areas of the Eastern Gulf of Mexico..."

Exploration: "...expand oil and gas exploration in frontier areas, such as the Arctic Ocean and areas in the Atlantic Ocean, to gather the information necessary to develop resources in the right places and the right ways."

Conservation: "...calls for the protection of special areas like Bristol Bay in Alaska...national treasure[s] that we must protect for future generations."

In a companion announcement (U.S. Department of the Interior, 2010b), within the Administration's "Exploration" component, the Secretary asked the U.S. Geological Survey (USGS) to conduct an initial, independent evaluation of the science needs that would inform the Administration's consideration of the right places and the right ways in which to develop oil and gas resources in the Arctic OCS, particularly focused on the Beaufort and Chukchi Seas (fig. 1).

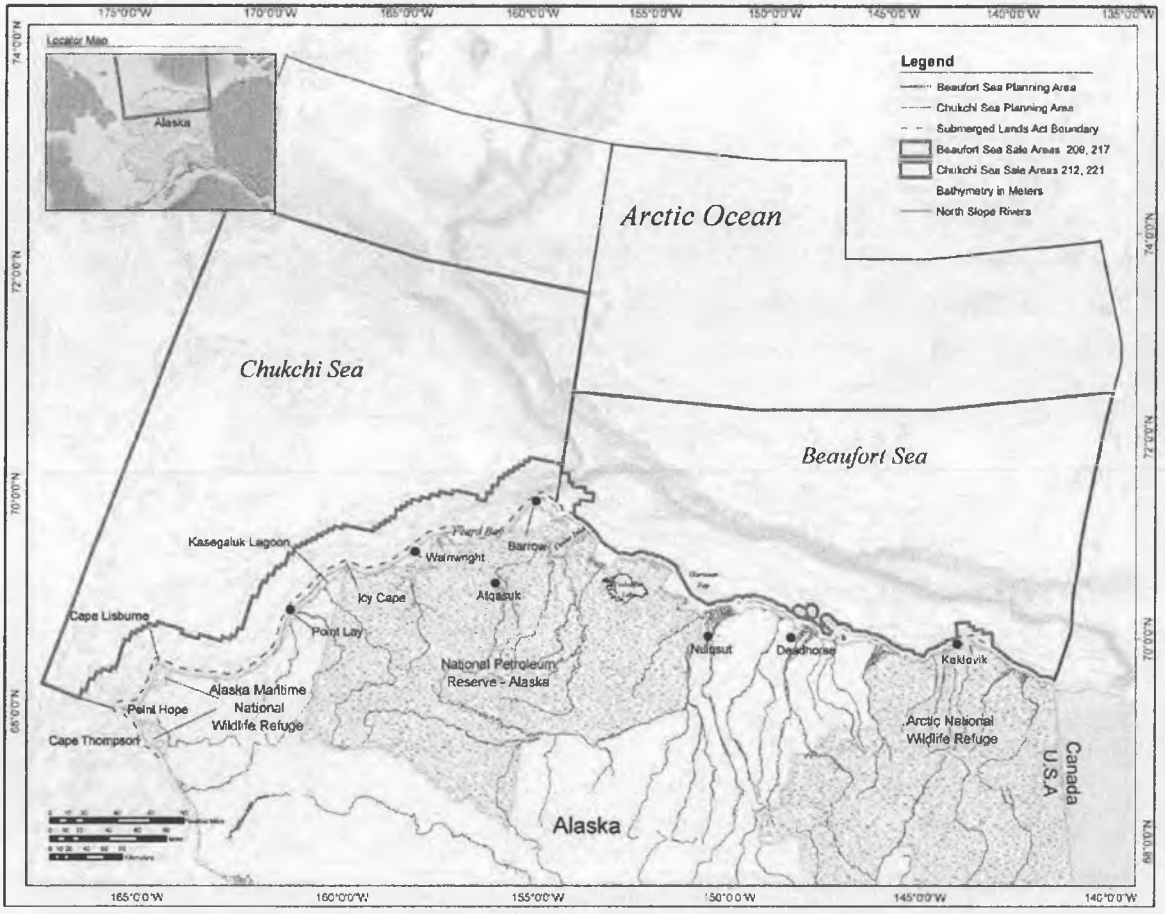

Figure 1. North Slope of Alaska from Point Hope to the United States–Canada border showing principal coastal communities, Outer Continental Shelf oil and gas leasing areas, and major Federal land holdings. From the Bureau of Ocean Energy Management, Regulation and Enforcement, formerly the Minerals Management Service (2008).

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June 2011

Oil and gas potential is significant in Arctic Alaska (fig. 2). On Alaska's North Slope, the Nation's largest oil field, Prudhoe Bay, has been in production for several decades. Oil has been produced from the Beaufort Sea OCS since the early 2000s, and the Arctic OCS potential for production of additional oil and gas resources is significant. Beyond petroleum potential, this region supports unique fish and wildlife resources and ecosystems, and indigenous people who rely on these resources for subsistence. While the potential for, and interest in, energy resources is clear, there is significant public discourse over the ability to develop oil and gas resources safely, to understand environmental and social consequences of any development, and to implement effective impact prevention and mitigation strategies. Such discourse often revolves around different views on the sufficiency of the scientific information available to evaluate energy development options and to understand environmental sensitivity in this frontier area.

The USGS was asked to summarize key existing scientific information, develop a rapid process to identify where knowledge gaps exist, and provide initial guidance of what new and (or) continued research could improve decision making. Determining what is a "science gap" or what is "sufficient science" is difficult. These concepts vary with the values and beliefs of every concerned individual when faced with complex issues and uncertainty. Decisions to develop resources in the Arctic are inherently difficult because they must consider factors such as the economic stakes, Native traditions, environmental risks, and multiple objectives.

Figure 2. Assessment units of the Circum-Arctic Oil and Gas Assessment, color-coded according to the mean estimated undiscovered, technically recoverable oil resources. The open rectangle denotes the approximate location of the Alaska North Slope and Beaufort and Chukchi Seas OCS areas. Modified from Gautier and others (2009).

High levels of project uncertainty are inherent in working in a frontier environment. Decisions are complicated because multiple choices need to be made and multiple organizations must make those choices.

Thus, the USGS OCS Team took an inclusive approach to its "science gap and sufficiency" evaluation by not only examining available literature, but also gathering input from many entities that influence decisions about what science is "needed" for oil and gas development in the Arctic OCS.

The USGS OCS Team examined more than 400 scientific publications, workshop findings, science policy documents, and web sites. The team met with more than 40 individuals and organizations that have research or science assessments on these issues. Our group conducted a series of structured discussion sessions with key vested parties, including Alaska North Slope and Native interests, the oil industry, State of Alaska, Federal regulatory agencies, and non-regulatory organizations. Finally, we held a special session at the Alaska Marine Science Symposium (in Anchorage, January 2011) to gain focused input from the science community on key topics.

Results

The USGS developed more than 50 findings and an equal number of recommendations in the course of our examination of these topics. Specific and detailed scientific information, key knowledge gaps, and recommendations are presented in Holland-Bartels and Pierce (2011). Those recommendations are important for understanding what the USGS discovered in the course of this study and to help inform and improve decision making. In this Fact Sheet, we provide a high-level summary and synthesis of our findings to help inform the Secretary of the Interior's considerations to develop oil and gas resources in the Arctic OCS.

Climate change is impacting physical, biological, and social conditions in the Arctic and affecting all resource-management strategies. Climate conditions in the Arctic have been undergoing remarkable changes, particularly during the last 20 years. Climate model projections show pronounced warming that will continue to change the physical environment and ecological conditions (for example, ocean acidification, sea-ice ecosystems, species response). While international development of global climate models is progressing rapidly, forecasting techniques currently lack sufficient regional grain, particularly in the Arctic. Thus, a more refined regional understanding of climate change is required to help clarify development scenarios. Uncertainties exist on topics for which more science focus is required, including: (1) physical parameters, such as storm frequency and intensity, and circulation patterns, and (2) species' response to environmental changes, for which periodic population and distributional surveys could provide key data.

A key aspect critical to any development planning scenario is sufficient information for effective ***oil-spill risk assessment, preparedness, and response***. There have been significant advances in spill-risk evaluation and response knowledge, but concern remains that key inputs to spill models (oceanographic, weather, ecological) are insufficient and that the manner in which ecological data are included is not always clear, nor quantitative. Further, the applicability of laboratory and mesoscale studies to full field conditions remains largely untested, although international efforts are improving this foundation. Both the *Exxon Valdez* and the *Deepwater Horizon* oil spills demonstrate that spill contingency planning and a suite of spill response tools must be available

and effective. Significant questions exist about the scientific and technical information needed for contingency planning and prompt emergency response (response gap) in the Arctic, which are potentially complicated by a changing climate.

Inherent in understanding the full suite of impacts—both beneficial and detrimental—is the need to understand the cumulative effects of all changes (human and natural) in the Arctic. The development of a comprehensive, quantitative, cumulative effects analysis for the Arctic OCS remains a challenge. Numerous efforts have been unsuccessful at developing a transparent, quantitative, and comprehensive method to assess cumulative impacts. This methodology challenge, combined with the lack of available foundational geospatial data for the Arctic OCS, makes the process and findings of cumulative impact analyses inadequate to a broad suite of stakeholders. Climate change exacerbates this challenge by influencing the baseline such that it becomes a "moving" target. Thus, development of new, more analytical approaches to cumulative analyses would likely benefit the overall decision making on oil and gas development options.

Resonating throughout every topic we studied were several overarching themes, which include the need for: (1) ***large-scale synthesis of data and information,*** (2) ***enhanced dialog and collaborative science planning,*** and (3) ***a more transparent and inclusive planning and decision-making process.***

Information and data in the Arctic are emerging rapidly, but most studies focus on subjects with small spatial and temporal extent and are independently conducted with limited synthesis. Access to information, especially in Arctic frontier areas, is critical to move forward strategically. Thus, large-scale synoptic efforts are needed to synthesize the many studies, on a full range of topics and on individual topics, by many researchers and organizations examining the Arctic. One example, from onshore Alaska (fig. 3), shows the type of data synthesis that is needed to inform decision making.

Enhanced dialog and collaborative science planning are essential, both domestically and internationally. There are many entities in the "decision arena" of *Federal* oil and gas development, all of which bring critical information to the decision process and have responsibility along the spectrum of potential

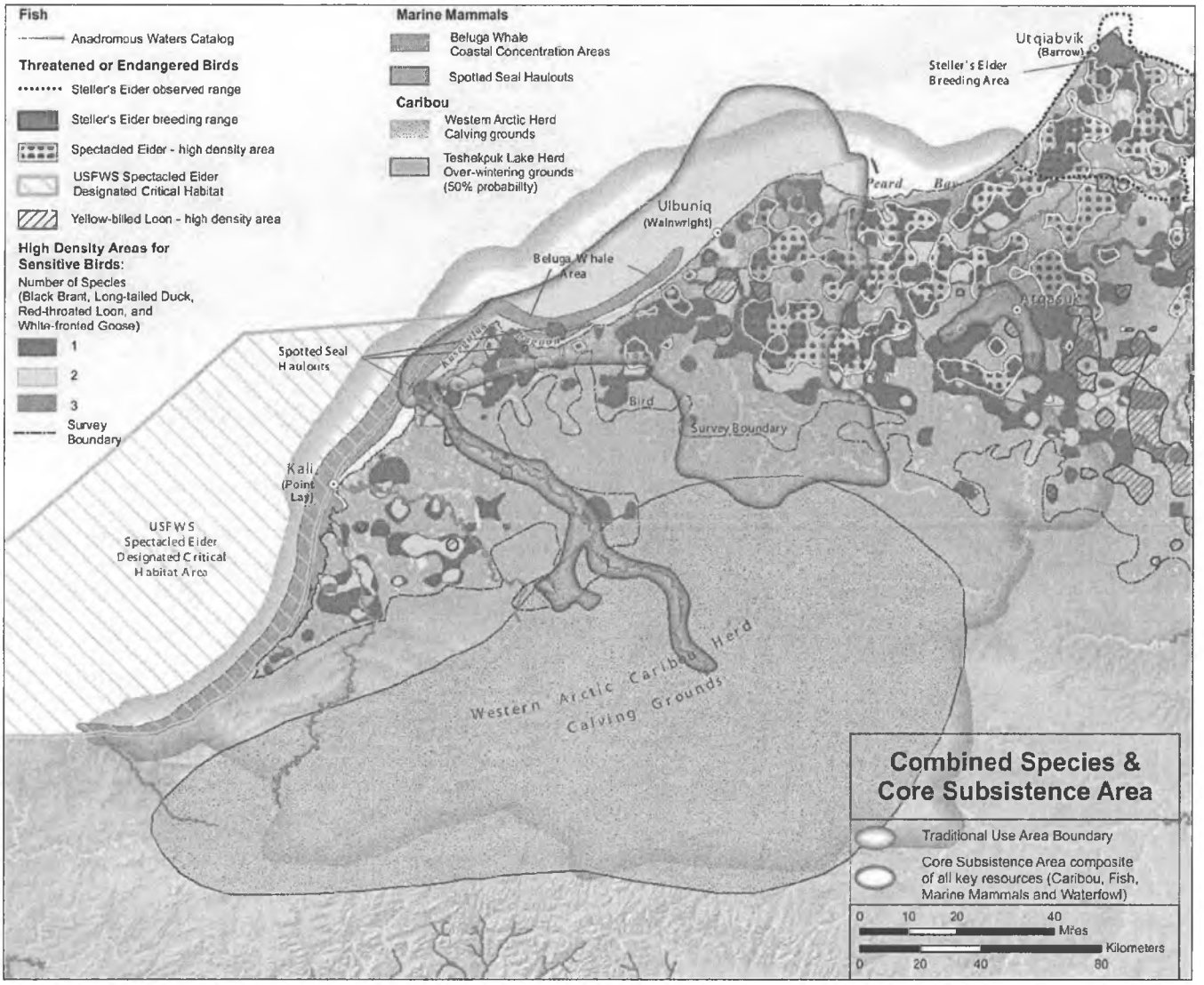

Figure 3. Combined sensitive species habitat areas and core subsistence areas for onshore Arctic Alaska. Modified from The Nature Conservancy and Wainwright Traditional Council (2008).

development. The many planning processes and consultations do not necessarily develop a consensus view on science gaps. There is a need for additional science dialogue with *Native communities* to more comprehensively incorporate local traditional knowledge into decisions. Significant research also is being conducted *internationally*, and emerging opportunities exist with other Arctic Nations. Enhanced science dialog and joint efforts would benefit all countries.

All these efforts will lead to a more transparent and inclusive science planning and decision-making process. Tools like Structured Decision Making (SDM) help the decision maker develop the fullest possible understanding of the complexities of the decision, including decision objectives, tradeoffs, uncertainties, and risks (fig. 4). In our discussions with individuals and groups, it became clear that evaluating science needs and filling identified science gaps will not be sufficient to address the many issues surrounding energy development in the Arctic. People have strong feelings about oil and gas development, which span the spectrum—some think there is already enough science and some think there will never be enough science. There are clearly areas of significant scientific research that form a sound basis upon which to make decisions; there are clearly areas where additional science is needed; but there also is an area in which more than science is needed. For that reason, we suggest the use of tools like Structured Decision Making to promote broad, transparent, and structured participation to inform decisions about energy development in the Arctic.

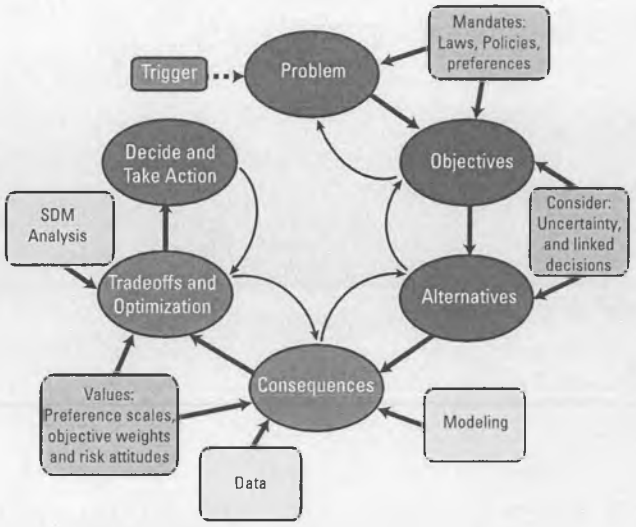

Figure 4. Schematic representing various steps included in a Structured Decision Making process. Modified from U.S. Fish and Wildlife Service (2008).

Thus, while there is a growing base of scientific and technical information for the Arctic, which is synopsized in Holland-Bartels and Pierce (2011), as are science gaps that should be addressed, many of the challenges emerging in Arctic oil and gas development decision making are beyond the ability of science alone to resolve. A collaborative and comprehensive Arctic science planning process would bring great value to the decisions required to proceed with development of oil and gas and other strategic assets in the Arctic in a changing climate environment. Such a science plan and its implementation must be informed by an SDM-like process and the syntheses of information we discussed above. This process needs to include appropriate measures of accountability for all responsible parties or entities. In our many discussions, we heard that managers, responders, scientists, and community members are willing to engage in discussing information needs, but they have a growing expectation that those needs will be considered and, if appropriate, addressed in a visible, documented manner.

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Authors: Leslie Holland-Bartels and Brenda Pierce

For more information, contact:

Energy Resources Program Coordinator
U.S. Geological Survey, MS 915A
Reston, VA 20192

Regional Executive, Alaska
U.S. Geological Survey
4210 University Drive
Anchorage, AK 99508

Fact Sheet 2011–3048

An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska

By Leslie Holland-Bartels and Brenda Pierce

Background

On March 31, 2010, Secretary of the Interior Ken Salazar announced a national strategy for Outer Continental Shelf (OCS) oil and gas development. In that announcement, the Administration outlined a three-pronged approach (U.S. Department of the Interior, 2010a):

> ***Development:*** "...expand development and production throughout the Gulf of Mexico, including resource-rich areas of the Eastern Gulf of Mexico..."
>
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>
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In a companion announcement (U.S. Department of the Interior, 2010b), within the Administration's "Exploration" component, the Secretary asked the U.S. Geological Survey (USGS) to conduct an initial, independent evaluation of the science needs that would inform the Administration's consideration of the right places and the right ways in which to develop oil and gas resources in the Arctic OCS, particularly focused on the Beaufort and Chukchi Seas (fig. 1).

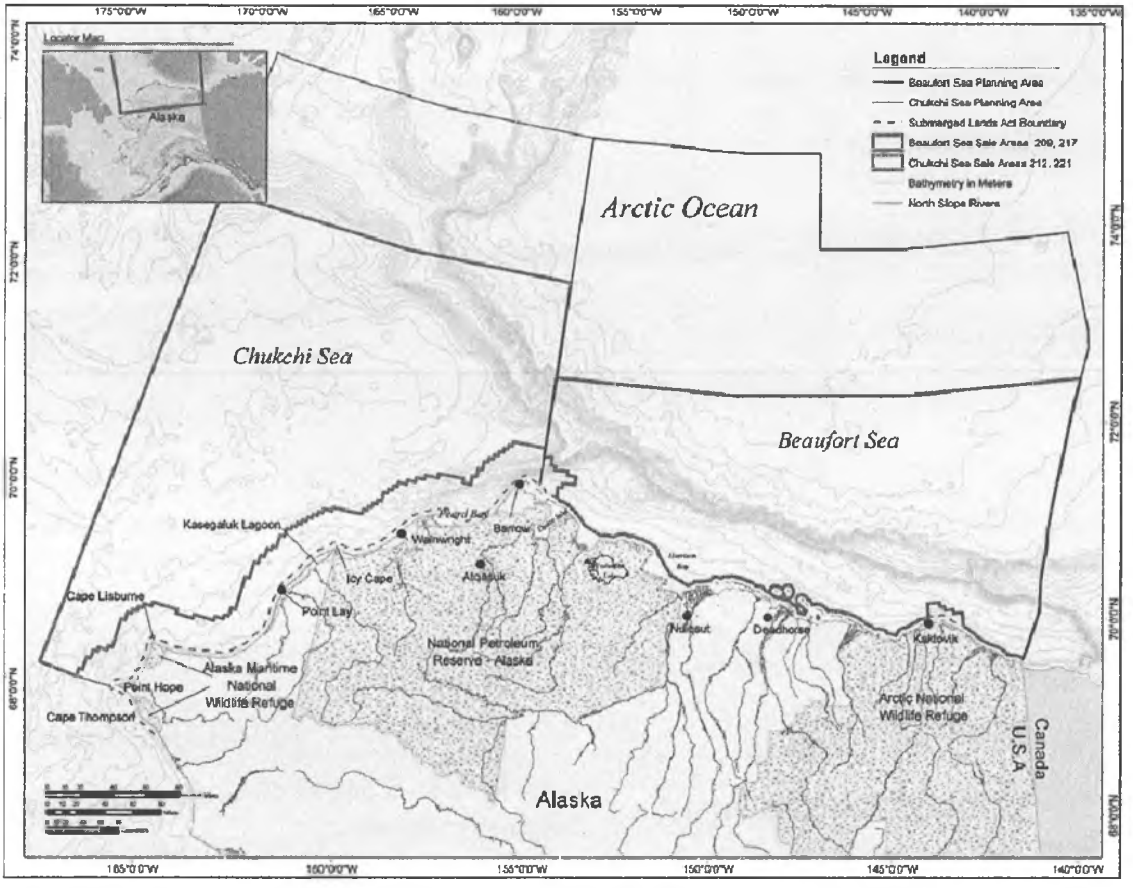

Figure 1. North Slope of Alaska from Point Hope to the United States–Canada border showing principal coastal communities, Outer Continental Shelf oil and gas leasing areas, and major Federal land holdings. From the Bureau of Ocean Energy Management, Regulation and Enforcement, formerly the Minerals Management Service (2008).

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- **Report** PDF (1.75 MB)

For additional information contact:
Energy Resources Program Coordinator
U.S. Geological Survey, MS 915A
Reston, VA 20192

Regional Executive, Alaska
U.S. Geological Survey
4210 University Drive
Anchorage, AK 99508

Part or all of this report is presented in Portable Document Format (PDF); the latest version of Adobe Reader or similar software is required to view it. Download the latest version of Adobe Reader, free of charge.

Oil and gas potential is significant in Arctic Alaska (fig. 2). On Alaska's North Slope, the Nation's largest oil field, Prudhoe Bay, has been in production for several decades. Oil has been produced from the Beaufort Sea OCS since the early 2000s, and the Arctic OCS potential for production of additional oil and gas resources is significant. Beyond petroleum potential, this region supports unique fish and wildlife resources and ecosystems, and indigenous people who rely on these resources for subsistence. While the potential for, and interest in, energy resources is clear, there is significant public discourse over the ability to develop oil and gas resources safely, to understand environmental and social consequences of any development, and to implement effective impact prevention and mitigation strategies. Such discourse often revolves around different views on the sufficiency of the scientific information available to evaluate energy development options and to understand environmental sensitivity in this frontier area.

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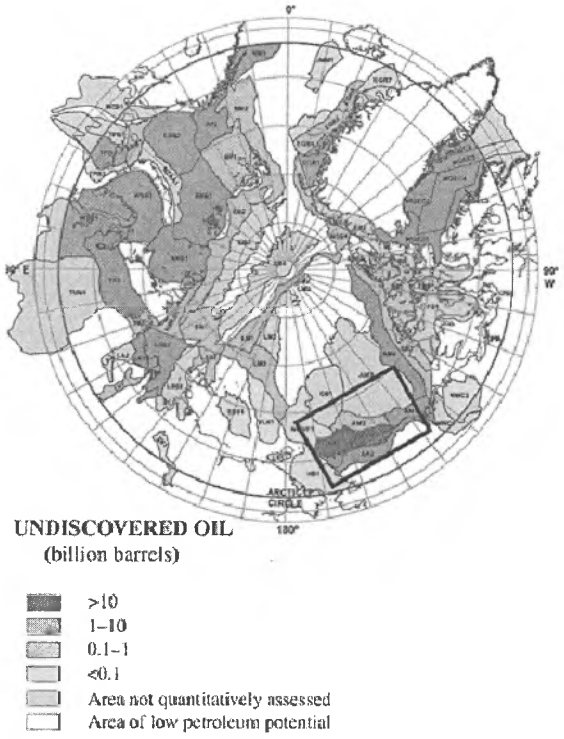

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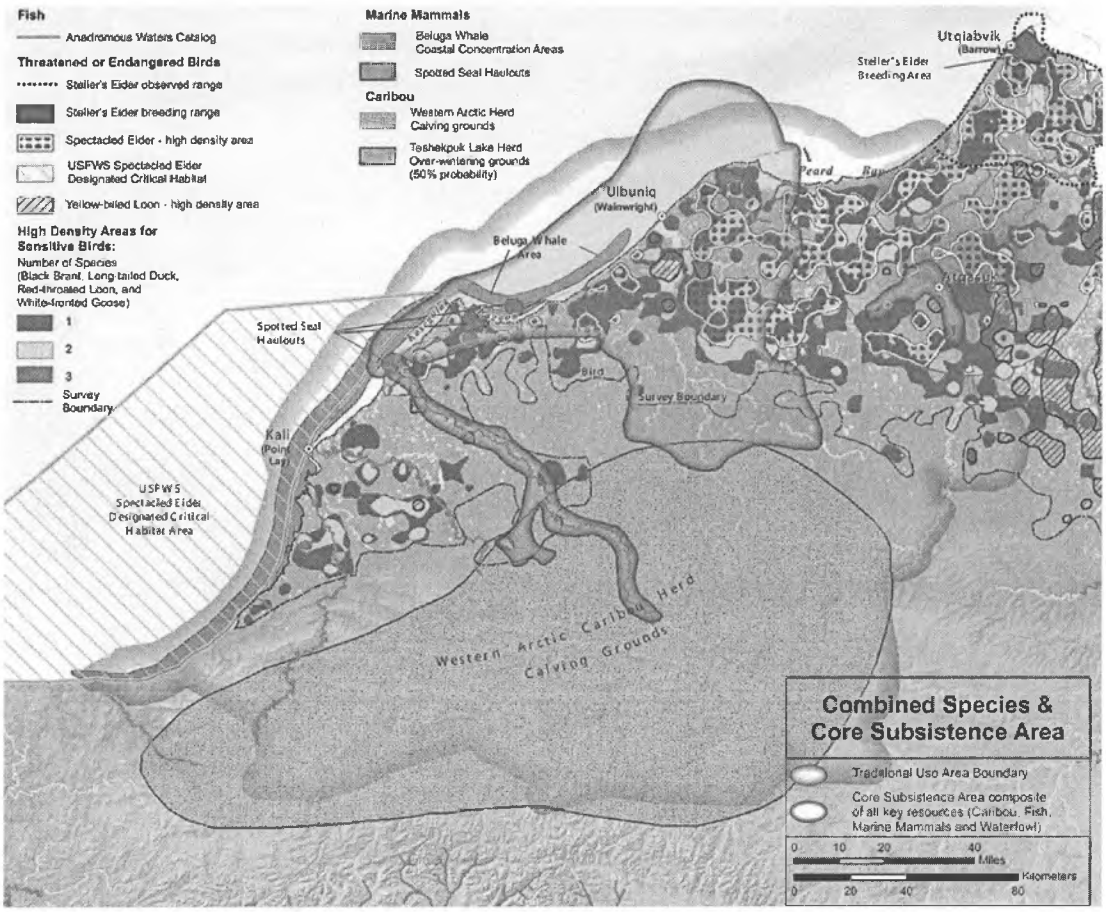

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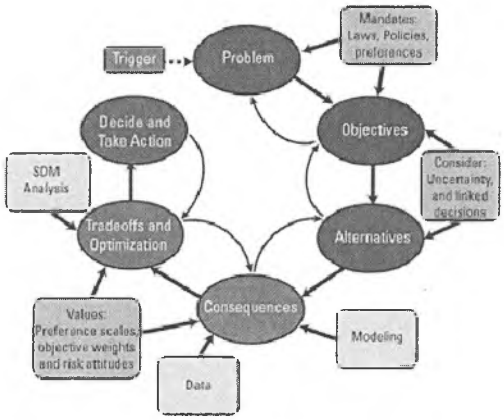

Figure 4. Schematic representing various steps included in a Structured Decision Making process. Modified from U.S. Fish and Wildlife Service (2008).

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Providing coverage of Alaska and northern Canada's oil and gas industry
May 2011

Vol. 16, No. 20 **Week of May 15, 2011**

Northern Waters Task Force fills gap

Rep. Reggie Joule, chair of task force, says Alaska needs to be involved in Arctic policy decisions for both benefits and protection

Steve Quinn

For Petroleum News

The state's Northern Waters Task Force is off to a slow start, but don't blame its leader Rep. Reggie Joule.

The 11-person group has been entrusted with a joint state/federal commission designed to oversee development of northern oceans.

And Joule is ready to get down to business.

But thanks to a special session Joule has had to postpone meetings and even a trip to Norway, an Arctic nation with similar resource development issues as Alaska.

The group was established with unanimous backing of the Legislature toward the end of last year's session.

The task force will spend the rest of the year addressing areas including Arctic governance; oil, gas and mineral development; Arctic fisheries; marine transportation; Arctic research and Arctic infrastructure.

It features some familiar names like Vice-Chair Sen. Bert Stedman, a Sitka Republican, Sen. Lyman Hoffman, a Bethel Democrat, and Rep. Bob Herron.

Others include leaders from coastal communities and Department of

Environmental Conservation Commissioner Larry Hartig.

Joule will provide a final report to the Legislature by Jan. 30, 2012.

Joule is in his 10th term with the Legislature and a member of the House Finance Committee which reviews all resource development issues with price tags attached to them.

Joule sat down with Petroleum News to discuss his goals for the task force and what may be ahead for the state's oil tax rewrite debate.

Petroleum News: How did this group come together?

Joule: The Senate President (Gary Stevens) and House Speaker (Mike Chenault) made the decisions. It's largely for those communities to be impacted, from the North Slope to Dutch Harbor, which is kind of the springboard for marine transportation.

Petroleum News: Did you want to be chairman?

Joule: I guess so, yeah. I just wanted to get on the task force because it's timely. I try to take somewhat of a balanced approach to how the agenda gets set, so that when we sunset in 2012, we try to come up with a sound set of recommendations for the Legislature that would hopefully set up a permanent commission or task force that would continue to monitor efforts in Alaska regarding our oceans. I think we are going to see huge activity.

Petroleum News: What are some of the priorities?

Joule: I guess mostly that we are aware and are responsible, and definitely engaged. I have my own opinion about oil and gas development offshore, but if this is something that is going to happen, how can we benefit from it and how can we safeguard ourselves at the same time? Those are conversations that are happening at the federal level. But as a state what should we be getting excited about and what should we be moving with caution. The same with fisheries and marine transportation. There already is a huge research effort going on, but is it the right kind for the activity that's being proposed? Are we taking advantage of the science and the research that should be done to ensure the safety of the ecosystems not only in the oceans, but as they come to shore and the people who depend on those things onshore?

Petroleum News: What are your thoughts on offshore drilling?

Joule: I'll just keep that to myself.

Petroleum News: Is this anything like coastal management?

Joule: There is a huge difference. Actually, they are almost not even related. They

may intersect in places. Coastal zone management is about permitting and getting local input into those things that are needed to obtain permits whether large-scale coastal areas or even local efforts such as accessing gravel for communities. All that stuff needs to get permitted. The Northern Waters Task Force, one of the reasons that we put this together, with the advent of climate change there are a lot of things that we became aware of that presented themselves as opportunities and challenges all rolled into one. The legislature and global community were having discussions about these potential events in Arctic waters. The Alaska Legislature was not even in the mix of knowing what those things were. You've got the Arctic Council, which the United States has a seat at because of Alaska's place on the Arctic.

There are others active there. Oil companies, shipping firms, fishing industries and even the coast guard are formulating plans figuring out how do deal with all of these kinds of activities.

We weren't part of that conversation. Part of all of this effort is to bring us up to speed. There is going to be a need for infrastructure; there is going to be a need for science; there is going to be a need for communications with communities and Alaskans. There is probably going to be at some point some policy calls that we need to be involved in. There could be opportunities for jobs.

But there may be times where we are going to have to deal with mitigation. All of those things taken together is why the Northern Waters Task Force was formed, recognizing of course that as one of the few coastal states in this country, we didn't have any kind of a way to be plugged into what's going on with the oceans. Here we had a president and an administration putting together a national oceans council in search of members to sit on a task force. We were nowhere.

Petroleum News: You mentioned various events, what kind of events did you have in mind?

Joule: I'm not sure. Let's see. Could it be things like melting ice? Could it be things like fish moving to colder water? Ocean acidification? Diminishing sea levels? Diminishing sea ice?

Petroleum News: So you have those changes, but there are also events like prospective drilling, right?

Joule: There are things to consider like OCS, whether we like it or not, the north pacific management council, marine shipping, national defense and the need for infrastructure, whether it's the coast guard or military. All of those may mean potential jobs. Some of the challenges like over-the-top transportation corridors — there are some choke points in the Bering Straits. There is some concern about invasive species that are cling-ons to hulls of ships. With offshore drilling there are concerns about are we prepared to deal with the unfortunate events of potential spills and the destructions of what goes on there? How is that going to impact search and rescue efforts, cleanup efforts? Are we prepared for that? Are

we prepared for the potential economic opportunities in terms of workforce and companies? Are we up to speed on what's going on? There are both sides, and we are trying to bring focus to all of that. Then there is the issue of governance, which I'm not sure I've completely wrapped my own arms around: When Russia threw a flag under the water somewhere and started staking a claim. America through Alaska's position has offered to set boundaries that we may be able to lay claim to, maybe even more so if we pass the Laws of the Sea treaty. That may impact us in a largely more positive way, so there is a lot of stuff out there to consider.

Petroleum News: Shifting gears, but still on resource development, what, if anything would you like to see done with oil taxes? House Bill 110 is stuck in the Senate, what do see happening next year.

Joule: I voted against the oil tax (HB 110) and I think with some modest changes I could vote for it. Back when we did the legislation back in 2007, the House was under a cloud of corruption.

I recognize what we ended up settling on was probably a little bit overboard; we may have taken it a bit too far in my opinion. We probably needed to find a sweet spot that still allows the state to benefit from our resources.

I don't know that the state or the people in the government are happy with that level but on the other I don't think the oil companies would have been completely happy with everything.

When the bill comes back up, there is going to be probably a different level of conversation.

Recently BP successfully pulled about 350 barrels of heavy oil, and converted that and shipped it down the pipeline. How does that factor into that discussion?

The president of ConocoPhillips (Jim Mulva) has made some commitments in terms of the type of things what can be expected of them in terms of investment in Alaska. We didn't have any of that on the House side. Then there is the exploration piece. How do we encourage those who are interested in wildcatting and exploring, finding new sources of oil utilizing the new technology so we can continue to get new barrels of product into the TAPS? So I actually think when the conversation comes up, it's going to begin at a whole different level with information that we didn't have prior to this.

Petroleum News: What has been the most important thing for your region as far as resource development?

Joule: Whether it's the North Slope, which has been primarily onshore development, or at Red Dog Mine, it's important that the industries have been — I don't know if willing is the correct word — but the end result is that the caribou populations are still healthy through an oil field and all the infrastructure. People

still have access to their land-based food source. We've set up systems that by working with local people that can ensure for that. That has probably been the biggest milestone of development in those resource rich parts of the state. All of that did not come easy.

Petroleum News: You were supposed to have completed a trip to Norway, but the special session pushed that back. What did you hope to learn from that trip?

Joule: I was interested in how they conducted their offshore development. I wanted to see what the differences were. I wanted to see how they accomplish some things. I want to see what restrictions they place on industry and still yet see how that development would occur and how does that compare to what is being asked in Alaska. Are we being unreasonable or can this still occur? Being an Arctic nation, they too are going to be impacted by less ice. I want to see what they are doing. How are they planning and preparing for those kinds of times? How do they monitor their fisheries? We don't have very much by way of commercial fisheries in the north. Is that even an issue there? Then there is the whole piece on infrastructure. So, there is a lot to learn from folks who have been engaged in those things.

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Oil Spill Task Force

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Learning from the Deepwater Horizon Oil Spill of National Significance

The member agencies of the Pacific States/British Columbia Oil Spill Task Force continue to monitor the response, Natural Resource Damage Assessments, Lessons Learned and policy developments associated with the Deepwater Horizon Spill of National Significance. The Office of Spill Prevention and Response (OSPR) at the California Department of Fish and Game continues to send personel to the Gulf of Mexico to assist with shoreline cleanup and assessment as well as Natural Resource Damage Assessments.

We were honored to host officials and experts who were involved in the Deepwater Horizon response as speakers at our 2010 Annual Meeting in October. You can view their presentations - which addressed the complexities of responding to a Spill of National Significance, the technologies used and pending policy developments - at this link: http://oilspilltaskforce.org/2010conference/index.htm.

A Coast Guard HH-65C Dolphin helicopter passes over the site of the Deepwater Horizon oil spill, July 4, 2010. U.S. Coast Guard photo by Petty Officer 1st Class John Masson; photo courtesy of the Associated Press.

We have also tracked various reports on the response and are awaiting the final report from the U.S. Coast Guard's Incident Specific Preparedness Review (ISPR) Team. Larry Dietrick, Director of the Division of Spill Prevention and Response for the Alaska Department of Environmental Conservation and Dale Jensen, Program Manager for the Washington Department of Ecology Spill Prevention, Preparedness & Response Program participated as member and alternate to the ISPR Team to represent the Task Force. Most recently, the Task Force Coordinating Committee met by conference call to review the recommendations in the recent report from the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, which is available at http://www.oilspillcommission.gov/final-report.

Key policy themes for the Pacific States/British Columbia Oil Spill Task Force going forward include:

- Continued state access to planning through the Area Contingency Planning process;
- Continued state access to decision-making during a response through Unified Command and the Incident Command System;
- Coordinating industry contingency planning with Area Plans in order to ensure that sufficient response equipment is available for both offshore and nearshore response to a Worst Case Discharge; and
- Ensuring that each coastal region - including our Pacific Coast area - has adequate response capacity for mutual aid at the regional level.

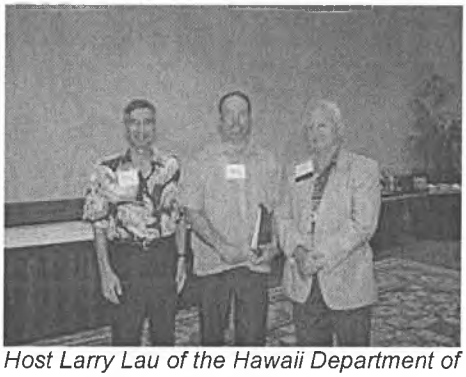
Our 2010 Annual Report

Our 2010 Annual Report provides updates on the activities of the Oil Spill Task Force and its member agenices. Our 2009 regional spill data is also included.
Download the report. (pdf, 3.8MB)

Our 2010 & 2011 Annual Meetings

Our 2010 Annual Meeting, hosted by the Hawaii Department of Health, was a great success!

Seventy-five persons participated, eagar to hear from various speakers who addressed the theme "What the Deepwater Horizon Spill of National Significance Can Teach Us."



Host Larry Lau of the Hawaii Department of Health (left) visits with Mike Zollitsch from the Oregon Department of Environmental Quality (center) and Roland Guidry, the Louisiana Oil Spill Coordinator, one of our speakers (right).

Other speakers included (photos below in the following order) USCG CAPT John Caplis, John Tarpley from NOAA, Al Allen from Spiltec, Ann Hayward-Walker of SEA, Brian Parscal of CIC, Ed Owens of Polaris, and Skip Volkle of the Marine Resources Group.

You can view videos of their presentations, as well as updates from each of our member jurisdictions and an update on the Pacific States/British Columbia Oil Spill Task Force activities at this link:
http://oilspilltaskforce.org/2010conference/index.htm

The Alaska Department of Environmental Conservation will host our 2011 Annual Meeting on August 24th in Anchorage. Stay tuned for hotel information and a program agenda.

The Stakeholder Workgroup Review of Planning and Response Capabilities for a Marine Oil Spill on the U.S./Canadian Transboundary Areas of the Pacific Coast - Final Project Report.

The Pacific States/British Columbia Oil Spill Task Force has sponsored a stakeholder workgroup to review the status of oil spill planning and preparedness on the U.S./Canadian borders between Alaska and British Columbia, and between Washington and British Columbia. The final Workgroup report - with recommendations - is available at
http://oilspilltaskforce.org/docs/notes_reports/Final_US_Canada_Transboundary_Project_Report.pdf (pdf, 9.4MB).

Known as "the U.S./Canadian Transboundary Spill Planning and Response Project Stakeholder Workgroup," they first convened in June of 2008 and adopted a Work Plan that fall. Their stated goal was to review and document existing U.S./Canadian Transboundary oil spill response plans and capabilities for the British Columbia/Alaska and British Columbia/Washington borders, acknowledging existing authorities and response management systems; and to recommend improvements as needed for joint response and planning efforts, as well as for planning and capacity building within each jurisdiction.

The Project Workgroup chartered five Subcommittees (Command, Planning, Operations, Logistics and Finance) which then developed reports on a variety of topics ranging from management of multiple command posts to remote location logistics. Those draft reports have undergone an iterative review and comment process over the past two years to produce this final Project Report with recommendations to improve spill response on the two Pacific Coast borders of the U.S. and Canada.

Many persons - representing many organizations and interests - have made a significant investment in this review of oil spill planning and preparedness. Many of these same persons will now be involved in implementing the recommendations in this Project Report. The Pacific States/British Columbia Oil Spill Task Force is deeply grateful for their ongoing commitment.

Events Calendar (pdf, 40k)

A handy reference guide to conferences and other events of interest to oil spill professionals.
If you would like to add your event to this calendar, please send information to JeanRCameron@oregoncoast.com.

Clean Pacific Conferences

Our 2009 Clean Pacific Conference was held September 14 - 16th at the lovely - and Green - Oregon Convention Center, 852 persons participated, and everyone seemed pleased with the program and the exhibitors, as well as with the setting.

We were pleased to have the U.S. Coast Guard co-host the conference, and RADM Gary Blore, Commander of the 13th Coast Guard District, delivered the keynote address. Jessica Keys, Natural Resource Advisor to Oregon Governor Kulongoski, welcomed the conference delegates to Oregon.

The conference also featured the Pacific States/British Columbia Oil Spill Task Force's 2009 Legacy Awards and a reading of the 1999-2008 Legacy Award Honor Roll, activity updates from state, provincial, and federal agencies (U.S. & Canada), two pre-conference workshops, three "Super Sessions", six poster sessions, and fifteen regular sessions. An Opening Night Reception honored our 20th Anniversary, and the U.S. Coast Guard held an Open House for their FOSCs. We are most

RADM Gary Blore, Commander U.S.

Jessica Hays of the Oregon Governor's

grateful to the Conference Sponsors, to the fine exhibitors, and to everyone who attended for making this such a success!

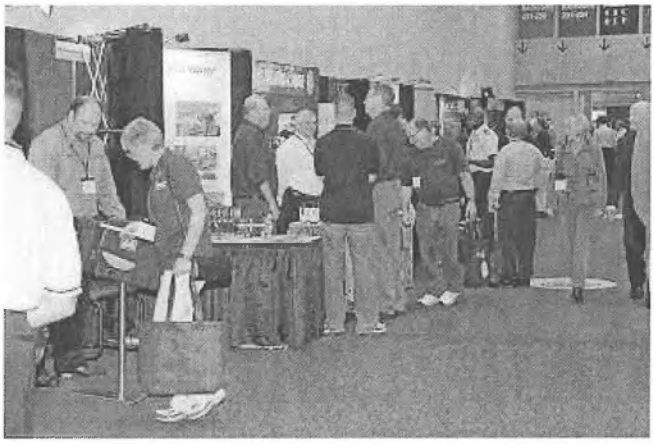
Please click on the Clean Pacific logo below for more information on the conference and for access to the presentation archives (if you were an attendee TradeFair Group will email you an access password for this).

Based on feedback to the TradeFair group (who organizes the Clean Pacific Conferences) from potential exhibitors who cannot participate in both the International Oil Spill Conference in May 2011 and a Clean Pacific Conference in September 2011 - both on the West Coast - we have agreed to reschedule the next Clean Pacific Conference to May 15-17, 2012 at the Long Beach Convention Center.

We look forward to seeing you in California in 2012!

Coast Guard District 13 was the Keynote Speaker

Office and Dick Pedersen, Oregon's Task Force Member



CLEAN PACIFIC

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The Washington Post

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Shocking discovery for joint relief

How does the FBI quickly learn new languages?

Pondering impact of drilling off remote northwest Alaska

By Steven Mufson, Published: August 16

WAINWRIGHT, ALASKA — To archaeologist Richard E. "Rick" Reanier, the 10-foot-high mound on a sandy spit on the coast of northwest Alaska was no mere pile of sand.

Circling in front, he found the top of an old kerosene tin. Around the side, he turned over a rusty door from a nearly century-old cast iron stove. Brushing away some sand, he uncovered the ruins of an entrance corridor to an Inupiat house made of sod and driftwood.

Beyond this stretch of beach lies the vast Chukchi Sea, stretching from eastern Siberia to the Alaskan coast on the edge of the Arctic. For centuries, Native Alaskan Inupiat have roamed these shores hunting bowhead whales, bearded seals, walruses and caribou.

Now Shell Oil is also hunting in the Chukchi Sea. This pristine area inside the Arctic Circle is the next frontier for offshore oil drilling in the United States. The Interior Department estimates the Chukchi Sea could hold as much as 12 billion recoverable barrels of oil, about half of current U.S. proved reserves.

Shell agrees, and some in Washington are inclined to support the company at a time of soaring energy costs. Even though it has not drilled a single hole yet, Shell has spent $2.1 billion to acquire Chukchi leases, plus almost $2 billion to collect seismic data, study the coast, and refurbish ice-breaking ships for drilling 70 miles offshore here and in the Beaufort Sea during the summer of 2012.

Reanier, working under a contract with Shell, is identifying cultural sites to be avoided if and when a pipeline comes ashore. "If you don't know where they are, you can't protect them," he said, marking the location of the sandy mound.

Two decades ago, a handful of wells were drilled in the Chukchi Sea, but oil companies didn't think it was worth developing. Now, prices have soared, and Shell thinks there is more recoverable oil there than previously thought.

"There is a prize over there," says Pete Slaiby, vice president of Shell Alaska.

But oil development could threaten the sea mammals the Inupiat people hunt for food. Several lawsuits have been filed to get government agencies to block

Chukchi drilling. Alaska Natives worry that the mere noise of drilling would disrupt the feeding and migration patterns of bowhead whales, beluga, walruses and seals. The draft of a study done for Shell suggests that seismic surveys have already silenced walruses, or frightened them off to other feeding grounds.

A sea-centered culture

"Our culture revolves around the ocean," Mae Hank, an outspoken resident of Point Hope, to the south of the village of Wainwright, says tearfully. "The ocean is very sensitive."

The drilling moratorium after the Gulf of Mexico spill last year put Shell's plans on ice for a time and heightened anxiety about how Shell could deal with an Arctic spill. And in the past week, a 1,300-barrel oil spill at a Shell platform in the North Sea aroused drilling foes.

Coast Guard Rear Adm. Paul Zukunft said recently that dispersants wouldn't work in icy water, that the Arctic doesn't have the same oil-chomping microbes the gulf has and that the nearest Coast Guard response vessel is 1,200 miles away. Whereas thousands of workers flocked to the gulf coast to fight the spill there, there are only a handful of rooms at the tiny Olgoonik Hotel here.

The window for drilling here is short, from July through October. The rest of the year, temperatures drop as low as 56 degrees below zero and the Chukchi Sea is largely frozen. So Shell is pressing to line up regulatory approvals for the Chukchi as well as the Beaufort Sea to the northeast.

"Even in areas that are [in theory] open to production, we still face debilitating regulatory red tape," Marvin Odum, president of Shell in the Americas, said in a speech to the U.S. Chamber of Commerce in Washington on July 28. Odum, who has made several trips to Alaska to reassure Alaska Natives, said the lease sale was, "in effect, an invitation from the government" but lamented that Shell had "been strung along by regulatory and legal barriers."

Shell's efforts have become a cause celebre in Washington. In June, the House passed a measure that would force the Environmental Protection Agency to speed up permit decisions and prohibit the EPA's Environmental Appeals Board from hearing challenges to air permits needed by drill ships. But Rep.

Henry Waxman (D-Calif.), ranking Democrat on the House Energy and Commerce Committee, says that delays have been caused by multiple revisions in Shell's permit applications.

Piles of permits

Shell needs about 10 permits for each of the three wells it hopes to drill next summer in the Chukchi Sea (as well as others in the Beaufort Sea). It has obtained one from the Army Corps of Engineers for a drilling structure and one from the EPA to discharge drilling fluids; it awaits others from the EPA, the U.S. Fish and Wildlife Service, the Coast Guard, the National Oceanic and Atmospheric Administration and the Bureau of Ocean Energy Management, Regulation and Enforcement. Slaiby says "we have to bat 1.000 to be ready to go."

President Obama appears inclined to go ahead with Chukchi exploration, provided there are safeguards to prevent or limit any spill. The president has established an inter-agency group to streamline permitting in Alaska. And he has endorsed oil development in the National Petroleum Reserve, which lies along the probable 280-mile-long route that would link a Shell pipeline to the Trans-Alaska Pipeline System, which carries oil south from Prudhoe Bay.

But the mere thought of a spill is daunting, despite Shell's extensive preparations and assurances. Much of the Chukchi is shallow, so Shell's wells are in water only 150 feet deep. The company also says that the pressure in the reservoirs is lower and easier to manage than in the Gulf of Mexico. Its blowout preventers will have two blind shear rams, instead of the customary one; the rams are designed to cut through and seal steel drill pipe.

Yet in its revised exploration plan submitted in May, Shell said that the worst case spill — while a "very low likelihood" — could reach 23,100 barrels a day, nearly half the rate of BP's gulf spill. A Canadian government study said that bad weather would prevent any spill response one out of five days in June, the mildest month, and two out of three days in October, the end of the open-water season.

The company, however, has refurbished a ship called the Kulluk whose conical hull is designed for Arctic conditions. Positioned between the Chuckchi and Beaufort seas, the Kulluk could reach the drill site and complete

a relief well in 34 days. A tanker capable of holding half a million barrels could be on hand within 24 hours, Shell says; that would store the first 20 days of a leak until another tanker could arrive. A nearby barge would also be able to store oil. And a capping stack like the one used to stop the BP spill last year would be warehoused on land between the Chukchi and Beaufort seas.

In an old gravel pit along the lagoon behind Wainwright, Shell has already stored 18 yellow and blue containers with boom for oil spills and a handful of small boats to spread them.

Studying shore and currents

Shell is also collecting scientific data, an answer to environmental groups who argue that more research needs to be done. In addition to hiring Reanier, Shell has deployed small teams of hydrologists, soil experts and naturalists to scout the shoreline. Two tiny antennae on a bluff generate information about currents by bouncing high-frequency radar off the water surface. The company has dropped buoys the size of medicine balls offshore to collect more information about the currents, which often go one way on the surface and the opposite way below.

Standing beside Reanier on the beach, the calm sea in one direction and soggy brownish-green tundra in the other appear endless. Aside from a few caribou tracks and sea birds, there are few signs of life — except for swarms of mosquitoes. A pair of hydrologists working for Shell walks nearby, measuring the shape of the shoreline as currents deposit sand and rich black muck inside a lagoon.

After a while, a helicopter chartered by Shell drops Reanier farther down the coast, where he pokes around some more sod houses. He finds the bottom of a beer bottle and jots down a pattern and some numbers from it. He later goes online and finds that the bottle was probably produced by an Owens Illinois plant in Charleston, W.Va., in 1933.

The nearest settlement is the ramshackle Inupiat village of Wainwright, population 540, named for a lieutenant who came here on an 1826 expedition. A skinned walrus head sits drying on a porch there. A caribou carcass is perched awkwardly on another. Strips of seal dry in the summer sun. Boats, pickup trucks and four-by-four vehicles are parked helter skelter amid the

homes of wood and corrugated metal. People chat on an open radio line, trading the mundane details of life 72 miles from Barrow, the nearest town.

In the distance sits an abandoned early warning station built when the Air Force worried about a Soviet attack. Now, all that guards the town are rows of snow fences that prevent drifts from burying homes during the long, sunless winters.

Many people work for the North Slope borough government. Seventeen work at the school. Others do maintenance work. But almost everyone hunts, from boats and from cabins on the tundra or along the coast. Food is stored in large chests, or in holes dug in the ground where temperatures stay in the 20s during the summer.

Some people keep souvenirs; one home displayed 24 fist-sized eardrums taken from killed whales.

At the fire station one recent evening, members of a local dance group, the Kuugmiut Dancers of Wainwright, gracefully move their arms and stomp their feet as others chant and beat drums. They are preparing for a competition in Fairbanks. "We listen for the animals, and after we hunt the animals, we sing and dance," one song goes, says the group's founder, McRidge Nayakik.

There is support for development here.

"You have to think of your country, like that president said," says the village mayor, Enoch Oktollik, struggling to recall the name of John F. Kennedy. Oktollik, who maintains boilers and does other handy work, says that more than half the people in Wainwright are unemployed. They might be able to find work supporting the oil companies.

For it and against it

Though people here talk about protecting their subsistence way of life, they still rely on planes and ships for some supplies. Those shipments are expensive. A new port would reduce those expenses, the mayor adds. Bob Shears, a local contractor, estimates that building a road costs $1 million a mile and buying gasoline, even with subsidies, costs about $7 a gallon.

The Olgoonik Corp., the village company that runs the hotel and store, has

printed a slick brochure with a vision for a port and encampments for oil workers.

"They smell money," says resident Frank Bester Jr.

But there is uncertainty among the Alaska Natives along the coast, especially further south in Point Hope but even in Wainwright.

Oktollik asks, "Are we willing to risk our subsistence way of life?" He says, "We don't have gardens to grow vegetables, or potatoes or tomatoes."

Bester says that he's "both for and against" oil development.

The Chukchi and the tundra are Wainwright's lifelines. Recently, after a Shell helicopter shuttling scientists to points along the coast landed, Oktollik rushed up to the pilots to make sure they weren't frightening caribou spotted to the north.

Time after time, people mention the spill in the Gulf of Mexico.

"I'm afraid being so rural here, they may not have the proper equipment to take care of it," says Ralph Aveoganna, who works at a local gasoline station. He also fears oil development might change the migration patterns of the bowhead whale.

Yet change is probably coming to Wainwright in any case. Climate change is altering the ice melt and could change migration patterns. It could also turn the Arctic into a shipping channel; last year the first commercial cargo trip was made, carrying iron ore from Norway to China.

One night recently, with the summer sun still shining across the water and bouncing off the pale pastel colors of the homes here, Muriel Panik, a 34-year-old single mother who has attended the tribal college in Barrow, sat on her four-by-four vehicle. She said that oil development would be good for jobs and that she wants her own daughter to do something different. She doesn't want big changes in Wainwright, but she recognizes they could come about anyway as video games transfix the village's young people and climate change threatens its fast-eroding shoreline.

"The older generation says this is the last frontier," she says. "I say this is the

next frontier."

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Trying To Unravel The Mysteries Of Arctic Warming

by RICHARD HARRIS

Enlarge John McConnico/AP

An iceberg is seen melting off the coast of Ammasalik, Greenland, in July 2007. This year, scientists say sea-ice extent in the Arctic has reached its lowest level since monitoring by satellite began in 1979, the result of rising temperatures.

The Arctic may be the world's next geopolitical battleground. The melting ice will have profound consequences for the roof of the world, opening strategic waterways to shipping, reducing the ice cap on Greenland, and spurring a rush to claim rights to the wealth of natural resources that lie beneath. NPR examines what's at stake, who stands to win and lose, and how this could alter the global dynamic.

The final installment in a six-part series

August 20, 2011

text size A A A

The Arctic is heating up faster than anyplace on Earth. And as it heats, the ice is growing thinner and melting faster. Scientists say that sometime this century, the Arctic Ocean could be free of ice during the summers. And that transition is likely to be chaotic.

Arctic sea ice has always seen dramatic swings. Every winter, the ocean is completely covered with ice. It starts to melt in the late spring, and by September about half that ice has melted away.

The Arctic's Diminishing Sea Ice

Now, add to that annual gyration a more recent trend. The seasonal melt has been claiming more and more ice since at least 1979, when researchers started monitoring that trend from space.

"Within the satellite record, this [year] is the lowest ice extent for July that we've ever seen," says Mark Serreze, who heads the National Snow and Ice Data Center at the University of Colorado.

In fact, current conditions aren't far from the 2007 record low for seasonal ice loss.

"The Arctic keeps surprising us," Serreze says. "The point is we're losing the sea ice faster than we think we ought to be. And this is causing us to revise some of our estimates."

Challenges To Predicting An Ice-Free Arctic

Just a few years ago, scientists forecast that global warming would clear summer ice from the Arctic Ocean by the year 2100. Now, many forecasts say that could happen in the middle of this century. And Serreze says a few peg that ice-free spell as early as 2030.

"We very likely will live to see ice-free summers in the Arctic," says Marika Holland, of the National Center for Atmospheric Research in Boulder, Colo. "Or if we don't live to see it, our children will."

Holland says nobody can pinpoint a date because Arctic sea ice is hard to predict year to year. That unpredictability has implications for people who are thinking about exploiting Arctic resources and expanding Arctic sea routes.

Enlarge Jackie Northam/NPR

A polar bear makes its way across the ice in Canada's Northwest Passage. Melting ice in the Arctic will make survival increasingly difficult for wildlife in the region.

"Some of these shipping routes will become open much more reliably," she says. "But we're not close to that yet and we can't really predict exactly when that's going to happen."

The sea ice is at the mercy of currents, cloud patterns and a host of other variables that change naturally from year to year.

"We could have instances of very rapid sea-ice loss. Those might be followed for years, or even a decade, by quite stable sea-ice conditions. But it's difficult to predict exactly when these instances of rapid sea-ice loss could occur," Holland says.

Repercussions Ripple Outside Arctic

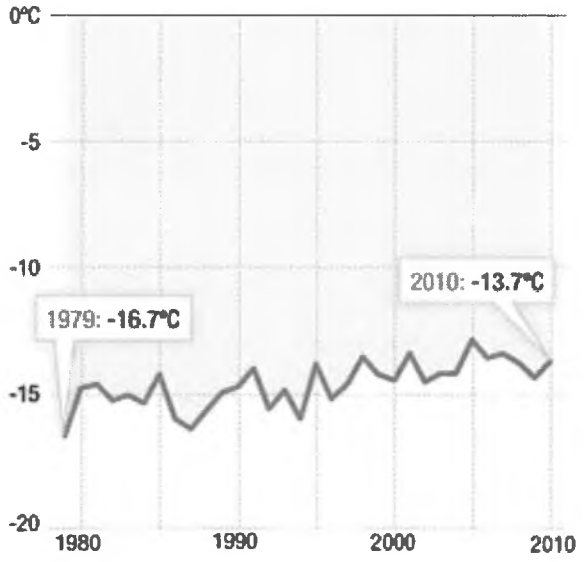
The consequences of melting ice are going to be felt first in the Arctic region. For example, polar bears and walruses rely on sea ice as hunting platforms and places to rest. As those ice edges move out into deeper water, farther from the shore, it will become harder for those animals to survive.

Leonid Polyak, from the Byrd Polar Research Center at Ohio State University in Columbus, says wildlife had to face a temporary warm spell in the Arctic about 8,000 years ago. Then, it was actually hotter than it is today, the result of a temporary change in the Earth's orientation relative to the sun. But this time is different.

"Significant changes in the ice cover will affect the ecological system very profoundly," Polyak says. "And it's not given that many of those species will survive if Arctic ice disappears completely in summer."

Warming In The Arctic

Annual Air Temperatures From 1979-2010



Credit: Stephanie d'Otreppe/NPR

And the changes aren't just going to affect wildlife. The ice serves as a giant reflector for energy. Some 80 percent of the sun's energy bounces back into space when it hits the ice. But when the ice melts and exposes the ocean, that darker surface absorbs 90 percent of the incoming energy. As a result, the loss of ice leads to more warming.

That will drive up the temperature on nearby land masses. In the coming decades, the frozen ground that makes it relatively easy to get around in the Arctic will start turning to mush. And the effects of Arctic warming will gradually reach farther south.

"What happens in the Arctic affects heat waves in Chicago — or elsewhere," Holland says.

And then there's global sea-level rise — an effect that isn't as obvious as it might seem. Because when sea ice melts, it does not raise sea level. After all, lemonade doesn't overflow when the ice that's floating in it melts.

But what happens to the ice that's sitting out of the water, on the Greenland bedrock, is another story altogether.

"If we see this enhanced warming, due to sea-ice loss, we'll very likely start to melt more of the Greenland ice sheet," Holland says. "That water does lead to sea-level rise."

And those global impacts are going to be much more noticeable than the changes in the remote north, which will gradually reshape the Arctic.

In The Land Of White Nights And Erik The Red

by PHILIP REEVES

1 of 6

Some of the world's largest energy and mineral companies are interested in drilling and mining around Disko Bay, off the west coast of Greenland. To date, there have been relatively few such projects on the island because of the harsh conditions. (Photos by Philip Reeves/NPR)

August 17, 2011

text size A A A

For most of history, Greenland has been one of the most remote and inhospitable places on the planet. You would be hard-pressed to find someone who could say exactly where it is, who runs the place and who lives there. But with the Arctic ice retreating, some of the world's largest energy and mining companies are now eager to explore for oil, gas and rare earth minerals. As part of our series on the Arctic this week, NPR's Phil Reeves visited Greenland and talked to the people about the prospects of change. You can hear his reports on Morning Edition. Here are some of his observations during his recent stay in Greenland's capital, Nuuk.

Enlarge Philip Reeves/NPR

Nuuk, Greenland's capital, has 16,000 residents — or about one-quarter of the island's population. It's a town of stark contrasts, home to supermarkets stocked with Italian wines and French cheese as well as shops selling whale skin, blubber and racks of seal ribs.

A drizzling fog has sauntered in from the sea and swallowed up the town. The hour is late. Finally, I have my fingers around the neck of Erik the Red.

Erik was the man who, about 1,000 years ago, gave this giant island the wrong name. He was keen to persuade his fellow Norsemen to leave neighboring Iceland and settle on these shores.

So he talked of a place called Greenland, thinking this alluring billing would surely attract boatloads of Vikings. At least, so say the Icelandic Sagas.

The name was a lie: Greenland was then, and is now, a vast wilderness of ice, snow and rock, most of which is above the Arctic Circle.

Even in its exposed parts, along the coastal fringe, Greenland is more brown than green: I haven't seen a tree.

Greenlanders of the modern age have rewarded Erik's outrageous hype by immortalizing him in liquid form.

Heard On NPR

August 18, 2011
Mineral Companies Eye Greenland's Untapped Wealth
[7 min 46 sec]

August 17, 2011
Greenlanders Divided On Arctic Oil, Gas Exploration
[7 min 46 sec]

In the bars of Nuuk, you can buy bottles of locally brewed "Erik the Red" beer. I have my hand wrapped around one now. A swig of Erik is an antidote to a day spent pounding the streets of this unusual town.

Nuuk lies in a rocky cradle of land, surrounded by jagged mountains beside a cold, clean sea that is ornamented, in the summer, by the occasional shard of passing ice.

A few days ago, two whales were spouting in the steely waters below the wheels of the Fokker 50 propeller plane as we prepared to land in Nuuk from Iceland.

Beyond the town lies a vast, wild network of fjords and glaciers, the plumbing system for the runoff from the gigantic ice cap that covers most of Greenland, the world's largest island and a self-governing dependency of Denmark.

Nuuk is the capital of Greenland, and the town therefore holds itself in high esteem. Yet only 16,000 people live here.

In Greenland, 16,000 is a big number, more than a quarter of the island's entire population — most of whom are indigenous Inuits. The tourist blurb in my hotel calls Nuuk "tiny," but also boasts of a "sprawling metropolis."

One Greenlander I interviewed compared Nuuk with Las Vegas. At least, she says, that is how dazzling the town seems to an Inuit hunter or fisherman when he arrives for the first time from one of Greenland's tiny, faraway coastal villages.

Enlarge Philip Reeves/NPR

Some Soviet-style apartment blocks in the middle of Nuuk are crumbling, reeking and covered in graffiti. Apartments such as these were built in the 1960s and '70s to house Inuit hunters and fishermen forced out of their remote settlements to supply labor for fish factories.

That hunter-fisherman will find that Nuuk has several big, well-stocked stores, including a large supermarket selling Italian wines, French cheese, olives and pineapples.

He will find a shop that sells cuts of whale skin, big lumps of blubber and racks of seal ribs.

If he tours around town by taxi — and he should expect breathtakingly high fares — he will also find a few boutiques, cafes, bars and restaurants, including one that serves surprisingly good Thai food.

During the summer's "white nights," when the sun barely sets, the hoots and howls of drinkers echo into the early hours. Sometimes these chime with the pounding rhythms of a Nuuk rock band. The town has a remarkably active music scene.

Yet Nuuk is not Sin City, not by a long shot. There are just two traffic lights, and much of the time the city is hushed.

A few days in, I find myself wondering why the town is not dying of boredom. Yet the people tell me there is much to do, especially if you have a family. "We celebrate everything that happens in the family," one Nuuk resident told me.

"If it's your birthday, we have a party. If you're setting off to college, there's a party. If you're coming home from college — another party," I was told. There is evidence of this in the local paper. It carries big advertisements announcing the birthdays of children.

Enlarge Philip Reeves/NPR

The tiny fishing village of Maniitsoq is located on Greenland's west coast. The global aluminum giant Alcoa is proposing to build a large smelter there.

Proof of another great passion lies down in the harbor. There is a large fleet of tiny boats in which people sail out in the summertime to explore the fjords. They build cabins, fish and shoot seals. Residents say they fill their freezers with the meat and fish they've killed.

Evidence of Greenland's hunting culture is everywhere. Even the chairs in Nuuk's cheerful little airport are lined with seal fur.

This picture has one big — and, to the outsider, surprising — blemish. Dotted around Nuuk, looking utterly out of place, there are some giant down-at-heel Soviet-style apartment blocks.

They are the product of a program a few decades back, when Inuit hunters and fishermen were forced to move out of their coastal settlements and into Nuuk to provide labor for the fishing industry.

The issue remains a sore point. Greenlanders tend to blame the Danes, their former colonial masters. The apartments are gradually being knocked down, but they remain a nasty scar on an otherwise idyllic landscape.

Erik the Red — the Viking equivalent of a Realtor — would surely have been appalled at these eyesores.

Related NPR Stories

Summer's Not So Fine For Greenland's Huskies July 20, 2011

Iceland: Land Of Stark Beauty And, Lately, A Run Of Bad Luck July 8, 2011

Russia Pushes To Claim Arctic As Its Own

by DAVID GREENE

Enlarge David Greene/NPR

Murmansk, Russia, is the largest city above the Arctic Circle. If Russia follows through with plans to explore for oil and natural gas offshore in the Arctic Ocean, the city and its port could see significant economic benefits.

The Arctic may be the world's next geopolitical battleground. Temperatures there are rising faster than anywhere else in the world, and the melting ice will have profound consequences for the roof of the world, opening strategic waterways to shipping, reducing the ice cap on Greenland, and spurring a rush to claim rights to the wealth of natural resources that lie beneath. NPR examines what's at stake, who stands to win and lose, and how this could alter the global dynamic.

Second in a six-part series

August 16, 2011

text size A A A

Four years ago, Russian researchers made a bold, if unseen, move. From a submarine, deep beneath the icy waters of the North Pole, they planted a Russian flag on the ocean floor.

Russia has the world's longest Arctic border, which stretches more than 10,000 miles. And for Russia, that 2007 research mission was only the beginning of a major drive to claim ownership of vast portions of the Arctic, as well as the oil and gas deposits that are beneath.

Credit: Stephanie d'Otreppe/NPR

At present, Russia has some islands in the Arctic Ocean. But aside from that, the country's northern border effectively ends where the Arctic Ocean begins.

Yet the Russian government is now making the argument that its border should be extended northward. The government says that hidden under the Arctic's icy waters is a mountain range, the Lomonosov Ridge, which goes all the way to the North Pole. They say this shows that Russia continues north below sea level, and the country has scientists in the Arctic Ocean now, collecting evidence for the claim.

On a recent visit, a speedboat raced up the Pechora River in one small part of the vast region. The river cuts through hundreds of miles of empty green and sandy tundra and empties into the Arctic Ocean.

In a small fishing village with a smattering of wooden houses in the Nenets Autonomous Region, Yuri Tyulyubayev, a travel company owner, says many local residents agree with the government.

"People are happy that we have oil because ... we have more work, we have more profit, we have everything," says Tyulyubayev.

Enlarge David Greene/NPR

Nadezhda Lyashenko is a spiritual leader in the Saami tribe, indigenous people who live in Russia's northwest Arctic region. As Russia and other world powers search for oil in the

In many ways, Tyulyubayev is a poster child in Russia's campaign for

Arctic Ocean, she worries about the environmental consequences.

Arctic energy. He arranges travel for the oil industry. So his small company stands to profit if foreign energy companies flock here. His native land of north-central Russia is largely unspoiled.

"It's a very, very reindeer region," he says. "We have more than 150,000 reindeer for 40,000 people."

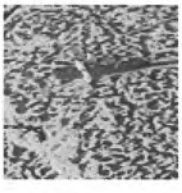
'They Could Break Everything'

And now, a lot of oil and gas companies. There are Russian firms, but also companies from the U.S. and Vietnam, all exploring for oil and gas onshore. And if Russian leaders have their way, exploration will begin in the Arctic Ocean itself as early as this winter. Tyulyubayev says the more money and business that come to this region, the better.

But what about the risks to the environment?

"Of course we worry. But I would not say that this is the first worry in our life," he says. "Economic life is much more important for people."

More In This Series



Arctic Warming Unlocking A Fabled Waterway

For centuries, the ice-choked Northwest Passage has been prized as a potential trade route.

In The Land Of White Nights And Erik The Red

Change is coming to Greenland, the world's largest island, and its 56,000 residents.

The Russian Arctic has the scars of history. The northwest, around the port city of Murmansk, was pummeled by Adolf Hitler's forces during World War II. The Arctic was also one of Soviet dictator Josef Stalin's favorite places to send his perceived enemies, with gulags that dotted the snowy landscape.

The indigenous people of this region bore much of the brunt. The Saami

In The Arctic Race, The U.S. Lags Behind

U.S. readiness for increased activity in the Arctic is limited, and it's not part of a key treaty.

The Arctic's Diminishing Sea Ice

The Earth is warming, with profound consequences for the Arctic, the roof of the world.

tribe, for one, has lived centuries in Russia's northwest, near the Norwegian border. Saami people were forcibly collectivized on farms under Stalin. Nadezhda Lyashenko, the Saami woman singing traditional tribal music here, can recount the horror stories. Her grandfather, a reindeer shepherd, was shot in 1937, accused of being a spy after he crossed into Finland chasing a reindeer herd.

After decades of relative peace, Lyashenko says, trouble seems to be returning to her native Arctic lands. She sees Russia and other world powers in a race for oil and gas, ignoring the potential impact to a part of the Earth that's been rarely touched.

"The Arctic is just so fragile," she says. "This time, it's a research boat going out there. It's like the prick of a needle, and the land will heal. But if they go with knives, with spears, they could break everything. And then what?"

Putin's Political Gift

Russia has signaled that it means business. The government seems determined to militarize the Arctic, announcing recently that two army brigades — several thousand troops — will soon be patrolling there.

Prime Minister Vladimir Putin, in a speech to the country's ruling United Russia party this summer, vowed to open the Arctic Ocean for offshore development. He announced plans to build a new, year-round port on the Yamal Peninsula in the center of Russia's north coast. Putin said that Russia would consult with other Arctic countries. But, he added, Russia will be "firm and persistent" in protecting its interests.

Enlarge David Greene/NPR

The village of Teriberka, in the Murmansk region of Arctic Russia, is an impoverished and desolate community. Many of the 700 residents are out of work.

Konstantin Simonov, who heads the National Energy Security Fund, a Russian think tank that consults with

oil and gas companies, says the Arctic is a political gift for Putin. As Soviet power fades into memory, Putin can say this is one part of the world where Russia still calls the shots.

"With the help of Arctic, Putin can show to people that Russia is still a serious power," Simonov says.

The risk, Simonov says, is exaggerated expectations. Many of the offshore oil and gas projects are at least a decade away from bringing economic benefit — assuming they succeed.

Yet Russians who live above the Arctic Circle are growing excited. They look to neighboring Norway, or to Alaska, where citizens share in oil profits. And they believe their time has come. Simonov thinks about one desolate village, Teriberka. It's on the coast near the Norwegian border. People there were told that as soon as a new offshore gas deposit, known as the Shtokman field, is explored, the community will get a natural gas processing plant and plenty of jobs.

Enlarge David Greene/NPR

Andrei Udin, 33, works odd jobs around Teriberka — including at this repair shop — but he can't find steady work. He has grown impatient, fearing a natural gas processing plant promised to this community will never materialize.

"I can understand these people because they have no other alternative but to dream that our plans to develop Arctic will be realistic," Simonov said.

Holding On To Hope

To reach the village of Teriberka requires driving 100 miles across empty tundra. It's a place that's struggling. It has dirt roads and

maybe 700 residents who live in old Soviet housing that's crumbling.

According to 33-year-old Andrei Udin, life in Teriberka is depressing. He has tried for years to find real work. Udin likes the tough talk from Putin, the promise to fight for Arctic territory. "What's ours should be ours," Udin says. But after years of delay, he's beginning to wonder if that natural gas processing plant is really coming to Teriberka.

"If I don't have a job, natural gas does nothing for me," Udin says. "I can't exactly use the gas for food." Frustration is growing around this village. People are beginning to say that unless the oil and gas riches will be shared, maybe it's best to leave nature alone.

In The Arctic Race, The U.S. Lags Behind

by MARTIN KASTE

Enlarge Prentice Danner/AP

The U.S. Coast Guard Cutter Healy breaks ice to support scientific research in the Arctic Ocean near Barrow, Alaska, in this file photo from July 2006 provided by the Coast Guard. In addition to the medium-class Healy, the U.S. just has two polar-class icebreakers — one of which will be decommissioned soon.

The Arctic may be the world's next geopolitical battleground. Temperatures there are rising faster than anywhere else in the world, and the melting ice will have profound consequences for the roof of the world, opening strategic waterways to shipping, reducing the ice cap on Greenland, and spurring a rush to claim rights to the wealth of natural resources that lie beneath. NPR examines what's at stake, who stands to win and lose, and how this could alter the global dynamic.

Fifth in a six-part series

August 19, 2011

text size A A A

Seattle is the home of the U.S. Coast Guard's entire fleet of polar-class icebreakers.

Both of them.

Capt. George Pellissier commands both the Polar Sea and the Polar Star. He has spent much of his career on these ships, which were built in Seattle in the 1970s.

"The two ships are almost identical. They were built a year apart. Our design is to break 6 feet of ice continuously, and we can break up to 21 feet of ice," Pellissier says, referring to the thick "pressure ridges" that can form between sheets of ice in the waters north of Alaska, and which can trap and even crush less sturdy vessels.

He takes pride in the fact that these "polars," as they're called, are still among the most capable icebreakers out there — not counting the Russians' big nuclear-powered icebreakers.

But Pellissier admits that if an ice-breaking emergency broke out, America wouldn't have much to offer because, right now, neither polar icebreaker is functional.

Four decades of ramming sea ice will do that. The Polar Star will recover — it's currently being refurbished — but the Polar Sea will be scrapped.

Enlarge Martin Kaste/NPR

U.S. Coast Guard Capt. George Pellissier stands aboard the Polar Sea, one of two of the Coast Guard's polar-class icebreakers. But the ships — built in the 1970s — have seen better days, and the Polar Sea will soon be scrapped.

"I would dearly love to keep them both. I understand the fiscal realities that we're in. It's always sad to actually decommission a ship," Pellissier says.

The U.S. also has a medium-class icebreaker, the Healy, but it's a research vessel and isn't designed to break through ice more than 8 feet thick.

Building 'A Persistent Presence'

The Coast Guard has told Congress it needs at least three medium and three heavy icebreakers. Global warming means more activity in the Arctic, and more civilian vessels are venturing north into harm's way.

In early August, the Obama administration gave a tentative green light to Shell Oil to start drilling for oil in the waters north of Alaska. The U.S. is also in the process of mapping the seafloor north of Alaska, with an eye to claiming more of the continental shelf, and the resources it may contain.

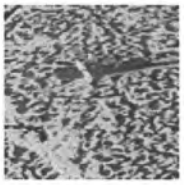
The increased activity means the U.S. could face more challenges to its interests in the polar latitudes. Yet the U.S. isn't party to a major treaty that will shape territorial claims in the region.

Lisa Murkowski, the Republican senator from Alaska, is a big believer in establishing a more persistent U.S. presence in the Beaufort and Chukchi seas, north of her state.

"We are an Arctic nation. And as such, we have responsibilities and obligations in the Arctic," she says.

It's not just about icebreakers; she says it's time for a deep-water port on Alaska's north shore. That is an expensive proposition, she admits, but the U.S. has to protect its interests.

More In This Series



Arctic Warming Unlocking A Fabled Waterway

For centuries, the ice-choked Northwest Passage has been prized as a potential trade route.

Russia Pushes To Claim Arctic As Its Own

Russia has launched a drive to own vast parts of the Arctic, including its oil and gas deposits.

"There are a lot of folks that are looking with great interest at the level of activity by the Chinese up in the Beaufort and Chukchi. And they're wondering, 'What's going on up there?' Because we don't think that they're doing any sightseeing," she says.

Arctic Skepticism

In The Land Of White Nights And Erik The Red

Change is coming to Greenland, the world's largest island, and its 56,000 residents.

The Arctic's Diminishing Sea Ice

The Earth is warming, with profound consequences for the Arctic, the roof of the world.

The big argument for establishing a more "persistent presence" in the Arctic is the expectation that, in the next couple of decades, melting ice will turn the Arctic Ocean into a major commercial shipping route between the Atlantic and Pacific. But Lawson Brigham says that expectation is overblown.

"Most of us that work on this don't believe that's going to happen," says Brigham, a former U.S. Coast Guard icebreaker captain who has a doctorate in polar oceanography. He studies sea ice, and he says people have to remember that even though the ice is rapidly thinning, it's not going away altogether.

"Perhaps during the summertime, today and in the future, there will be a window, a short period of time of opportunity to sail ships across the top of the world," he says. "But as a regular, year-round and just-in-time cargo-carrying system, it's going to be very difficult to do with the ice cover present."

Brigham imagines the time savings would be offset by the ships' slower speed as they watch for rogue ice, and he doubts their insurance companies would consider the Arctic route a good bet.

He is even more dismissive about the much-heralded Northwest Passage through Canada's northern archipelago. He says the ice in those narrow straits and inlets may prove more stubborn than the polar ice cap itself.

"It just gets fused in those islands, and breaks up at various times, and the ice cover is extraordinarily variable from year to year, so it's a hugely variable and complicated place," he explains.

Brigham is also skeptical of the ominous warnings about the Russians and Chinese, and possible conflict over resources in the Arctic — a skepticism shared by Navy Rear Adm. David Titley in testimony to the Senate in July.

"I'm sure many of you have heard in the media, especially a year or two ago, people talk about the Arctic as the 'Wild West,' and it's the 'race for resources.' That really isn't true," he said.

It isn't true, he says, because of the United Nations Convention on the Law of the Sea. Among other things, the global treaty lays out how countries go about claiming natural resources on the ocean floor.

Law Of The Sea, But Not The U.S.

Yet the U.S. Senate has never ratified the treaty, because of anti-U.N. sentiment among some conservative Republicans. Titley says that puts the U.S. in an awkward spot as the Arctic opens up.

"Other countries are frankly looking for the U.S. to show leadership, and it's hard to show leadership in this treaty when we're not a party to it," he said.

It's a common complaint among those who favor more development in the Arctic. Alaska's Murkowski, for instance, wants the Senate to ratify the treaty so the U.S. can extend its claim on the continental shelf north of Alaska, and also so it can participate in the treaty organization's future decisions relating to Arctic resources.

But Steven Groves, an international law analyst at the conservative Heritage Foundation, says that's no reason to embrace the U.N.'s Law of the Sea.

"As a conservative, I believe the United States and the American people have a right to all of [its continental shelf]. They don't have to lay claim to it by being a party to a treaty. They own it already," he says.

Plus, Groves says, the treaty requires offshore oil companies to pay royalties to the international treaty organization, shortchanging the U.S. Treasury. Treaty supporters — the Obama administration among them — acknowledge this, but they're still pressing for ratification, perhaps this fall.

They say as long as the U.S. isn't a party to the treaty, when it comes to shaping the future of the melting Arctic, the U.S. will be stuck on the outside, looking in.

Arctic Warming Unlocking A Fabled Waterway

by JACKIE NORTHAM

1 of 9

The Louis S. St.-Laurent crashes through ice along the Northwest Passage, a series of waterways winding through Canada's Arctic archipelago. Affectionately known as the Louis, the country's largest icebreaker spends most of its time in the Arctic these days dedicated to scientific research. (Photos by Jackie Northam/NPR)

The Arctic may be the world's next geopolitical battleground. Temperatures there are rising faster than anywhere else in the world, and the melting ice will have profound consequences for the roof of the world, opening strategic waterways to shipping, reducing the ice cap on Greenland, and spurring a rush to claim rights to the wealth of natural resources that lie beneath. NPR examines what's at stake, who stands to win and lose, and how this could alter the global dynamic.

First in a six-part series

August 15, 2011

text size A A A

It appears as just a speck on the horizon, a slightly darker shape against a vista of Arctic ice. Soon enough, the ship's bridge makes the announcement: "Polar bear, starboard."

Crew and passengers onboard the CCGS Louis S. St.-Laurent, Canada's largest icebreaker, head to the open deck, binoculars and cameras ready, and watch as the bear lumbers from one ice floe to another, quickly dipping into the inky blue water and effortlessly pulling himself back up again.

Often, a bear will head toward the ship and gaze up at the people gazing down at it, head tilted to one side. The massive creatures don't demonstrate any fear, just curiosity.

That's likely because they rarely see anything like a ship passing through the Northwest Passage, a series of waterways winding through Canada's Arctic archipelago of 36,000 islands. It's midsummer and the first time the coast guard icebreaker, affectionately known as the Louis, is making its way through the ice-choked waters this season.

Enlarge Jackie Northam/NPR

A polar bear approaches the Louis S. St.-Laurent, Canada's largest icebreaker, as it makes its way through the Northwest Passage in mid-July. The ship was on a journey that began in Newfoundland and would ultimately take it to the Beaufort Sea.

But temperatures in the Arctic are rising faster than anywhere else in the world, making the Northwest Passage easier to navigate. As the ice melts faster, the vitally strategic waterway is expected to open up for longer periods of time — an attractive notion for shipping companies hoping to shorten trade routes and gain easier access to economic powerhouses such as China and India, as well as for nations within the Arctic Circle jockeying for vast, untapped natural resources.

'Everything Is Going To Change'

For hundreds of years, the Northwest Passage has been prized as a potential transit route across the polar region, linking the Atlantic and Pacific oceans and greatly reducing transit times for ships that would have relied on the long, southern route through the Panama Canal. In the past, it proved to be a dangerous and difficult waterway, and the chilly Arctic waters hold the wrecks of earlier attempts to navigate the passage.

Andrew McNeill, captain of the Louis, says it's not nearly as difficult as it was when he first started sailing in Arctic waters some 30 years ago.

"My first season here was, it was 36 hours of constant ramming of ice to get through this area. ... There's been times when the ship has had to reschedule events because of delays getting through the passage," he recalls.

More In This Series

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As the Louis makes its way through the waterway, it slices easily through the polar ice sheet. It's mesmerizing: Enormous blocks of shimmering ice shoot up, twist onto their sides and bob along in the clear water, regrouping in the ship's wake.

Eddy Carmack, a leading oceanographer with Fisheries and Oceans Canada, has carefully charted the changes in the Arctic since he first visited in 1969. He is part of a diverse group of business, science and government leaders who are traveling aboard the Louis, brainstorming about the Arctic and its future. The ship is wending its way from Newfoundland in Canada's northeast, with stops in Resolute and Cambridge Bay, all the way, ultimately, to the Beaufort Sea off the country's northwest coast.

Carmack says the ice on this voyage looks the same as earlier trips he's made on the Northwest Passage, but it has a different feel.

"I would say what we're experiencing now is softer ice, it's not as formidable, it's yielding to the pressure of the ship, it's breaking easily. And that's because the ice itself is warmer," he says.

Rising air and water temperatures in the Arctic mean there is less ice each year, and for longer periods of time. Steve MacLean, president of the Canadian Space Agency, says that trend is expected to continue throughout the Northwest Passage.

"It's always opened up for the last 15 years for about six weeks in the summer. Now it is expected that period will extend. And because it's going to extend, everything is going to change," MacLean says.

Historically, that season has generally spanned late July into early September — and sometimes as late as October.

Enlarge Jackie Northam/NPR

As Arctic temperatures rise, the Northwest Passage will be open up for longer periods of time. Here, the Louis slices through sea ice.

These longer periods of ice-free waters will likely mean more vessels trying to navigate the narrow straits and channels of the Northwest Passage, including commercial shippers looking for a shortened trade route. Yet only about 10 percent of the Northwest Passage is charted.

Competing Claims In The Region

As the waterway opens up, so, too, does the issue of who controls it. The U.S. and other nations see it as an international waterway that just happens to pass through Canada's Arctic region. Under that premise, Canada would not have the right to deny passage to foreign ships.

But Canada calls the Northwest Passage an internal waterway, and maintains it has the right to regulate and protect the passage. Leona Aglukkaq, Canada's minister of health, is from Gjoa Haven, a tiny town along the Northwest Passage. She says Canada's sovereignty over its land and its waters in the Arctic is longstanding and well-established.

"Our position is that these waters are Canadian, subject to full Canadian regulation and control. And [foreign vessels] only enter Canadian internal waters with the consent of Canada. That's our position; that remains our position," Aglukkaq says.

Last year, Canada released a new northern strategy that emphasized how it would bolster its sovereignty claims. That includes increasing scientific and environmental research of the region, and promoting exploration, along with economic development and governance of the indigenous communities.

Canada is beefing up military operations in the Arctic as well, and is conducting a five-year, $100 million study of the region's natural resources — oil, gas and minerals. It's believed that more than 20 percent of the world's oil and gas reserves are hidden in the Arctic.

Enlarge Jackie Northam/NPR

Much of the Northwest Passage experiences 24 hours of light during the summer months. But as the Louis heads further south toward Cambridge Bay, a sunset appears on the horizon.

David Boerner, a director general of the Canadian Geological Survey, says he believes those figures are generally "in the right ballpark." But he says they're often underestimated because geologists aren't able to conduct enough detailed work to establish the full extent of the resources.

Canada has also been mapping the Arctic seabed to determine how far its land mass, or continental shelf, extends past its visible coastline. This is critical to proving its right to

resources under the water. Canada has until 2013 to present its case to the United Nations. The U.S., Russia and others are doing the same.

Warwick Vincent, director of the Center for Northern Studies at Laval University in Quebec City, says there's a need to quickly put international border and sovereignty agreements into place because development of the region is already taking place. And, he says, it's accelerating.

"Right at this moment, the Arctic is experiencing unprecedented transformation as a result of not only climate but as a result of economic development. So we need those regulations in place, rapidly," Vincent says.

Challenges Remain In Inhospitable Terrain

Even if all of these claims are settled, the Arctic is still an extremely difficult place to operate, says Martin Bergmann, director of Natural Resources Canada's Polar Continental Shelf Program, a key logistical facility for research in the Arctic.

"The Arctic in Canada is basically the size of Europe, has maybe 30 kilometers of roads, no trains, very few airports," Bergmann says, adding that about 30 communities have the capability to land small aircraft on gravel.

Bergmann says sealift — the main form of bringing heavy cargo and larger equipment to the region — only happens "once a year when a ship visits the Arctic, just like Christmas comes once a year."

But the land and the weather are inhospitable, and the waters will stay frozen for much of the year for decades to come. And that, geophysicist Boerner says, makes it extremely expensive to do any kind of work in the area. Given all that, he says, it's

It's an untouched area; very few people come through here still. You feel very humbled and fortunate to experience that.

unlikely there will be a mad rush to the Arctic by oil and gas companies anytime soon.

- Andrew McNeill, captain of the icebreaker Louis S. St.-Laurent

"You don't really know what's there until you've tried to extract it or drill it. ... It's also not sort of who gets there first. There are well-established regulatory regimes for giving out land, and giving the rights to explore and ... a whole bunch of environmental checks and controls and balances," he says.

Given the warming trend, development is inevitable in the Arctic. Yet despite the changes, McNeill, captain of the Louis, says he still feels the magic, and mystique, as he journeys through this pristine, mostly unexplored area.

"It's an untouched area; very few people come through here still," McNeill says. "You feel very humbled and fortunate to experience that, and you can relate to the hardships that those early explorers and traders had to deal with back then."

Related NPR Stories

PHOTOS: Washing Away The Arctic Coastline April 19, 2011

Christine Hess

From: Christine Hess
Sent: Friday, September 23, 2011 3:07 PM
To: nwtf
Subject: FW: Press Release: BOEMRE Awards $5.6 Million for Arctic Environmental Study

FYI

Bureau of Ocean Energy Management, Regulation and Enforcement

For Immediate Release
Date: September 20, 2011
Contact: Marjorie Weisskohl (703) 787-1304

BOEMRE Awards $5.6 Million for Arctic Environmental Study

Research to Focus on Hanna Shoal Ecosystem in Alaska's Chukchi Sea

WASHINGTON — The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) today announced it has signed a cooperative agreement with the University of Texas at Austin and a team of highly qualified and experienced Arctic researchers for a comprehensive study of the Hanna Shoal ecosystem in the Chukchi Sea off Alaska's northwest coast. The study will be conducted from 2011-2016 and is expected to cost $5,645,168.

Ongoing studies have highlighted Hanna Shoal as an important biological ecosystem between the Chukchi Sea and Arctic Ocean waters. BOEMRE analysts and decision makers will use the information developed by this study in future *National Environmental Policy Act* analyses and decision-making regarding potential energy development in the Chukchi Sea.

"Over the course of many years, we have devoted substantial resources to promote better understanding of the Arctic environment," said BOEMRE Director Michael R. Bromwich. "This five-year study will greatly contribute to the body of knowledge regarding the biological diversity of the Hanna Shoal area and will provide additional valuable information about the ecosystem that supports marine life."

The main objectives of the study are to identify and measure important physical and biological processes that contribute to the high concentration of marine life in the Hanna Shoal area. The study will document physical and oceanographic features, ice conditions, and information concerning local species. BOEMRE will integrate data gained from this study with other relevant Chukchi Sea studies to provide a more complete understanding of environmental considerations such as food web and contaminant bioaccumulations.

Dr. Kenneth H. Dunton, University of Texas at Austin, will serve as Principal Investigator. His team will include researchers from the Florida Institute of Technology, Old Dominion University, the University of Alaska Fairbanks, the University of Maryland, the University of Rhode Island, and the Woods Hole Oceanographic Institution. BOEMRE will be involved in all phases of the study, including substantial input to the field research design and coordinating with other research efforts in the Chukchi Sea to ensure BOEMRE information needs are met. BOEMRE staff may also participate in field cruises, field data interpretations and analyses, and in writing articles that flow from research that will be conducted under this cooperative agreement.

Although BOEMRE developed the Hanna Shoal study parameters in 2010, the study will also address several issues raised by the U.S. Geological Survey June 2011 report, *An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska.*

Since the early 1970s, BOEMRE and its predecessor organizations have funded more than $340 million in studies in Alaska. The Hannah Shoal study is one of approximately 40 ongoing studies the bureau's Alaska Region is currently coordinating and managing. The bureau's Environmental Studies Program conducts and oversees world-class, scientific research to inform policy decisions regarding leasing and development of OCS energy and mineral resources.

For additional information about BOEMRE's studies program, see: http://www.boemre.gov/eppd/sciences/esp/index.htm.

– BOEMRE –

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April 2011

Aleutian wave

HAGINAA KIDUL • HELPING TO GROW

Shipping Pollution in the Alaska Arctic

by Steve Sumida and Bruce Wright

With climate change reducing Arctic ice, Aleut and Pribilof people will find themselves living at the crossroads of two shipping lanes - the Great Circle route to Asia and the fabled Northwest Passage. It also means that those of us living in the Bering Sea region will be increasingly exposed to unprecedented levels of virtually unregulated emissions.
Ships in this region are allowed to use high sulfur fuels with 45,000 ppm sulfur - a much higher level than those set in most US waters of 10,000 ppm sulfur content for the majority of bulk fuel blends.

So Alaskan waters are once again the battleground for resolving hydrocarbon pollution. In 1989 the Exxon Valdez spilled crude oil that spread for hundreds of miles in the pristine waters along Alaska's coast. Our understanding at the time discounted oil as little more than a semi-noxious pollutant and a killer of birds. But oil toxicity research funded by the multi-million dollar settlement from the Exxon Valdez Oil Spill Trustee Council changed that almost benevolent view of oil pollution. We now know it is thousands of times more toxic than realized. Marine species have continued to be effected long after that catastrophic spill, evidenced mostly by salmon not returning to spawning streams. Many other birds and mammals were also harmed or killed.

The pollution caused by burning high sulfur fuels can have the same toxic effects.

Large container ships, tankers, bulk carriers, cruise ships and Lakers are significant contributors to air pollution in many of our nation's cities and ports. There are two types of engines used on large ships: main propulsion and auxiliary engines. The main propulsion engines on most large ships are "Category 3" marine engines with displacement greater than 30 liters per cylinder, which can stand over three stories tall and run the length of two school buses. Auxiliary engines on large ships typically range in size from small portable generators to locomotive-size engines.

Studies by the Environmental Protection Agency determined that emissions from large marine vessels burning bunker fuel within 200 miles of the U.S. west coast shore can result in serious impacts to human and environmental health as well as permanent environmental degradation as far inland as the Grand Canyon. As a result, the United States negotiated an international law preventing emissions from this fuel anywhere within 200 miles of the U.S. coast - except for the regions from the Alaska Peninsula, through the Aleutians and Pribilof Islands, western Alaska and along the Arctic coast. These regions remain exposed and unprotected to bunker fuel burning up to 45,000 parts per million sulfur content and unprecedented levels of virtually unregulated emissions. This at a time when the EPA requires all fuel for small marine vessels, highway, and non-road diesel engines including locomotives to be limited to 15 ppm sulfur content.

Story continues on page 3

Plant Reports

Atka Pride Seafoods

2010 was the first year of operations following the major plant renovation that took place between 2008 and 2010. Celebrating the preseason and the reopening of APS, a BBQ was held in May of last year attended by community members and staff. APS's operating season went smoothly, although longer than usual due to fishing difficulties caused by weather. While major repairs were being made to the APS dock last season, offloading and transport from the Atka city dock to the plant proved to be highly successful; our thanks and appreciation to the city. APS managers Larisa and Jimmy Prokopueff attended the Boston Seafood Show along with Shore Side Operations Manager Ken Smith and Shore Side Operation Specialist Kevin Gramson in mid-March. The Boston show assists the Shoreside Division of APS and BPS in the continual creation of a cutting edge production team. APS will begin hiring processors in April and the 2011 production season begins on May 1st.

APS 2010 Production Highlights:
310,967 lbs. halibut H&G.
38,239 lbs. skin on/off of halibut fillets.
121,947 lbs. sablefish.

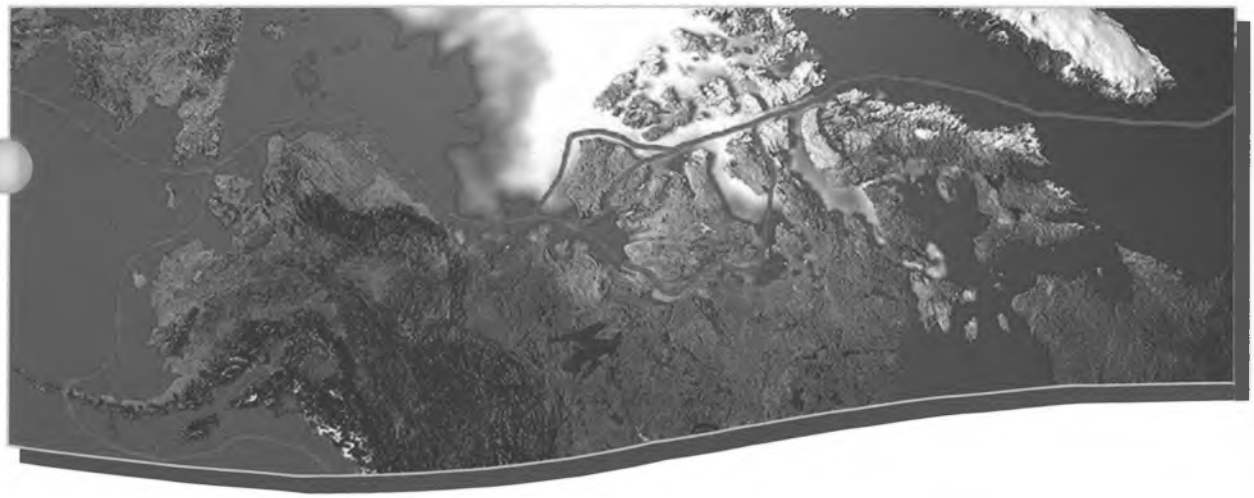
Bering Pacific Seafoods

2010 marked the third year of operations for BPS. Improvements to power generation and refrigeration systems during the previous offseason proved to be a success and BPS operations are showing continual improvement on a yearly basis. A test program of value added production showed a reasonable amount of success last season and the program is being taken into consideration for the 2011 production season. BPS, along with APS, will be looking to purchase higher quantities of halibut and sablefish during the 2011 season. Bering Pacific Seafoods will open this year on June 7th.

BPS 2010 Production Highlights:
485,811 lbs. of salmon processed.
242,962 lbs. processed in July.
15,000 lbs. of value added Sockeye fillets.

Work at APS and BPS this summer!

Hiring for Atka Pride Seafoods will begin in April and in May for Bering Pacific Seafoods. Local residents of Atka and False Pass as well as other regional community members are encouraged to apply. If you are interested in working as a processor in one of these great locations this summer, please contact APICDA Human Resources at (888) 927-5273.
See page 11.



Shipping Pollution in the Alaska Arctic

continued...

The EPA does not have any emissions monitoring stations in the Aleutian region. But the number of vessels moving through Unimak Pass is large and increasing, so we can't begin to know the exposure level to people living and working in the Bering Sea region.

We do know increased shipping activity and lack of emission controls over sulfur will contribute to the serious problem of ocean acidification and nutrient enrichment in the North Pacific Ocean through significant increases of nitrogen and sulfur deposits.

By 2020, international shipping is expected to account for 10 to more than 25 per cent of total annual sulfur deposition along the entire Atlantic, Gulf of Mexico, and Pacific coastal areas of the U.S. The impact of these deposits will extend inland for hundreds of kilometers. This means International shipping will contribute to total annual sulfur deposition not only along all U.S. coastal areas, but throughout the entire U.S. land mass, impacting sensitive terrestrial and aquatic ecosystems in the vast interior and heartland regions.

Researchers with a U.S. Forest Service study conducted in Southeast Alaska found evidence of sulfur emissions impacting lichen communities.

The authors concluded that the main source of sulfur and nitrogen found in the lichens in likely the burning of fossil fuels by cruise ships. Lichen are an important food source for caribou and there is a probability that large vessel emissions are damaging lichens and impacting the southern Alaska peninsula caribou hear which is an important food source to local subsistence-based cultures. This heard has been decreasing in size, has poor calf survival and low pregnancy rates which has resulted in the current ban on caribou hunting in this region. One can only imagine the effects these emissions are having on the dwindling Bering Sea fishing stocks.

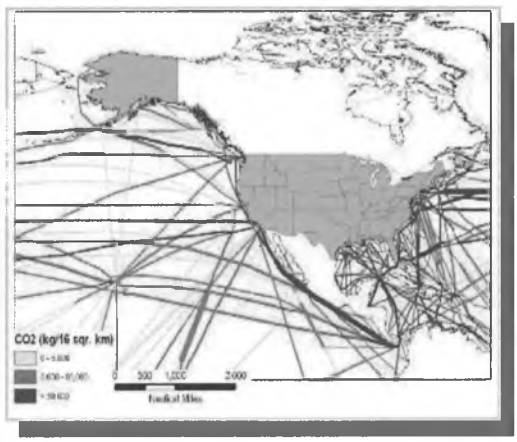
Steve Sumida
Director of Programs, Pribilof Aleuts, Inc.
Bruce Wright
Senior Scientist
Aleutian Pribilof Islands Association,
Anchorage
brucew@apiai.org

Nature Conservancy

Everette Anderson presenting the CDQ overview for APICDA

On November 16 - 17, 2010, Everette Anderson represented APICDA at an event entitled, "Fisheries Management in an Ecosystem Context: An exchange between the Humboldt Current and the Eastern Bering Sea" held by the Nature Conservancy in Seattle, WA.

The purpose of the event was to discuss the opportunities and challenges of adopting ecosystem based management principles into large scale fisheries. While on opposite hemispheres and possessing unique ecosystems, the Humboldt Current (anchovy/sardine fisheries) and Eastern Bering Sea share the distinction of hosting the world's largest scale fisheries. These fisheries are facing similar issues including the use of quota systems, monitoring, certification, and optimizing profits while providing biomass for top predators and other species. Investigation and understanding the challenges and opportunities for adopting ecosystem based management principles in large scale Pacific pelagic fisheries were explored. The meeting focused on exchanging information regarding:



- Management approaches taken in the anchoveta and Eastern Bering Sea Pollock fisheries that attempt to optimize profits in the fishery and biomass in the sea for top predators and other species.
- How the needs of local communities and artisanal fishermen can be integrated into the management framework of large industrial fisheries.
- The key components and collaborative approaches needed to design and implement effective monitoring systems in large industrial fisheries.

Chilean delegates discussing anchovy fishery issues

CDQ & IFQ : Sablefish

CDQ and IFQ Sablefish Harvest totals for CY2010

BS/AI CDQ Sablefish
BS CDQ:125,332 round pounds
Total Harvested: 124,946 round
CDQ SECTOR: harvested 76%
OA BS Industry wide: harvested 46%

AI CDQ: 112,000 round pounds
(increased 6,937)
Total Harvested: 111,599 round
CDQ SECTOR: harvested 91%
OA AI Industry wide: harvested 58%

BS/AI IFQ Sablefish
BS IFQ: 104,682 round pounds
Total Harvested: (23%) 24,228 round
Remaining: (77%) 80,454 round pounds
IFQ BS Industry wide: harvested 43%

AI IFQ:91,777 round pounds
Total harvested: (99.3%) 91,213 round
Remaining: (0.7%) 564 round pounds
will carry over to 2011
IFQ AI Industry wide: harvested 52%

CG/WG IFQ Sablefish
WG IFQ: 33,842 round pounds
Harvested: (99%) 33,402 round
Remaining: (1%) 440 round pounds
IFQ WG Industry wide: harvested 95%

CG IFQ: 31,878 round pounds
Harvested: (104%) 33,056 round
Remaining: 1178 will be deducted
from next year
IFQ CG Industry wide: harvested 100%

SE/WY IFQ Sablefish
SE IFQ: 8,022 round pounds
Harvested: (100%) 8,021 round
IFQ SE Industry wide: harvested 99%

WY IFQ: 4,752 round pounds
Harvested: (100%) 4,752 round
IFQ WY Industry wide: harvested 100%

Area 4 CDQ and IFQ Halibut Harvest totals for CY2010

Area 4B CDQ Halibut:
432,000 net pounds
Harvested: (93%) 400,677 net pounds

Area 4B IFQ Halibut:
Harvested 7,733 pounds

Area 4C CDQ Halibut:
121,875 net pounds
Harvested: (99%) 120,873 net pounds

Area 4D IFQ Halibut:
53,576 net pounds
Harvested: 22,371 net pounds

Tourism

Ugludax Lodge, LLC

When APICDA first started marketing reindeer hunts in the Aleutians, it was admittedly a small and limited operation. Initially, we offered a few guided hunts on Umnak Island out of the Ugludax Lodge in Nikolski. After enjoying a moderate level of success, APICDA management knew that Nikolski could provide world class reindeer hunts to a much larger group of hunters - If marketed properly.

Our marketing opportunity came in 2009, when Tourism Division management formed a partnership with world renowned big game hunter Jim Shockey. Since partnering with Jim Shockey's hunting adventures in 2009, the Tourism Division has been able to turn both Atka and Umnak into world class reindeer hunting destinations. Currently, both locations are booked through 2013!

On a yearly basis, we now offer 7 day hunts, 16 in Umnak and another 10 in Atka. We have enjoyed a high level of success in both locations due in part to excellent marketing by Shockey's team but also due to the hard work of the local community residents, team members, and tourism management. To further sales and promote tourism in our region by increasing name recognition through networking, APICDA attended hunting and fishing trade shows in Dallas, Reno, Miami, and Long Beach in early 2011.

In the future, we hope to expand our hunting and halibut fishing operations in Atka to the level that we operate on Umnak. One of the goals in the expansion of the Atka operation is to build a cabin that would house hunting and fishing clients during their stay. Presently, APICDA has secured local housing for clients.

For questions, pricing, and scheduling please contact us at (888)430-8329 or visit our website at www.aleutianadventures.com.

Umnak Island Tourism Highlights for 2010:

-The Ugludax Lodge in Nikolski welcomed seven fishermen and fourteen reindeer hunting clients in 2010.

-Ugludax is a fully equipped hunting lodge with cedar finished bedrooms, private decks, panoramic views of the island, and home cooked meals.

-A new tent camp was constructed on Umnak which serves as a field site for hunters. The tent camp will eventually be upgraded to a modest cabin.

-Film was shot for episodes of *Jim Shockey Adventures* on Umnak and Atka during hunts with Barbara Crown, Eva Shockey, and Shockey Adventures VP of sales and marketing Dan Goodenow. The shows will air on the Outdoor Channel this year.

-Editor Barbara Crown wrote about her Umnak reindeer hunting experience in the November 2010 edition of the Hunting Report. To read about the hunts in a condensed online version please see:
http://www.huntingreport.com/temp_Adventure_In_The_Aleutian_Islands_Alaska_10_28_2010.cfm

To read more about the lodge and hunts please see:
http://www.nikolskiadventures.com/

Aleutian Adventures Highlights for 2010:

Nelson Lagoon:

The Sapsuk River tent camp was completed last season. The Steelhead Camp received major upgrades, including a cook tent, bathhouse, outhouse, and interconnecting decks between tents. The camps welcomed twenty-nine fishermen and five duck hunters.

The 2011 fishing and hunting seasons in Nelson Lagoon are well on their way to being successful as well. Presently, there are ten fisherman and eight duck hunters booked.

Atka

There were four reindeer hunters to visit Atka in 2010, among them Barbara Crown from *The Hunt Report*. An episode of *Jim Shockey Adventures* was also filmed on Atka and will be aired on the Outdoor Channel this year. For more information about Aleutian Adventures, Nelson Lagoon, and Atka please visit our website http://www.aleutianadventures.com/index.html

A SHORT HISTORY OF ST. GEORGE

The St. George Community's relationship with the federal government began with the purchase of Alaska from Russia. The Aleut residents of St. George were slaves/wards of the U.S. government as their labor was required for the commercial fur seal industry. As such, residents were not allowed to leave the Island by the US Government for medical, educational or other needs the residents deemed necessary without government permission. Aleut residents employed in the fur seal industry did not earn a daily wage for their work but instead were given staples that were allotted to them on a weekly basis depending on family size. Residents that defied the US Government and left the Island were not allowed back to the community and lost their jobs and homes.

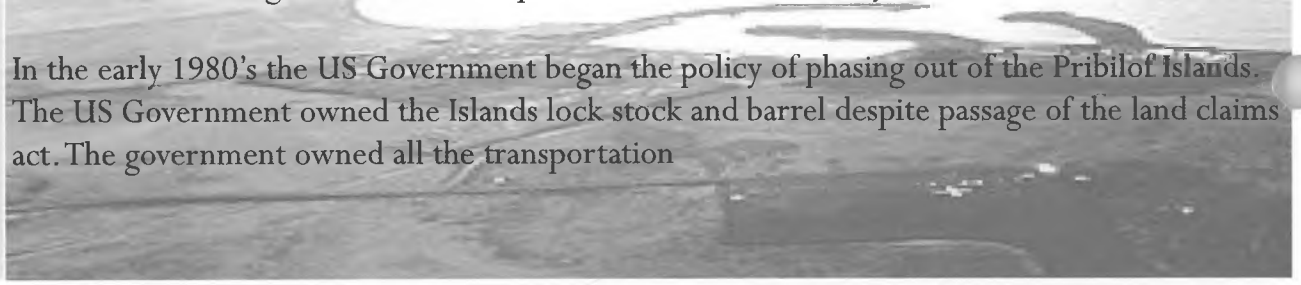
In the early 1960's the US Government initiated a policy to terminate the community of St. George, wanting instead to consolidate both St. George and St. Paul into one community. Residents of St. George were offered jobs and housing in St. Paul if they agreed to move from St. George. Many families did move, although many more protested and refused to move. The homes of the families that did move were bulldozed and burned to the ground to reinforce the US Government policy at the time.

Then State of Alaska Representative Carl Moses flew to St. Paul to campaign and visit his constituents. The US Government representative at the time met the plane and refused to allow Carl Moses to leave the plane stating these residents were not State of Alaska voters. Carl Moses was forced to leave and he started a protest that was heard in the halls of Washington DC and elsewhere. Howard Rock, the Publisher of the Tundra Times, published an article in his newspaper describing the plight of the Aleuts in the Pribilof Islands. Immediately, Congressional hearings were held by then US Senate "Bob" Bartlett that led to the Fur Seal Act of 1966. Thereafter, residents were allowed to vote, earned a civil service wage with benefits and more importantly not forced off St. George Island.

The ensuing years to 1983 were not much better. Commercial Fur Sealing was ended in St. George in 1972 and the tree huggers started in earnest with their attempts to stop the commercial harvest altogether. The only mode of transportation off St. George was by ship four times a year and the US mail was dropped out of Coast Guard planes

In 1968 St. George residents built a small airstrip on their own time without compensation or federal funding. But, the first plane did not arrive until January, 1971 when a US Navy plane (an albatross) was in St. Paul during Russian Orthodox Christmas with US Senator Ted Stevens. When the navy co-pilot refused to fly to St. George from St. Paul, co-pilot Ted Stevens flew by himself to St. George with Christmas presents for the community.

In the early 1980's the US Government began the policy of phasing out of the Pribilof Islands. The US Government owned the Islands lock stock and barrel despite passage of the land claims act. The government owned all the transportation



infrastructure, the homes, and public utilities. All of this was slated for transfer to the Islanders. St. George prepared for the phase out by incorporating a City Government on September 13, 1983 and on October 28, 1983 the US Government ceased to operate in the Pribilof Islands.

As part of the termination of government control on the islands, a Memorandum of Understanding between the federal government, the state of Alaska and the communities of St. George and St. Paul was signed that recognized the special needs for infrastructure on the islands. This recognition acknowledged that transition to a non-fur seal economy required access to fishery resources, which could only occur if safe harbors were constructed in both communities.

Planning for the St. George harbor project started in 1982. Site investigation, geotechnical and bathometric data were collected and analyzed and presented to the City in 1983-1984. In 1984 the City of St. George authorized bidding on the project and subsequently awarded a contract for construction in September of 1984. The contractor was unable to accomplish the terms of the contract in 1986. The City of St. George, thru force account, purchased the contractor's construction equipment and mined armor rock in 1986 and 1987, constructing the three North, South and Inner breakwaters.

In 1988 two docks were constructed along with a mooring dolphin by force account.

In 1989 the City issued General Obligation Bonds of $3 million (after the State refused to fund the project despite signing a MOU with the Feds and local entities recognizing the special needs under the federal phase out in 1983) to match the Corps $4 million under the Section 104 dredging program. The Corp awarded a contract in 1989 for dredging of the St. George harbor. The dredging project was substantially completed in late summer of 1990. The contractor failed to dredge to design depths in the entrance channel leaving high spots of -18.8 feet. That failure allowed the Corp to maintain that the Corp had no legal responsibility for maintenance dredging. The contractor subsequently sued the Corp for cost overruns on the project. In Federal Court the Contractor prevailed with an award of $1.2 million by the judge -- the irony is the City owes the Corp for the claim award.

Since completion of dredging in 1990, opilio and bairdi crab processing occurred in the St. George Harbor from 1990-2001. In 2004 a major storm event damaged the South Breakwater Arm and deposited sand in the entrance channel. The harbor had limited function and vessels could not utilize the harbor for crab processing under the newly implemented crab rationalization program. The City of St. George declared a disaster and the harbor was included in the federal disaster DR-1571. FEMA funding was applied for and FEMA made available to the City $8 million to repair the damage. The South Breakwater was repaired with approximately 15K cyds of armor rock placed in 2006 and the entrance channel was dredged this spring with 12K cyds of sand removed from the channel. And they lived happily ever after.....

2011 APICDA Scholarships

Congratulations, 2011 Spring Higher Education Scholarship Recipients!
A total of $54,594 was awarded in scholarships to the following students for the spring semester. APICDA is very proud to give these awards and to assist you in earning your education.

Recipient	School	Community
Sarah Bereskin	University of Alaska Anchorage	Akutan
Theresa Bindley	Wenatchee Community College	Unalaska
Kelsey Clark	Brigham Young University	Unalaska
Chase Guitard	Lake Washington Technical College	Unalaska
Jake Herring	University of Oregon	Unalaska
John Honan	George Fox University	Unalaska
Susan Honan	George Fox University	Unalaska
Michelle Kashevarof	Mat-Su College	St. George
Evangelina Kenezuroff	University of Alaska Anchorage	False Pass
Chantae Kochuten	University of Alaska Anchorage	False Pass
Nadine Kochuten	University of Alaska Anchorage	False Pass
Renee Kochuten	University of Alaska Anchorage	False Pass
Alicia LaPlant	Central Washington University	Unalaska
Brittany Larson	Rocky Mountain College, Montana	Unalaska
Delores Gregory	University of Alaska Fairbanks	Unalaska
Okalena Lekanoff-Gregory	University of Alaska Fairbanks	Unalaska
Tracy Lekanof	University of Alaska Anchorage	St. George
Derrick Magnusen	Seattle University	Unalaska
Jblynn Magpantay	Gonzaga University	Unalaska
Samantha Mierzejek	University of Alaska Anchorage	St. George
Carlene Moller	Northwest University	Unalaska
Anna Myrgorod	American University, Washington DC	Unalaska
Perfina Pletnikoff	University of Jyvaskyla, Finland	St. George
Jack Pound	Seattle University	Unalaska
Christopher Price	Alaska Pacific University	Unalaska
Nikita Robinson	University of Alaska Anchorage	Unalaska
Aidee Rodriguez	University of Alaska Anchorage	Unalaska
Julie Rowland	University of Alaska Fairbanks	Unalaska
Kimberly Rowland	University of Alaska Fairbanks	Unalaska
Candace Schaack	University of Alaska Anchorage	Nelson Lagoon
Katie Shae	University of Idaho	Unalaska
Danelle Shellikoff	University of Alaska Anchorage	False Pass
Evan Teranda	Bellevue College, Washington	Unalaska
Doanh Tran	University of Alaska Anchorage	Unalaska
Tina Tran	University of Alaska Anchorage	Unalaska
Patrick Trinidad	Pacific Lutheran University, Washington	Unalaska
Anfesia Tutiakoff	University of Alaska Anchorage	Unalaska
Hallidie Wilt	University of Alaska Anchorage	Unalaska

2011 Spring GPA Scholarship Recipients

Students earning a GPA of 3.5 or greater
who received an additional $500 scholarship.

John Honan
Evangelina Kenezuroff
Chantae Kochuten
Aidee Rodriguez
Julie Rowland
Anfesia Tutiakoff

Construction

Various APICDA facilities will undergo energy efficiency audits this year beginning with Bering Pacific Seafoods. The energy audits will establish an energy consumption baseline which will allow APICDA to pursue grants for renewable energy projects. A generator waste heat recovery system to reduce fuel consumption will also be installed at BPS.

The first construction crew of the season headed out to False Pass in March to begin preseason improvements. Improvements will include expanding the size of the blast freezers to allow for an increase in production capacity; enhancements to the cold storage area; a reinforced ice bin and installing an ice chute. In addition to improvements in the main plant, the BPS multi-purpose building will have new work and storage areas added. The 80'x 50'structure is currently undivided and separate rooms for a machine shop, welding area, carpentry shop, and tourism storage will be partitioned out.

Preseason improvements to Atka Pride Seafoods have also begun including improvements to the blast freezers and upgrades to the processing line.

Human Resources

-Steven Kashevarof, Assistant to the General Manager of Shoreside Operations
Steven was hired in October of 2010 and will be working with the GM of Shoreside Ops, Ken Smith, in the Anchorage office and in-region.

-Kevin Gramson, Shore Side Operations Specialist
Kevin became a permanent employee in October of 2010 after having worked as an invaluable productions consultant for APICDA for three years; he will work in production and sales.

-Alvin Merculief, Port Engineer
Alvin joined the APICDA team in January of 2011 as the new Port Engineer for APICDA Vessels and will be working in Anchorage, Homer, and in-region.

To read more please see: http://www.apicda.com/staff_members.html

Bon Voyage Joe!

Joe Kyle resigned as APICDA's Chief Operating Officer and Chief Financial Officer in early January. Joe has been with APICDA since its formation in 1992. He played an invaluable role in making APICDA what it is today. We will miss Joe, and wish he and his wife Lisa the very best in the future.

Rob Smith has been named as the new Chief Financial Officer. Rob has been APICDA's controller for the past fifteen years. We are confident Rob will do an excellent job in his new position.

Welcome aboard Don!

We are pleased to announce that Don Beeson has been hired as the Chief Operating Officer for APICDA Joint Ventures, Inc. Don worked for Icicle Seafoods for 21 years in a variety of positions including plant manager for Icicle's Homer facility and manager of Icicle's Arctic, Yukon and Kuskokwim operations. For the past ten years Don has been the project manager for a company constructing multiple housing developments. We had a number of very good applicants. Don had the right mix of skills and experience for this particular job. As COO, Don will oversee and manage seafood harvesting/processing and construction/ maintenance operations. Don started at APICDA's Anchorage office April 11th.

Congratulations Desiree!

Desiree Merculief of St. George, daughter of Chris and Sally Merculief, was named the 2011 Fur Rondy Queen. See: http://www.adn.com/2011/02/16/1707124/fur-rondy-2011.html#id=1707122&view=large_view

Welcome Katie Johnson!

Katie joined the APICDA team this March as Nelson Lagoon's newest Community Liaison Officer.
She may be reached at nelsonlagoonclo@apicda.com. For more information about APICDA CLO's please visit our website at http://www.apicda.com/clos.html

Human Resources

APS and BPS Processors Job Announcement!

Atka Pride Seafoods, Inc. is currently accepting applications for seafood processors for their halibut and sablefish processing plant in Atka, AK.

Rate of Pay: $ 9.00 per hour
Start Date: May 1, 2011
A 90 day employment agreement is required for the season. Transportation to and from the job site is provided with a completed agreement. Room and board is also provided. For more information or to submit an application, please contact:
Human Resources Laura or Becky 1-888-927-4232

Bering Pacific Seafoods is accepting applications for seafood processors for their salmon fish plant in False Pass, AK

Rate of Pay: $ 9.00 per hour
Start Date: June 1, 2011
A 90 day employment agreement is required for the season. Transportation to and from the job site is provided with a completed agreement. Room and board is also provided. For more information or to submit an application, please contact:
Human Resources Laura or Becky 1-888-927-4232

Job Opening Announcement!

Aleutian Adventures

www.aleutianadventures.com
www.nikolskiadventures.com

For more information or to submit an application, please contact Human resources via email at ldelgado@apicda.com

CAMP COOK

This position is located in Nelson Lagoon, Alaska and will cook for 4-6 salmon sport fish clients and crew at the remote river camp site. Trips are approximately 3 days long at the camp site and 1-2 days in town preparing for the next trip. Applicants must have 2 years previous cooking experience, valid Alaska Food Worker Card, excellent time management skills, willing to work in remote locations, excellent customer service skill, motivated, organized and a self-starter.

Duties include:

- ☐ Preparing a hot breakfast, bag lunch and hot dinner each night at the camp.
- ☐ A menu guide will be provided for this position.
- ☐ Prepping food for camp while in town
- ☐ Assisting guides in preparing gear and food for trips to camp
- ☐ Being part of the team that ensures clients enjoy their stay with Aleutian Adventures!

Position Begins mid-June until mid -September.
Rate of Pay is: $2,500 per month DOE plus tips
Transportation to and from work site and lodging is provided.

LODGE COOK

This position is located at The Ugludax Lodge on Umnak Island in the village of Nikolski. This position is responsible for cooking for 6-8 hunting clients and crew. Applicants must have 2 years previous cooking experience with menu planning, valid Alaska Food Worker Card, excellent time management skills, willing to work in remote locations, excellent customer service skill, motivated, organized and a self-starter.

Duties include:

- ☐ Menu planning and ordering food
- ☐ Cooking three family style meals a day for 6-8 people
- ☐ Baking and preparing appetizers for clients
- ☐ Housekeeping duties for the lodge
- ☐ Being part of the team that ensures clients enjoy their stay with AleutianAdventures!

Position Begins mid –September through November 1st.
Rate of Pay is: $3,000 per month plus tips
Transportation to and from work site and lodging is provided.

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Glossary of Acronyms

Acronym	Definitions
ACMP	Alaska Coastal Management Program
ADF&G	Alaska Dept. of Fish & Game
AEWC	Alaska Eskimo Whaling Commission
AMBCC	Alaska Migratory Bird Co-management Council
ABWC	Alaska Beluga Whale Committee
BLM	Bureau of Land Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
CAA	Clean Air Act
COE	U.S. Army Corps of Engineers
CRSA	Coastal Resource Service Area
CWA	Clean Water Act
DCOM	Alaska Department of Natural Resources Division of Coastal and Ocean Management
DEC	Alaska Dept. of Environmental Conservation
DNR	Alaska Department of Natural Resources
DOD	Dept. of Defense
DOI	Dept. of the Interior
EPA	Environmental Protection Agency
EWC	Eskimo Walrus Commission
FERC	Federal Energy Regulatory Commission
ISC	Ice Seals Committee
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NC	Nanuuq Commission
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fisheries Management Council
NPRB	North Pacific Research Board
NPS	National Park Service
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
OCS	Outer Continental Shelf
OPA	Oil Pollution Act
UA	University of Alaska
USCG	U.S. Coast Guard
USFS	U.S. Forest Service
USFWS	U.S. Fish & Wildlife Service

First Name	Last Name	Title	Agency	Email
Federal				
Doug	DeMaster	Regional Team Lead	NOAA	douglas.demaster@noaa.gov
Amy	Holman	NOAA Coordinator	NOAA	amy.holman@noaa.gov
William	Hines		NOAA	william.hines@noaa.gov
Chris	Campbell	socio-cultural specialist	BOEMRE	chris.campbell@boemre.gov
Cathy	Coon	marine biologist	BOEMRE	catherine.coon@boemre.gov
Mitch (Thomas)	Deely	District 17	US Coast Guard	Thomas.M.Deely@uscg.mil
John F.	Payne, PhD	Director, North Slope Science	Bureau of Land Management	john_f_payne@blm.gov
Bob	Pawlowski	Legislative Liaison to the Denali	Denali Commission	BPawlowski@denali.gov
Cheryl	Rosa	Deputy Director	US Arctic Research	crosa@arctic.gov
State				
Kim	Kruse	Deputy Director, Division of Coastal	Alaska Department of Natural	kim.kruse@alaska.gov
Gary	Mendivil	Program Coordinator, Commissioner's Office	ADEC	gary.mendivil@alaska.gov
Michele	Bonnet		ADEC	
Doug	Dasher		ADEC	
Doug	Vincent-Lang	Special Projects Coordinator	Alaska Department of Fish	douglas.vincent-lang@alaska.gov
Ed	Fogel	Deputy Commissioner	DNR	ed.fogels@alaska.gov
Mead	Treadwell	Lt. Governor & Arctic Policy Advisor	State of AK	mead.treadwell@alaska.gov
Michelle	Toohey	Deputy Chief of Staff, Lieutenant	State of AK	
Christine	Hess	Chief of Staff for Representative	Northern Waters Taskforce	Christine_Hess@legis.state.ak.us
Local				
Gordon	Brower	Dept. of Planning & Community	North Slope Borough	gordon.brower@north-slope.org
Robert	Suydam	Dept. of Wildlife Management	North Slope Borough	robert.suydam@north-slope.org
Ukallaysaaq Tom	Okleasik	Planning Director	Northwest Arctic Borough	tokleasik@nwabor.org
Grant	Hildreth	Deputy Director of Planning	Northwest Arctic Borough	ghildreth@nwabor.org
Johnny	Aiken	Executive Director	Alaska Eskimo Whaling	aewcdir1@gci.net
Earl	Comstock	Co-Counsel	Alaska Eskimo Whaling	earl.comstock@mac.com
Vera	Metcalf	Executive Director	Eskimo Walrus Commission	VMetcalf@kawerak.org

First Name	Last Name	Title	Agency	Email
International				
Barry	Briscoe	Regional Director, Central and Arctic Region	Fisheries and Oceans Canada	Barry.Briscoe@dfo-mpo.gc.ca
Calvyn	Wenghofer	Inuvialiut Settlement Region	Inuvialuit Regional	
NGOs & Other				
Molly	McCammon	Executive Director	Alaska Ocean Observing	mccammon@aoos.org
Jordan	Diamond	Staff Attorney	Environmental Law Institute	diamond@eli.org
Ed	Page		Marine Exchange of Alaska	edpage@mxak.org
Jena	Carter		The Nature Conservancy	jcarter@TNC.ORG
Ian	Dutton		Alaska Sea Life Center	ian_dutton@alaskasealife.org
Fran	Ulmer	UAA Chancellor	UAA	affau@uaa.alaska.edu
Carrie	Eischens	Program Manager	North Pacific Research	carrie.eischens@nprb.org
Research Team				
Betsy	Baker	Associate Professor	Vermont School of Law	bbaker@vermontlaw.edu
Laura	Chartier	Marine Conservation Planner	The Nature Conservancy in	lchartier@tnc.org
Glenn	Gray	Consultant	Glenn Gray and Associates	glenn@glenngray.net
Sharman	Haley	Professor of Economics and Public	ISER, UAA	afsh@uaa.alaska.edu
Sue	Hazlett	PhD Candidate in Marine Biology	UAF School of Fisheries &	sdhazlett@alaska.edu
Chanda	Meek	Assistant Professor	UAF Dept of Political Science	clmeek@alaska.edu
Dave	Norton	Research Associate/Adjunct	UAF & Institute of Arctic	dwnorton@alaska.edu
Sarah	Palmer	Senior Program Manager	US Institute for	palmer@ecr.gov
Jim	Powell	Instructor and PhD Candidate	UAS & UAF	jim.powell@alaska.gov
Leigh	Coppola	Research Tech - UAA		anlac@uaa.alaska.edu
Erin	Shew	Grad Assistant - UAF		eshew@alaska.edu

2011
Alaska Forum on the Environment

February 7-11, 2011

Dena'ina Convention Center

Anchorage, Alaska

North Slope / Robert & North Aten 617 miles
offshore / operating.
Sound defects avinaes / impact on subsistance,
Health / Social impacts / ability to clean up
limitations research needed.
8 points for offshore 1. Baseline science
2. stricter regulations 3. cumulative impacts
4. revenue sharing 5. zero volume discharge
6. oil spill prevention / response 7. CO presence
8. Marine Pilotage. 4 are information needs
Climate Changes - large in Arctic unkown variables
don't know if data have is good anymore
collaboration, cooperation, & communication
Industry must work with b/w industry agencies,
locals, feds. Feds must fund

www.arcticoilspill.org

About the Alaska Forum on the Environment - A 501(c)(3) Non-Profit

Our Organization:

The Alaska Forum, Inc. was initially formed to support an annual education event, the Alaska Forum on the Environment, which celebrates its 13th year in 2011. This widely recognized event began in 1990 as the Alaska Federal Facility Environmental Roundtable; an annual conference focused on contaminants, hazardous waste cleanup, hazardous materials management, pollution prevention, etc., at federal facilities. It was expanded by an agreement called the Statement of Cooperation between the leadership of environmental regulators, military departments, and federal agencies. The Alaska Forum on the Environment– the Alaska Forum, Inc. operates as a 501(c)(3) non-profit organization to support this annual educational event and to extended our mission to promote effective cooperation, communication, and education in Alaska.

Our Process:

The Alaska Forum on the Environment results from the efforts of a diverse group of organizations that serve as our Planning Committee and seeks to provide an open exchange of ideas and information in a respectful and courteous atmosphere. The structure of the event allows the opportunity to reach a greater understanding of the issues and of each other among the full range of participants: rural and urban; industry and private; agency and public; students and scholars; ...and those who are just plain interested in the environment!

Our event is successful with the dedicated support of volunteers using a team approach that is respectful of the diversity of opinions and perspectives of all Alaskans.

We actively seek agenda input throughout the planning process. While most topics are informational, others present more complex issues and challenges facing environmental, corporate, and regulatory agencies in Alaska. We actively work to best address all issues including those that are complex by structuring sessions to encourage problem solving and present diverse perspectives and alternative viewpoints. We encourage the opportunity for an informed and respectful dialogue with all of our presenters.

The Alaska Forum on the Environment, and other Alaska Forum programs and projects do not take political or advocacy positions. The result is a hugely diverse agenda, with over 80 Breakout Sessions and four Keynote Events. Topics and the presenters range from Alaska's communities, to federal, state and tribal government agencies; international organizations and governments; to those specialized in technical science and the environment.

If you are interested in helping to shape the agenda of the Alaska Forum on the Environment, please contact us: your support is welcome!

Our Funding:

The Alaska Forum on the Environment is a 501(c)(3) non-profit organization. Approximately 40 percent of our funding is provided in voluntary contributions and sponsorships by our leadership partners. Our leadership partners are organizations that invest both staff resources and funding in the Alaska Forum on the Environment. Eight percent of our funding is invested by leading Alaskan industries and businesses. The remaining 52 percent of event funding is derived directly from participants through event registration fees. We regulate organizational and sponsor contributions to ensure that our funding sources represent the diversity we strive to achieve within the Alaska Forum on the Environment.

Our Commitment:

The Alaska Forum on the Environment actively solicits partners that can provide constructive input in our team approach. We value the individuals and the organizations that work with us in a statewide spirit of cooperation to achieve this premier event. We believe that we can find positive ways to maximize environmental benefits through cooperative approaches, partnerships, and the sharing of information and ideas in a respectful forum. We believe that effective communication can provide the foundation for Alaska's environmental community. Our mission is to promote a healthy environment through communication and education; and we welcome support from those who share in this goal.

The Alaska Forum on the Environment Mission

"Alaskans working together to promote a clean, healthy environment through communication and education."

The Alaska Forum and our programs or projects will not take political or advocacy positions. The Alaska Forum works to promote a more productive and efficient relationship between government agencies, businesses, organizations, tribes, and the public by:

- developing a more common understanding and educational foundation;
- providing opportunity for the exchange of information and experiences; and
- understanding the diversity of opinions and concerns of others.

Leadership Partners & Exhibitors 2011

Leadership Partners

Leadership Partners (Providing In-Kind and Financial Support)

Alaska Native Tribal Health Consortium
BP Exploration, Alaska
Canadian Consulate
ConocoPhillips Alaska
Knik Tribal Council
Oil Spill Recovery Institute
Prince William Sound Regional Citizens' Advisory Council
US Air Force, 11th Air Force
US Bureau of Ocean Energy Management, Regulation and Enforcement
US Coast Guard, District 17
US Department of Interior
US Environmental Protection Agency, Office of Policy
US Fish & Wildlife Service
US Forest Service, Alaska Region
US National Park Service
US Natural Gas Transportation Office
US Navy Region Northwest

Leadership Partners (Providing In-Kind Support)

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Alaska Native Science Commission
Alaska Pacific University
Cascadia Green Building Council
CH2MHill
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HDRinc
Mat-Su Borough
National Wildlife Federation
Resource Development Council
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University of Alaska
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US Army Corps of Engineers
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Alaska Native Tribal Health Consortium
Alaska Marine Science & Fisheries Career Coalition
Institute for Tribal Environmental Professionals
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UAF Bristol Bay Campus
Alaska Pacific University
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Rural Alaska Fuel Services
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Alaska Center for Climate Assessment & Policy
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Tok Welding
SGS North America
TestAmerica
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Alaska Native Tribal Health Consortium
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Green Star
Bureau of Land Managment
Pew Environment Group's US Arctic
US Forest Service
University of Alaska, Fairbanks - Cooperative Extension Service

Skip Bourgeois, Coffman Engineers ..... "AVEC Wind Turbine Foundation Designs"

Skip Bourgeois, Coffman Engineers ..... "Biomass Boiler System for the Delta-Greely School District"

Sunny Castillo, Soil Conservationist, Natural Resources Conservation Service..... "Biochar and its Benefits in Rural Alaska"

Chet Chambers, Sustainable Energy Technician, UAF Bristol Bay Campus ..... "The Passive Office"

Heather Lawrence, Savannah College of Art and Design..... "Reconnecting with Nature"
Winner, International Composting Awareness Week Poster Contest

Rachael Wadsworth, M.S. Candidate, UAF..... "Ecosystem-Based Management of Living Marine Resources in the Aleutian Islands Region"

Marilyn Sigman, The Alaska Center for Ocean Science..... "Traditional Knowledge and Climate Change"

YOUTH POSTERS

Alaska Youth for Environmental Action (AYEA), Dillingham, Emmonak, Fairbanks, Togiak, Yakutat ..... "Teens Fighting for Wild Salmon"

Cordova High School and the Copper River Watershed Project, Cordova..... "Odiak Pond Field Study"

Cordova High School Science Club, Cordova..... "Biogas Digesters Using AK Lake Mud"

Cordova High School Science Club, Cordova..... "Building a Wind Turbine"

Cordova High School Science Club, Cordova ..... "Converting Plastic to Oil"

EcoLogical Team, Homer ..... "Reduce, Reuse, Recycle Runway"

EcoLogical Team, Homer..... "Presidential Environmental Youth Award (PEYA) Winning Recycle and Waste Reduction Project"

Homer Flex High School, Homer ..... "The Garden of Eatin'"

Matanuska-Susitna Career & Tech High School, Wasilla ..... "Alaska Climate Research Using Tree Phenology"

Metlakatla High School, Metlakatla..... "Metlakatla High School School-to-Work"

Martin L. Olson Schools, Golovin..... "3 Girls Campaign-Changing Habits for a Healthier Tomorrow"

National Park Service Rivers, Trails, and Conservation Assistance Program, Anchorage ... "State and National Youth Environmental Award Programs"

National Park Service Rivers, Trails, and Conservation Assistance Program, Anchorage .. "Youth Environmental Engagement Opportunities in Alaska"

Polaris K-12 School, Anchorage ..... "Measuring Fish Food: Relative Abundance and Sizes of Macroinvertebrates in Anchorage Creeks"

Polaris K-12 School, Anchorage..... "Getting Un-Energized"

Rebels to the Pebble, Dillingham..... "Rebels to the Pebble"

The Center for Alaskan Coastal Studies, Homer..... "Youth Environmental Stewardship (YES) Camp"

2011

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Heather Rice, National Park Service
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Cherie Shelley, US Forest Service
Robert Shirley, US Air Force
Aurora Sidney-Ando, Alaska Pacific University
Lauri Strauss, kpb architects
Stephanie Tepperberg, US National Park Service
Win Westervelt, CH2M Hill
Carolyn Winters, US Navy

Monday, February 7

MORNING

7:30 a.m. - 9 a.m.

❒ Registration *Upper Lobby 3rd Floor*

8 a.m. - 8:30 a.m.

❒ Moderator Training (by Invitation Only)
K'enakatnu Executive Board Room

8:30 a.m. - 9 a.m.

❒ MORNING MUSIC EVENT *Tikahtnu Ballroom*
Michael Gorder on Acoustic

9 a.m. - 9:30 a.m.

❒ Introduction and Opening Comments *Tikahtnu Ballroom*

9:30 a.m. - 10:15 a.m.

❒ KEYNOTE EVENT *Tikahtnu Ballroom*
Mead Treadwell, Alaska Lieutenant Governor

10:30 a.m. - 11:45 a.m.

❒ Case Studies: Pore Water Issues at Two Contaminated Sites *Kahtnu 1*
❒ Youth Environmental Program Showcase *Kahtnu 2*
❒ Dealing with Invasive Plants: Strategies, Outreach and Success in Alaska *Tubughneng' 3*
❒ Tribal Mining Review in Lower 48 *Tubughneng' 4*
❒ Oil Drilling Basics for Onshore and Offshore Exploration *Tubughneng' 5*
❒ Effective and Meaningful Tribal Consultation: Perspectives and Experiences *Tikahtnu C*
❒ 7 Generations Training: A Tool for Tribes *Tikahtnu D*
❒ Human Overpopulation: Root Cause of Environmental Degradation *Tikahtnu E*

AFTERNOON

12 p.m. - 1:45 p.m.

❒ KEYNOTE EVENT *Tikahtnu Ballroom*
Scott Friedman, Inspirational Humorist

2 p.m. - 3:15 p.m.

❒ Alaskan Youth Environmental Engagement: A Poster Session *Upper Lobby 3rd Floor*
❒ Cutting PCB Cleanup Costs at Remote Sites: A Case Study of Grain Size Separation *Kahtnu 1*
❒ Marine Invasive Species in Alaska *Tubughneng' 3*
❒ Is Small Scale Nuclear Energy An Option for Alaska? *Tubughneng' 4*
❒ Recent Advances in Climate Science in Alaska *Tubughneng' 5*
❒ Cultural Sustainability in Environmental Program Development *Tikahtnu C*
❒ Tools for Tribal Governments on Environmental Planning *Tikahtnu D*
❒ Alaska Natives and Climate Change: Reactivating Indigenous Perceptions *Tikahtnu E*

3:30 p.m. - 4:45 p.m.

❒ Environmental and Public Health Agencies: Their Roles and How They Partner to Address Public Health Concerns at Contaminated Sites *Kahtnu 1*
❒ Recipe for Creating a Successful Youth-Led Program *Kahtnu 2*
❒ An Overview of Invasive Species in Alaska *Tubughneng' 3*
❒ Human Health Implications of Coal Combustion in Alaska *Tubughneng' 4*
❒ Toward a Coordinated Response to Climate Adaptation in Alaska *Tubughneng' 5*
❒ Alaska GAP Peer Assistance Provider Network Activities *Tikahtnu C*
❒ Tribal Perspectives on Planning For Climate Change *Tikahtnu D*
❒ Freshwater and Coastal Surveys by the Alaska Department of Environmental Conservation *Tikahtnu E*

Alaska Forum on the Environment
Registration Services and all Keynote Events
will be located at the Dena'ina Convention Center,
TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

AGENDA At a Glance

Tuesday, February 8

MORNING

8 a.m. - 8:45 a.m.

❒ MORNING KEYNOTE EVENT - Larry Persily, Federal Coordinator Alaska Natural Gas Transportation Projects *Tikahtnu Ballroom*

9 a.m. - 10:15 a.m.

❒ The Living Building Challenge and Net Zero Energy *Kahtnu 1*
❒ Youth Environmental Summit (Part 1 of 2) *Kahtnu 2*
❒ Endangered Species Research in Glacier Bay National Park and Preserve *Tubughneq' 3*
❒ Susitna Hydro Project *Tubughneq' 4*
❒ Renovate Right: Important Lead Hazard Information for Families, Child Care Providers, and Schools *Tubughneq' 5*
❒ Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 1 of 2) *Tikahtnu C*
❒ Success Stories in Alaska Small Demonstration Projects *Tikahtnu D*
❒ Environmental Analysis and Decision Making Processes *Tikahtnu E*

10:30 a.m. - 11:45 a.m.

❒ Breaking the Barriers to Green Building *Kahtnu 1*
❒ Youth Environmental Summit (Part 2 of 2) *Kahtnu 2*
❒ Candidates for Listing as Threatened/Endangered Species in Alaska *Tubughneq' 3*
❒ Teaching Alaska's Miners About Alaska's Fisheries *Tubughneq' 4*
❒ Climate Adaptation and Environmental Justice *Tubughneq' 5*
❒ Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 2 of 2) *Tikahtnu C*
❒ Environmental Restoration Efforts at Federal Sites in Alaska *Tikahtnu E*
❒ Using Natural Resources for Solving Energy Problems *K'enakatnu Executive Board Room*

AFTERNOON

12 p.m. - 1:45 p.m.

❒ LUNCH ON YOUR OWN

2 p.m. - 3:15 p.m.

❒ Introduction to Conservation Subdivisions *Kahtnu 1*
❒ Youth and Adult Partnerships Showcase *Kahtnu 2*
❒ Workshop on the Conservation/Recovery Plan for Polar Bears in Alaska (Part 1 of 2) *Tubughneq' 3*
❒ Energy Efficiency Opportunities in Alaska *Tubughneq' 4*
❒ Fugitive Dust - What is it? Why should I care? *Tubughneq' 5*
❒ Solid Waste and Contaminants in Alaska: A Talking Circle (Part 1 of 2) *Tikahtnu C*
❒ Environmental Protection Agency Civil/Criminal Enforcement Procedures for Environmental Violations *Tikahtnu D*
❒ Amchitka Underground Nuclear Test Site Monitoring Program *Tikahtnu E*

3:30 p.m. - 4:45 p.m.

❒ Case Studies: Conservation Subdivisions in Alaska *Kahtnu 1*
❒ Tribal Climate Change Training and Technical Assistance Efforts *Kahtnu 2*
❒ North Slope Methane Hydrates and Carbon Dioxide Exchange *Tubughneq' 4*
❒ Department of Environmental Conservation Water Quality, Permits and Communications *Tubughneq' 5*
❒ Solid Waste and Contaminants in Alaska: A Talking Circle (Part 2 of 2) *Tikahtnu C*
❒ Federal Site Remediation Roundtable *Tikahtnu E*
❒ Energy and Climate Action in Alaskan Communities: Resources, Examples, and Discussion *K'enakatnu Executive Board Room*

3:30 p.m. - 6 p.m.

❒ Workshop on the Conservation/Recovery Plan for Polar Bears in Alaska (Part 2 of 2) *Tubughneq' 3*

Alaska Forum on the Environment Registration Services and all Keynote Events will be located at the Dena'ina Convention Center, TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

Wednesday, February 9

MORNING

8 a.m. - 8:45 a.m.

❒ MORNING KEYNOTE EVENT - Dennis McLerran, US Environmental Protection Agency Regional Administrator *Tikahtnu Ballroom*

9 a.m. - 10:15 a.m.

❒ Experiences Needed for Students to Become Environmental Leaders *Kahtnu 1*
❒ Native Voices: Traditional Knowledge & Climate Change (Part 1 of 2) *Kahtnu 2*
❒ Shipping in Arctic Waters: Implications of Climate Change *Tubughneng' 3*
❒ The Arctic Environmental Response Management Application (ERMA) *Tubughneng' 4*
❒ Federal Interagency Coordination on Environmental Justice Issues (Part 1 of 2) *Tikahtnu C*
❒ US Forest Service Listening Session on Sacred Sites Policy (Part 1 of 2) *Tikahtnu E*
❒ Hydrocarbon Risk Calculator (Part 1 of 2)—Concepts, Regulatory Status, Data Needs, Closure Decisions *K'enakatnu Executive Board Room*

9 a.m. - 4 p.m.

❒ Brownfields Tribal Response Program Training *Marriott Hotel*

10:30 a.m. - 11:45 a.m.

❒ Drumbeats: Place-Based Environmental Education Certificate for Rural Alaska *Kahtnu 1*
❒ Native Voices: Traditional Knowledge & Climate Change (Part 2 of 2) *Kahtnu 2*
❒ What is Coastal and Marine Spatial Planning? *Tubughneng' 3*
❒ Oil Development in the Arctic *Tubughneng' 4*
❒ Federal Interagency Coordination on Environmental Justice Issues (Part 2 of 2) *Tikahtnu C*
❒ Contaminants in Subsistence Foods *Tikahtnu D*
❒ US Forest Service Listening Session on Sacred Sites Policy (Part 2 of 2) *Tikahtnu E*
❒ Hydrocarbon Risk Calculator (Part 2 of 2) - Case Studies *K'enakatnu Executive Board Room*

AFTERNOON

12 p.m. - 1:45 p.m.

❒ LUNCH ON YOUR OWN

2 p.m. - 3:15 p.m.

❒ Sustainable Energy in Environmental Education *Kahtnu 1*
❒ Marine Debris Workshop (Part 1 of 2) *Tubughneng' 3*
❒ Lessons Learned: Information Flow Comparison between the Selendang Ayu and the Deepwater Horizon Incidents *Tubughneng' 4*
❒ Tribal and Community Perspectives on Environmental Justice Issues in Alaska (Part 1 of 2) *Tikahtnu C*
❒ Geographic Information System Rural Alaska *Tikahtnu D*
❒ Community Gardening Benefits in Rural Alaska *Tikahtnu E*
❒ Vapor Intrusion Evaluation Case Studies (Part 1 of 2) *K'enakatnu Executive Board Room*
❒ Tracking Backhaul Success *Kahtnu 2*

3:30 p.m. - 4:45 p.m.

❒ Promoting Rural Workforce Development through Environmental Internships *Kahtnu 1*
❒ Annual Alaska Mining Report *Kahtnu 2*
❒ Marine Debris Workshop (Part 2 of 2) *Tubughneng' 3*
❒ Area Contingency Planning for Oil Spill Response in Alaska *Tubughneng' 4*
❒ Working Together to Address Environmental Justice Issues Identified by Tribal and Community Panelists (Part 2 of 2) *Tikahtnu C*
❒ General Assistance Program (GAP) Online *Tikahtnu D*
❒ Baseline Water Quality Monitoring - Lessons Learned *Tikahtnu E*
❒ Vapor Intrusion Evaluation Case Studies (Part 2 of 2) *K'enakatnu Executive Board Room*

EVENING

5 p.m. - 7:00 p.m.

❒ EVENING EVENT: Regional Tribal Operations Committee Social *Tikahtnu Ballroom*

Alaska Forum on the Environment Registration Services and all Keynote Events will be located at the Dena'ina Convention Center, TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

At a Glance AGENDA

AGENDA At a Glance

Thursday, February 10

MORNING

8 a.m. - 8:45 a.m.

❒ MORNING KEYNOTE EVENT:
Lynn Paulson, "As Within, So Without"
Tikahtnu Ballroom

9 a.m. - 10:15 a.m.

❒ Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 1 of 2) *Kahtnu 1*
❒ Climate Science in the Arctic and What It Means to Alaskans *Kahtnu 2*
❒ The National Environmental Policy Act De-Mystified *Tubughnenq' 3*
❒ How to Organize a Household Hazardous Waste Collection Program *Tubughnenq' 4*
❒ How to Perform a Village-Based Dump Site Assessment: A Scammon Bay Case Study *Tikahtnu C*
❒ Native American Lands Environmental Mitigation Program *Tikahtnu D*
❒ Hazard Communication Standard *Tikahtnu E*

9 a.m. - 4 p.m.

❒ Brownfields Tribal Response Program Training
Marriott Hotel

10:30 a.m. - 11:45 a.m.

❒ Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 2 of 2) *Kahtnu 1*
❒ Climate Change in Northern Communities: Canadian Federal and Municipal Perspectives *Kahtnu 2*
❒ New Landscape Conservation Cooperatives in Alaska to Address Climate Change *Tubughnenq' 3*
❒ Impacts of Poor Solid Waste Management on Village Health *Tubughnenq' 4*
❒ The National Environmental Policy Act: Tools and Tips *Tubughnenq' 5*
❒ Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues (Part 1 of 2) *Tikahtnu C*
❒ Environmental Issues Associated with Meth Lab Cleanup *Tikahtnu D*

AFTERNOON

12 p.m. - 1:45 p.m.

❒ AFTERNOON KEYNOTE EVENT - Fran Ulmer, Chancellor University of Alaska Anchorage
Tikahtnu Ballroom

2 p.m. - 3:15 p.m.

❒ General Assistance Program Solid Waste Solutions *Kahtnu 1*
❒ National Environmental Policy Act in the Courtroom: Case Law *Tubughnenq' 3*
❒ Rural Development Water and Environmental Program Overview and Application Process (Part 1 of 2) *Tubughnenq' 5*
❒ Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues (Part 2 of 2) *Tikahtnu C*
❒ Burn Unit Pilot Project *Tikahtnu E*

2 p.m. - 4:45 p.m.

❒ Coastal America Alaska Regional Implementation Team Meeting *K'enakatnu Executive Board Room*

3:30 p.m. - 4:45 p.m.

❒ Landfill Alternatives/Resource Recovery *Kahtnu 1*
❒ Alaska Youth and Climate Change: Building a Program that Works *Kahtnu 2*
❒ National Environmental Policy Act, Marine Fisheries, and Public Participation *Tubughnenq' 3*
❒ FILM FESTIVAL: People of the Seal film *Tubughnenq' 4*
❒ Rural Development Water and Environmental Program Overview and Application Process (Part 2 of 2) *Tubughnenq' 5*
❒ General Assistance Program (GAP) Peer Assistance Providers Open Working Session for Grants Management Assistance and GAP Proposal Development *Tikahtnu C*
❒ Resources for Tribal Environmental Advocacy *Tikahtnu D*

Alaska Forum on the Environment
Registration Services and all Keynote Events
will be located at the Dena'ina Convention Center,
TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

Friday, February 11

8 a.m. - 5 p.m.
❒ HAZWOPER 8-Hour Refresher Course *Kahtnu 1 & 2*

8:15 a.m. - 1:30 p.m.
❒ Oil Spill Recovery Institute Advisory Board Meeting
K'enakatnu Executive Board Room

8:30 a.m. - 10:15 a.m.
❒ GAP: Topics in Environmental Education and Outreach
Tikahtnu C

8:30 a.m. - 12 p.m.
❒ FILM FESTIVAL: Film event *Tubughneng' 4*

8:30 a.m. - 4 p.m.
❒ Climate Change and the National Environmental Policy Act Class
Tubughneng' 3

9 a.m. - 10:15 a.m.
❒ Introduction to Class III Landfills and Top 10 Problems
Tubughneng' 5

10:30 a.m. - 11:45 a.m.
❒ Best Practices for Solid Waste Management in Rural Alaska
Tubughneng' 5
❒ General Assistance Program Tribal Environmental Professionals Community Building Session and Conference Wrap Up *Tikahtnu C*

12 p.m. - 1 p.m.
❒ LUNCH ON YOUR OWN

2 p.m. - 4 p.m.
❒ Solid Waste Administration of North America Alaska Chapter Quarterly Business Meeting *Tubughneng' 5*

Alaska Forum on the Environment
Registration Services and all Keynote Events
will be located at the Dena'ina Convention Center,
TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

NOTES:

At a Glance AGENDA

NOTES:

2011 Alaska Forum on the Environment

Detailed Agenda

NOTES:

Alaska Forum on the Environment
Registration Services and all Keynote Events
will be located at the Dena'ina Convention Center,
TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

2011

Morning

February 7

MONDAY

7:30 a.m. - 9:00 a.m.

Registration
Upper Lobby 3rd Floor

Details: The Dena'ina Center opens for Registration at 7:30 AM.
Save time...Don't wait in line...Register Online!
http://www.akforum.com/register.html

Pick up conference information and name tags here.

8:00 a.m. - 8:30 a.m.

Moderator Training (by Invitation Only)
K'enakatnu Executive Board Room

Details: By Invitation Only. Moderators for the conference are asked to attend this training to help ensure all sessions progress in a timely and professional manner.

8:00 a.m. - 9:00 a.m.

MORNING MUSIC EVENT
Michael Gorder on Acoustic
Tikahtnu Ballroom

Details: Grab your morning coffee and listen to the acoustic music of Anchorage talent Michael Gorder.

9:00 a.m. - 9:30 a.m.

Introduction and Opening Comments
Tikahtnu Ballroom

9:30 a.m. - 10:15 a.m.

KEYNOTE EVENT

MEAD TREADWELL
Lieutenant Governor
Tikahtnu Ballroom

Details: Mead Treadwell was elected as Alaska's Lieutenant Governor in November, 2010. Lt. Governor Treadwell places a priority in fulfilling his constitutional duties, supporting Alaska's governor, and being accessible to Alaskans. He is committed to strengthening Alaska's economy by filling the Trans Alaska Pipeline, helping get a gas pipeline built, bringing affordable energy to Alaskans, and standing up to the federal government to ensure access to our natural resources. Mead Treadwell brings a record of private and public sector success to the job of Lieutenant Governor. He is recognized as one of the world's Arctic policy experts.

Treadwell was appointed to the United States Arctic Research Commission by President George W. Bush in 2001 and designated by the President as the Commission's chair in 2006. Under his leadership, a new United States Arctic Policy was developed and adopted by President Bush and is now being implemented by the current administration.

After graduating from Yale, Treadwell moved to Alaska in 1978 and worked as lead political reporter for the ANCHORAGE TIMES. In 1980, he was part of a team of writers which won the Blethen Award, a top prize for investigative reporting in the Pacific Northwest. In 1982, after completing his MBA at the Harvard Business School, Treadwell joined former Governor Hickel and former Governor Bill Egan as founders of the Yukon Pacific Corporation which started the all Alaska gas pipeline project.

During the Exxon Valdez oil spill crisis, Mead Treadwell went to Cordova and served as the city's director of spill response. He worked with Cordova citizens and Alaska's congressional delegation to launch the Prince William Sound Science Center, home of the Prince William Sound Oil Spill Recovery Institute. He also worked with Southcental coastal communities, Congress, and the oil industry to create the Prince William Sound Regional Citizens Advisory Committee.

When Wally Hickel was elected to his second term as Alaska's Governor, he appointed Mead Treadwell to serve as Deputy Commissioner of the Department of Environmental Conservation. Treadwell helped write Alaska's new environmental protection regulations and established the environmental crime unit for the state. He represented Alaska on U.S. delegations which established the eight nation Arctic Council, and supported Governor Hickel's establishment of the Northern Forum.

Over the years, Mead Treadwell has held leadership positions in a wide range of policy, professional, public service, governmental and international organizations.

Case Studies: Pore Water Issues at Two Contaminated Sites

Kahtnu 1

Details: Pore water is generally defined as water between grains of sediment, but can have its origin as either surface water or groundwater. For contaminated sites management, pore water is often more specifically defined as saturated zone water in the subsurface that is hydrologically connected to surface water. Thus it can serve as a transport mechanism between contaminated groundwater and surface water bodies, and be both an ecological and human health exposure pathway to contaminants. This presentation will focus on two case studies involving the use of pore water to understand exposure pathways as part of risk evaluation and regulatory compliance for contaminated site management.

Presenter: James Fish, Alaska Department of Environmental Conservation
Moderator: Susan Erben, Alaska Department of Environmental Conservation

Human Overpopulation: Root Cause of Environmental Degradation

Tikahtnu E

Details: Most environmental degradation from climate change to habitat loss can trace its roots to human overpopulation. Presentations will review the "state of the debate" on population and broach topics as the recent United States census, the demographic roles of immigration vs. birthrates, United States and global population projections, climate change, peak oil, and the key concepts of carrying capacity, "overshoot", and the ecological footprint. The Empty Space Delusion (why the earth, America, and even Alaska are overpopulated in spite of empty space to spare) will be discussed.

Presenters: Leon Kolankiewicz, Mangi Environmental Group; Paul Erlich, Stanford University
Moderator: Jerome Montague, Alaskan Command

Dealing with Invasive Plants: Strategies, Outreach, and Success in Alaska

Tubughnenq' 3

Details: Come learn about identifying and managing invasive plants. In this session, invasive plant species in Alaska will be identified, and speakers will describe outreach efforts and specific examples of managing invasive plants.

Presenters: Ashley Grant, Alaska Cooperative Extension Service; John Morton, US Fish & Wildlife Service; Dave Cannon, Aniak
Moderator: Barbara Schrader, US Forest Service

Youth Environmental Program Showcase

Kahtnu 2

Details: This session will feature representatives from 4 youth-led community projects: Teens Fighting for Wild Salmon (statewide), 3 Girls Campaign-Changing Habits for a Healthier Tomorrow (Golovin), Getting Un-Energized (Anchorage) and The Garden of Eatin' (Homer).

Presenters: Danielle McClain, US Fish & Wildlife Service; Joseph Ransdell-Green; Maka Monture; Sandi Echuck; Gunner Gregory; Aurora Hoefferle; Renatta Olson; Molly Moses; Chelsea Fagerstrom; Debbie Anungazuk; Delana Eby; Ryan McLaughlin; Barae Hirsch; Kilian Roberts; Kathryn Smith; Benson Eldon; Homer Olson; Jeff Szarzi; Shannon Kuhn, Alaska Youth for Environmental Action.
Moderator: Jessica Beecher, US Fish & Wildlife Service

Effective and Meaningful Tribal Consultation: Perspectives and Experiences

Tikahtnu C

Details: This session will focus on US Environmental Protection Agency Region 10 Tribal Consultation Procedures. There will be a panel discussion on perspectives and experiences.

Presenters: Harriette Kaufman, Native Village of Tyonak; Violet Yeaton, Port Graham Tribal Council; Sally Thomas, US Environmental Protection Agency; Tami Fordham, US Environmental Protection Agency
Moderator: Santina Gay, US Environmental Protection Agency

7 Generations Training: A Tool for Tribes

Tikahtnu D

Details: The 7 Generations approach to planning has been used as a tool to address environmental issues using a common sense approach that promotes and encourages community-driven environmental management.

Presentor: Larry Merculieff and Bill Stokes, 7 Generations Consulting
Moderator: Desirae Roehl, Alaska Native Tribal Health Consortium

Tribal Mining Review in Lower 48

Tubughnenq' 4

Details: This session will provide the opportunity for Tribes that participated in a coordinated tour of L ower 48 mines to reflect upon what they learned and observed.

Presenters: Chief Gary Harrison, Native Village of Chickaloon; Frank Standifer, Native Village of Tyonek
Moderator: Brian Hirsch, National Renewable Energy Laboratory

MONDAY Afternoon

February 7

10:30 a.m. - 11:45 a.m. (cont.)

Oil Drilling Basics for On-Shore and Off-Shore Exploration

Tubughnenq' 5

Details: This presentation traces the history of drilling from methods employed over 2,000 years ago using human power to modern drilling rigs. Also discussed is a history of offshore drilling and safety systems, including well design, used to avoid dangerous and environmentally damaging well blowouts.

Presenter: Les Skinner, Shell Exploration and Production Company
Moderator: Westley Foster, US Environmental Protection Agency

12:00 p.m. - 1:45 p.m.

KEYNOTE EVENT

SCOTT FRIEDMAN
Inspirational Humorist

Tikahtnu Ballroom

Details: Back for his second appearance at the Alaska Forum on the Environment, Scott Friedman is a humorous speaker who gets audience members laughing and feeling good ... while opening their minds to new ideas.

As Scott tickles their funny bones with his quick wit and playful style, he always slips in "how to" techniques and practical ideas.

In his programs, Scott skillfully challenges people to take control of their lives ... and offers concrete ways to do so. Specifically, he assists participants in mastering change, relieving stress and burnout, developing their own sense of humor, and creating more value in their careers. His improvisational skills and delightful nature add a refreshing quality to each program.

2:00 p.m. - 3:15 p.m.

Cutting PCB Cleanup Costs at Remote Sites: A Case Study of Grain Size Separation

Kahtnu 1

Details: Cleanup of PCBs (polychlorinated biphenyls) in Alaska is very costly, especially at remote sites. Reducing the soil volume by removing oversize material (rocks) can potentially save a significant amount of money on cleanup costs at some sites. A pilot study was performed at Anvil Mountain White Alice Radio Relay Station to evaluate the correlation between particle size and PCB concentration. This led to applying the strategy to a full-scale project. This Anvil Mountain case study can provide a model for how to implement a similar strategy for other PCB cleanups.

Presenter: Tamar Stephens, Alaska Department of Environmental Conservation
Moderator: Katharine Heumann, Alaska Department of Environmental Conservation

Recent Advances in Climate Science in Alaska

Tubughnenq' 5

Details: This session will provide an overview of recent scientific findings on changes in climate occurring in Alaska and their potential impacts such as new information about community specific climate change impacts being observed in the Northwest Arctic region of Alaska. The session will also discuss the implications for public health. Findings from recent assessments in Kivalina, Noatak, Kiana, and other Arctic communities will be presented.

Presenters: Sarah Trainor, University of Alaska, Fairbanks; Raj Chavan, Alaska Native Tribal Health Consortium, Center for Climate and Health; Larry Hinzman, International Arctic Research Center
Moderator: David Guest, US Environmental Protection Agency

Marine Invasive Species in Alaska

Tubughnenq' 3

Details: Invasive species in Alaska's marine environments are an emerging problem. This session will identify and describe issues associated with invasive marine species. Speakers will also outline methods to monitor and identify marine invasives.

Presenters: Linda Shaw, National Oceanic and Atmospheric Administration; Gino Graziano, Alaska Department of Natural Resources; Rachel Lord, Cook Inlet Keeper
Moderator: Barbara Schrader, US Forest Service

Alaskan Youth Environmental Engagement: A Poster Session

Upper Lobby 3rd Floor

Details: Please join us for an exciting poster session highlighting the innovative ways youth from all over the state are working to improve the environment throughout Alaska. Youth from the communities of Golovin, Wasilla, Cordova, Homer, Metlakatla, and Anchorage will be available during this session to discuss their projects with you.

Presenters: 3 Girls Campaign-Changing Habits for a Healthier Tomorrow; Alaska Climate Research Using Tree Phenology; Biogas Digesters Using AK Lake Mud; Center for Alaska Coastal Studies; Teens Fighting for Wild Salmon; Getting Un-Energized; Measuring Fish Food: Relative Abundance and Sizes of Macroinvertebrates in Anchorage Creeks; Metlakatla High School School-to-Work; Odiak Pond Field Study; The Garden of Eatin'; Building a Wind Turbine; Converting Plastic to Oil; Rebels to the Pebble; Reduce, Reuse, Recycle Runway; ECOlogical Group; Youth Environmental Stewardship Camp (YES Camp); Youth Environmental Engagement Opportunities; Youth Environmental Award Programs
Moderator: Stephanie Tepperberg, National Park Service – Rivers, Trails, and Conservation Assistance Program

Tools for Tribal Governments on Environmental Planning

Tikahtnu D

Details: Tools for Tribal governments on environmental planning is a Talking Circle session. Peer Assistance Providers will be present to share resources.

Co-Moderators: Adrienne Fleek, US Environmental Protection Agency; Klaudia Klaudi, Knik Tribal Council

Alaska Natives and Climate Change: Reactivating Indigenous Perceptions

Tikahtnu E

Details: This discussion will follow a traditional structure and will provide an opportunity for participants to exchange information with Tribal representatives from other regions. It will be a place for participants to share their concerns, tribal observations and information about climate change.

Moderators: Victoria Hykes-Steere, Alaska Pacific University; Michelle Davis, US Environmental Protection Agency

Is Small Scale Nuclear Energy an Option for Alaska?

Tubughneng' 4

Details: Many people have heard of the Toshiba 4S nuclear reactor that has been proposed for Galena. How do these small modular reactors, sometimes called 'nuclear batteries', actually work? What is the status of the technology, and what is the potential for Alaska?

Presenter: Gwen Holdmann, Alaska Center for Energy and Power
Moderator: Katherine Brown, US Environmental Protection Agency

Cultural Sustainability in Environmental Program Development

Tikahtnu C

Details: This session will follow a Talking Circle format, where session participants will discuss their experiences in education, and offer Tribal perspectives on building environmental programs with Native Language and Culture as the foundation.

Moderators: Tami Fordham and Santina Gay, US Environmental Protection Agency

NOTES:

3:30 p.m. - 4:45 p.m.

Environmental and Public Health Agencies: Their Roles and How They Partner to Address Public Health Concerns at Contaminated Sites

Kahtnu 1

Details: Representatives from two state agencies and a federal agency will discuss their roles and responsibilities, and how their agencies partner at specific contaminated sites in Alaska to address public health concerns. The presenters are from the Alaska Department of Environmental Conservation's Spill Prevention and Response Division, Contaminated Sites Program; the Alaska Department of Health and Social Services' Division of Public Health, Epidemiology Section; and the US Department of Health and Human Services' Agency for Toxic Substances and Disease Registry.

Presenters: Marty Brewer, Alaska Department of Environmental Conservation; Nim Ha, Alaska Department of Health and Social Services; Joe Sarcone, Agency for Toxic Substances and Disease Registry
Moderator: Susan Erben, Alaska Department of Environmental Conservation

Freshwater and Coastal Surveys by the Alaska Department of Environmental Conservation

Tikahtnu E

Details: The Alaska Monitoring & Assessment Program (AKMAP) will give an overview of recent freshwater and coastal surveys conducted by the State of Alaska. Topics will include the 2010-2011 Chukchi Sea Survey, 2009 Yukon River Survey, 2008 Cook Inlet Lakes and the upcoming 2011 Arctic Wetlands.

Presenters: Doug Dasher and Terri Lomax, Alaska Department of Environmental Conservation
Moderator: Tim Hoffman, Alaska Department of Environmental Conservation

Toward a Coordinated Response to Climate Adaptation in Alaska

Tubughnenq' 5

Details: On October 5, 2010, the federal Climate Change Adaptation Task Force, co-chaired by the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA) released its interagency report outlining recommendations to President Obama for how Federal Agency policies and programs can better prepare the United States to respond to the impacts of climate change. The report recommends that the Federal Government implement actions to expand and strengthen the Nation's capacity to better understand, prepare for, and respond to climate change. This session will focus on: (1) the use of science to enable more effective adaptation to climate change; (2) how federal agencies could cooperate and work together, in partnership with stakeholders in Alaska, to focus on climate impacts of greatest concern to Alaska and to implement effective climate adaptation strategies; and (3) lessons the rest of the nation can learn from Alaska's experiences adapting to climate change.

Presenters: Thomas Armstrong, Department of Interior; Larry Hartig, Alaska Department of Environmental Conservation; Daniel White, Alaska RISA-ACCAP; Mark Shasby, Alaska Climate Science Center and US Geologic Survey.
Moderator: Joel Neimeyer, Denali Commission

An Overview of Invasive Species in Alaska

Tubughnenq' 3

Details: Speakers in this session will discuss current strategies around the state to manage invasive species in various environments. We'll look into the future by examining climate change and its possible impacts on invasive species in Alaska and the Arctic.

Presenters: Tammy Davis, Alaska Department of Fish and Game; Ann Ferguson, US Animal and Plant Health Inspection Service; Denny Lassuy, US Fish & Wildlife Service
Moderator: Barbara Schrader, US Forest Service

Recipe for Creating a Successful Youth-Led Program

Kahtnu 2

Details: This interactive session will provide the essential ingredients to help you cook up a successful youth-led environmental project.

Presenter: Megan McBride, Alaska Youth for Environmental Action; Ann Mayo-Kiely, Alaska Geographic
Moderator: Annette Heckart, US Forest Service

Tribal Perspectives on Planning for Climate Change

Tikahtnu D

Details: Tribal representatives discuss the Indian General Assistance Program and other program approaches to addressing climate change impacts being observed in Alaska today. This session will focus on demonstrations of tools and information that tribes can use into their environmental programs to plan for climate change impacts on their traditional lands and resources. It will feature the Region 10 EPA's Tribal Climate Change Action Plan from the 2010 Tribal Leader's Summit in Juneau Alaska.

Presenters: Moses Tcheripanoff, Alaska Native Tribal Health Consortia; Sarah Trainor, University of Alaska Fairbanks; Jen Marlow and Jeni Krencicki Barcelos, University of Washington
Moderator: Michelle Davis, US Environmental Protection Agency

Human Health Implications of Coal Combustion in Alaska

Tubughneq' 4

In this third session on Coal in Alaska, the panel will address specific health concerns associated with coal ash, dust, mining, and emissions.

Presenters: Sarah Petras, Alaska Community Action on Toxics; Northern Alaska Environmental Center; Russ Maddox, Sierra Club; Dr. Michele Prevost
Moderator: Brian Hirsch, National Renewable Energy Laboratory

Alaska GAP Peer Assistance Provider Network Activities

Tikahtnu C

Details:This is a closed meeting of the GAP Peer Assistance Network representatives

Moderator: Mahri Lowinger, US Environmental Protection Agency

NOTES:

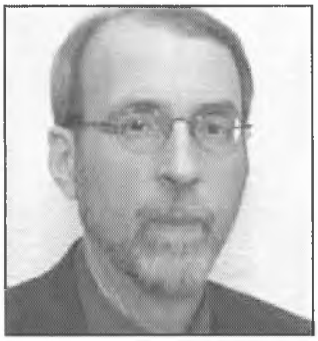
TUESDAY Morning

February 8

8:00 a.m. - 8:45 a.m.

MORNING KEYNOTE EVENT

LARRY PERSILY
Federal Coordinator - Alaska Natural Gas Transportation Projects
Tikahtnu Ballroom



Details: Please join us for an exceptional Morning Keynote at the Alaska Forum on the Environment, 2011.

Larry Persily is the federal coordinator for Alaska Natural Gas Transportation Projects, where he manages a staff in Washington, D.C., and Anchorage, working to ensure that federal agencies are ready to handle permit applications for construction and operation of a North Slope natural gas pipeline to the Lower 48 states.

Before starting the job in March as a presidential appointee, Persily worked as an oil and gas aide in the Alaska Legislature and, previously, as an aide in the governor's office in Washington on oil and gas issues.

He also has served as deputy commissioner at the Alaska Department of Revenue and was a journalist in Alaska for more than 20 years.

9:00 a.m. - 10:15 a.m.

The Living Building Challenge and Net Zero Energy
Kahtnu 1

Details: The Living Building Challenge (LBC) defines the most advanced measure of sustainability in the built environment possible today, and acts to diminish the gap between current limits and ideal solutions. Living Buildings are net-zero energy and water, and they contain no toxic materials. Worldwide there are over 70 Living Building projects underway, several of which are certified. Is it possible to build a Living Building that works in Alaska? This session will provide an overview of the LBC, net-zero energy construction, and what it all means for Alaskans.

Presenters: Clark Brockman, SERA Architecture; Eric Soladay, Integral Group
Moderator: Mark Masteller, Cascadia Green Building Council

Environmental Analysis and Decision Making Processes
Tikahtnu E

Details: This session will provide information and specific examples of environmental analysis in Alaska required under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the National Historic Preservation Act (NHPA) and Section 106, and the National Environmental Policy Act (NEPA).

Presenters: Diane Hanson, University of Alaska; Kendra Colyar and Amy Burt, US Navy
Moderator: Cindy O'Hare, US Navy

Renovate Right: Important Lead Hazard Information for Families, Child Care Providers and Schools
Tubughneq' 5

Details: A panel of EPA-approved Alaskan Training Providers will explain the use of lead-safe work practices for Renovation, Repair and Painting (RRP) of pre-1978 homes and child care facilities. This presentation will demonstrate how activities like sanding, cutting and demolition can create hazardous lead dust and chips by disturbing lead-based paint, which can be harmful to children and adults. The panel will respond to questions and will provide information about new funding opportunities.

Presenters: Dorothy Saunders, US Environmental Protection Agency; Dan Dougherty, Environmental Management, Inc.; Steven Wisdom, Wisdom and Associates.
Moderator: Katharine Heumann, Alaska Department of Environmental Conservation

Endangered Species Research in Glacier Bay National Park and Preserve

Tubughneng' 3

Details: In response to proposals to increase cruise ship traffic in Glacier Bay National Park and Preserve, the National Park Service formed a Science Advisory Board and implemented several Board-recommended research projects to assess the impact of cruise ships on Park resources. Much of this research is groundbreaking work. This session will outline research on birds and marine mammals in the Park that are either listed under the Endangered Species Act or are candidate species.

Presenters: Brendan J. Moynahan and Jamie N. Womble, National Park Service; Karin R. Harris, University of Washington
Moderator: Susan J. Alexander, US Forest Service, member Glacier Bay Science Board

Youth Environmental Summit (Part 1 of 2)

Kahtnu 2

Details: Teams of participants will identify an environmental problem common to their communities, develop a plan to address it, and present their solutions to the larger group for feedback.

Presenter: Laurel Devaney, US Fish & Wildlife Service; Lilly Goodman-Allwright, UAA Adjunct Faculty
Moderator: Meg Burgett, UAF-Cooperative Extension Service

Success Stories in Alaska Small Demonstration Projects

Tikahtnu D

Details: Tribal representatives take a look back at 2010 successful US Environmental Protection Agency Alaska Tribal Multi-Media demonstration project accomplishments. These are exemplary projects that have components which can be duplicated by other Tribes in Alaska.

Presenters: Traditional Council of Togiak; Algaaciq Tribal Government; Kenaitze Indian Tribe; Native Village Paimiut; Central Council Tlingit and Haida Indian Tribes of Alaska; Traditional Council of Togiak; Algaaciq Tribal Government; Kenaitze Indian Tribe; Native Village Paimiut; Central Council Tlingit and Haida Indian Tribes of Alaska; Native Village of Eyak; Native Village of Elim; Chilkoot Indian Association; Nunakauyak Traditional Council (Toksook Bay); and Pedro Bay Village Council
Moderators: Desirae Roehl, Alaska Native Tribal Health Consortium; AJ Salkoski, RurALCAP

Susitna Hydro Project

Tubughneng' 4

Details: Hydropower provides approximately 24 percent of the electric energy used in Alaska. The 2010 Alaska legislature declared a state energy policy in which 50 percent of state energy needs would come from renewable and alternative energy sources by 2025. The Alaska Energy Authority will present project information and impacts of the new Susitna Dam project.

Presenter: Bryan Carey, Alaska Energy Authority
Moderator: Katherine Brown, US Environmental Protection Agency

Alaska Brownfields Topics: Tribal, State and US Environmental Protection Agency Response Programs (Part 1 of 2)

Tikahtnu C

Details: This session will include case studies from US Environmental Protection Agency (EPA) Brownfields Tribal Response Program Coordinators. US EPA and Alaska Department of Environmental Conservation staff will also share updates of their Brownsfield Programs. EPA Technical Assistance to Brownfields (TAB) Grantee - Creative Center for Land Recycling (CCLR) will discuss competitive EPA Bronwfields grants and the assistance their organization can provide to potential grantees in the application process.

Presenters: Susan Morales, US Environmental Protection Agency; John Carnahan and Sonja Benson, Alaska Department of Environmental Conservation; Neli Nelson, Organized Village of Kasaan; Ignacio Dayrit of Creative Center for Land Recycling (CCLR)
Moderator: Mary Goolie, US Environmental Protection Agency

NOTES:

10:30 a.m. - 11:45 a.m.

Breaking the Barriers to Green Building
Kahtnu 1

Details: What is the future of green buildings in Alaska? How can we reduce our environmental impact? Will a living building and net zero energy ever be possible in the arctic? What are the technical and regulatory barriers and how can we mitigate those? This panel discussion will address actual and perceived obstacles to the future of sustainable building design in Alaska.

Presenters: Clark Brockman, SERA Architecture; Eric Soladay, Integral Group; Steven Apfelbaum, Applied Ecological Services; Louis Zizza, Coffman Engineers; Thorsten Chlupp, REINA Alaska LLC
Moderator: Lauri Strauss, KPB Architects

Environmental Restoration Efforts at Federal Sites in Alaska
Tikahtnu E

Details: This session will provide an opportunity for the Air Force, Army, and Federal Aviation Administration to present information on cleanup projects at federal sites in Alaska. The discussion will address progress that has been made in the past year to accomplish remediation goals.

Presenters: Steve Mattson and Mark Prieksat, US Air Force; Ken Andraschko, US Army Corps of Engineers; Scott Berglund, Federal Aviation Administration
Moderator: Scott Hansen, US Air Force

Climate Adaptation and Environmental Justice
Tubughnenq' 5

Details: A discussion examining tribal adaptation to climate change. Tribal governments and tribal community-based grassroots groups are pursuing options for their tribes to adapt to the changes in the environment due to climate change. This session will discuss the approaches being taken or considered, as well as opportunities for tribal governments and tribal community-based groups to collaborate on such approaches. The session will also initiate a discussion on the possible role of the US Environmental Protection Agency and other federal agencies in helping tribes and tribal organizations in their efforts.

Presenters: Jon Waterhouse, Yukon River Intertribal Watershed Council; Debra Lekanof, Swinomish Indian Tribal Community; Arlene Gundersen, Aleut International Association, Aleut Mammal Commission.

Candidates for Listing as Threatened/Endangered Species in Alaska
Tubughnenq' 3

Details: Presentations will focus on the species in Alaska which are currently under consideration and study for possible Federal listing as threatened or endangered. Information will be given on what they are, why they are being considered, and the process being followed.

Presenters: Marilyn Myers, US Fish & Wildlife Service; Brad Smith, National Marine Fisheries Service
Moderator: Pamela Bergmann, US Department of the Interior

Youth Environmental Summit (Part 2 of 2)
Kahtnu 2

Details: Teams of participants will identify an environmental problem common to their communities, develop a plan to address it, and present their solutions to the larger group for feedback.

Presenter: Laurel Devaney, US Fish & Wildlife Service; Lilly Goodman-Allwright, UAA Adjunct Faculty
Moderator: Meg Burgett, UAF-Cooperative Extension Service

Teaching Alaska's Miners About Alaska's Fisheries
Tubughnenq' 4

Details: This presentation is an overview of the 2-day short course on Mining & Fisheries, presented at the Alaska Miners' Association's annual convention in November 2010.

Moderator: Tom Manson, ConocoPhillips Alaska, Inc.

Using Natural Resources for Solving Energy Problems
K'enakatnu Executive Board Room

Details: This presentation will focus on the use of thermochemical conversion as a way to reduce organic waste streams such as fisheries waste, and use of low value natural resources and fire-killed biomass for the production of hydrocarbons and heat.

Presenter: J. Andres Soria, University of Alaska, Anchorage
Moderator: Westley Foster, US Environmental Protection Agency

10:30 a.m. - 11:45 a.m. (cont.)

Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 2 of 2)

Tikahtnu C

Details: This session will include Brownfields Jeopardy with updates from the AK Department of Environmental Conservation staff. US Environmental Protection Agency Brownfields Program will provide updates as well on AK Brownfields and Targeted Brownfields Assessments.

Presenters: John Carnahan, Sonja Benson, and Deborah Williams, Alaska Department of Environmental Conservation; Susan Morales and Joanne LaBaw, US Environmental Protection Agency
Moderator: Mary Goolie, US Environmental Protection Agency

12:00 p.m. - 1:45 p.m.

LUNCH ON YOUR OWN

2:00 p.m. - 3:15 p.m.

Introduction to Conservation Subdivisions

Kahtnu 1

Details: Conservation subdivisions preserve and restore healthy natural resources within developments and offer a multitude of benefits ranging from increased property values and reduced infrastructure (i.e., storm sewer systems, etc.), to greater human values and higher quality of life. This session will be your opportunity to learn more about what conservation subdivisions are, how they're created, successful conservation subdivision projects in the Lower 48 (with an emphasis on those built in cold climate and rural areas), and why conservation subdivisions make sense for Alaska.

Presenter: Steve Apfelbaum, Applied Ecological Services
Moderator: Ann Rappoport, US Fish & Wildlife Service Anchorage Field Office

Fugitive Dust - What is it? Why should I care?

Tubughneng' 5

Details: This session will discuss what fugitive dust is and potential sources of fugitive dust in Alaska, including an overview of other States' regulations to control fugitive dust and methods of control available. Alaska Department of Environmental Conservation staff will be available to discuss what are possible regulation options.

Presenters: Tom Turner and Nattinee Nipataruedi, Alaska Department of Environmental Conservation
Moderator: Katharine Heumann, Alaska Department of Environmental Conservation

2:00 p.m. - 3:15 p.m. (cont.)

Amchitka Underground Nuclear Test Site Monitoring Program

Tikahtnu E

Details: This session will provide an overview on the underground nuclear tests conducted on Amchitka Island between 1965 and 1971, subsequent monitoring efforts, and plans for future monitoring. The specific focus will be on plans for biota, sediment, and surface water sampling during the summer of 2011. Representatives from the US Department of Energy and it's contractors, Alaska Department of Environmental Conservation, Aleutian Pribilof Islands Association, US Fish & Wildlife Service and the University of Alaska Fairbanks will present information on the project and answer questions.

Presenters: John Halverson and Doug Dasher, Alaska Department of Environmental Conservation; Steven Jewett, University of Alaska; Mark Kautsky, US Department of Energy; Karen Pletnikoff, Aleutian Pribilof Islands Association
Moderator: Lisa Geist, US Army Corps of Engineers

Workshop on the Conservation/Recovery Plan for Polar Bears in Alaska (Part 1 of 2)

Tubughneng' 3

Details: The objective of the workshop will be to help the US Fish & Wildlife Service develop the Conservation/Recovery Plan for polar bears. The main topic will be human-caused removals: how to develop mitigation strategies for future impacts to Alaska's polar bears as a result of human-caused removals. The workshop is designed for entire-session participation. Participants are asked to stay for the entire workshop in order to effectively exchange information and ideas.

Moderators: James Wilder, US Fish & Wildlife Service; Colleen Matt, CAMatt

Youth and Adult Partnerships Showcase

Kahtnu 2

Details: Representatives from projects that feature youth and adult partnerships to accomplish scientific research and community projects will share their experiences. Projects presented will be: Biogas Digesters Using AK Lake Mud, Metlakatla High School School-to-Work, Odiak Pond Field Study, Alaska Climate Research Using Tree Phenology.

Presenters: Jessica Beecher, US Fish & Wildlife Service; Craig Bailer; Sophia Meyers; Shannon Lindow; Ben Americus; James Allen; Adam Low; Katherine McGillton; Demitrius Milne; Martin Vera; Brielle Pringle; Avery Winter; Taw Lindsey; Gabrielle Brown; Casey Smyke; Kate Alexander; Rachael Quiriarte; Alyssa Peters; Timothy Lundt
Moderator: Danielle McClain, US Fish & Wildlife Service

2:00 p.m. - 3:15 p.m. (cont.)

Environmental Protection Agency Civil/Criminal Enforcement Procedures for Environmental Violations

Tikahtnu D

Details: This session will outline the Environmental Protection Agency Region 10 enforcement procedures. Discussion will focus on various agency databases that can be accessed to review environmental monitoring information related to permitting and other regulatory requirements. Additionally, the discussion will include a survey of environmental crimes in Alaska to include past criminal cases in Alaska.

Presenters: John Pavitt, Keith Cohon, Frank Powers, Matt Goers, and Steve Witkin, US Environmental Protection Agency
Moderators: Tami Fordham and Katherine Brown, US Environmental Protection Agency

Solid Waste and Contaminants in Alaska: A Talking Circle (Part 1 of 2)

Tikahtnu C

Details: This session will be held in a Talking Circle format to cover the Environmental Protection Agency's capacity building grants, and how they address environmental impacts associated with solid waste and contaminants issues. Case studies from the General Assistance Program (GAP) grants and Brownfields State-Tribal Response Program grant programs will be among those issues highlighted during this session.

Moderators: Santina Gay, US Environmental Protection Agency; Larry Merculieff, 7 Generations Consulting

Energy Efficiency Opportunities in Alaska

Tubughnenq' 4

Details: This is a time of unprecedented opportunities for energy efficiency improvements in Alaska. In this presentation the Alaska Energy Authority will present an overview of recent energy efficiency programs and activities in Alaska, focusing on new programs for public and commercial buildings. Application forms will be available for the new state-wide Alaska Commercial Energy Audit Program. Renewable Energy Alaska Project will present more detailed information on the new state loan program for public buildings.

Presenters: Sean Skaling, Alaska Energy Authority; Michelle Wilber, Renewable Energy Alaska Project
Moderator: Mary Mae Aschoff, ConocoPhillips Alaska, Inc.

3:30 p.m. - 4:45 p.m.

Case Studies: Conservation Subdivisions in Alaska

Kahtnu 1

Details: Do conservation subdivisions work in Alaska? Two Alaska developers have proven that conservation subdivisions not only work in Alaska but they also make environmental and economic sense. Kevin Sorensen, residential land developer, owner and founder of Glacier Ridge Properties, LLC, in Palmer, Alaska has developed and sold over 35 residential lots in his conservation subdivision, River Bend, since 2006. Kevin will discuss the conservation principles he used at River Bend and why they are good, overall development practices. Devony Lehner and Tom Taffe, owners of Stream Hill Park in Homer, Alaska, will describe how they became interested in developing a conservation subdivision, obstacles they overcame during the development process, and recommendations on of how to go about pursuing development of a conservation subdivision.

Presenters: Kevin Sorensen, River Bend; Devony Lehner and Tom Taffe, Stream Hill Park
Moderator: Stephanie Tepperberg, National Park Service

Federal Site Remediation Roundtable

Tikahtnu E

Details: This session brings together the Federal government, Alaska state government, federally recognized tribes, environmental groups and the public to discuss cleanup of contaminated sites. The Roundtable welcomes the community to engage with the Federal government to promote understanding of community priorities for remediation. The focus of this facilitated discussion is the impact to tribes and communities, and collaborative strategies to address challenges. The purpose of this session is to create a productive dialog aimed to improve remediation at contaminated sites.

Moderator: Catherine Villa, US Environmental Protection Agency

Department of Environmental Conservation Water Quality, Permits and Communications

Tubughnenq' 5

Details: The Alaska Department of Environmental Conservation will present information regarding the collaboration between the State, US Environmental Protection Agency, and the Yukon Koyukuk Tribes on communications within the Alaska Pollutant Discharge Elimination System permitting process, the Permit Issuance Plan for 2011-13 that identifies waste water discharge proposals, and recent and upcoming regulatory changes to Alaska's Water Quality Standards Triennial Review.

Presenters: Katharine Heumann, Sharon Morgan and Jim Powell, Alaska Department of Environmental Conservation
Moderator: Susan Erben, Alaska Department of Environmental Conservation

3:30 p.m. - 4:45 p.m. (cont.)

Energy and Climate Action in Alaskan Communities: Resources, Examples and Discussion

K'enakatnu Executive Board Room

Details: Alaskan villages are affected by climate change and rely on costly fossil fuels. Actions in the areas of energy generation can reduce greenhouse gas emissions while allowing communities to adapt to climate change. The synergy between climate mitigation and adaptation will be discussed followed by presentations from communities who have planned for or implemented renewable energy, energy efficiency, and food security projects. Communities will discuss their experience including the challenges that they encountered, lessons learned and design methodologies. The session will end with a question and answer session.

Presenters: Peter Crimp, Alternative Energy and Energy Efficiency Programs, Alaska Energy Authority; Brian Hirsch, Department of Energy, National Renewable Energy Lab; Ross Coen, Tanana Chiefs Conference and University of Alaska
Moderator: Jackie Kramer, US Environmental Protection Agency

Tribal Climate Change Training and Technical Assistance Efforts

Kahtnu 2

Details: This session will provide an overview of the Institute for Tribal Environmental Professional's (ITEP) climate change training and technical assistance services. ITEP provides training and technical assistance to tribes nationally interested in issues related to climate change adaptation planning. Time will be given during the session to hear back from tribal representatives from Alaska about issues and resources that could assist them with adaptation planning and training.

Presenters: Mehrdad Khatibi, ITEP, Northern Arizona University; Rose Kalistook, Orutsararmuit Native Village
Moderators: Westley Foster and Michelle Davis, US Environmental Protection Agency

Solid Waste and Contaminants in Alaska: A Talking Circle (Part 2 of 2)

Tikahtnu C

Details: This session will be held in a Talking Circle format to address environmental impacts associated with solid waste and contaminants issues, where participants can voice their concerns and share in the development of solutions.

Moderators: Santina Gay, US Environmental Protection Agency; Larry Merculieff, 7 Generations Consulting

North Slope Methane Hydrates and Carbon Dioxide Exchange

Tubughnenq' 4

Details: What are methane hydrates, how they are they formed and where are they found in nature? This presentation will answer these questions and discuss a test of the carbon dioxide/methane hydrate exchange mechanism in naturally occurring hydrates present just below the North Slope permafrost.

Presenter: David Schoderbek, ConocoPhillips Alaska, Inc.
Moderator: Mary Mae Ashoff, ConocoPhillips Alaska, Inc.

3:30 p.m. - 6:00 p.m.

Workshop on the Conservation/Recovery Plan for Polar Bears in Alaska (Part 2 of 2)

Tubughnenq' 3

Details: A continuation of the workshop. The objective of the workshop will be to help the US Fish & Wildlife Service develop the Conservation/Recovery Plan for polar bears. The main topic will be human-caused removals: how to develop mitigation strategies for future impacts to Alaska's polar bears as a result of human-caused removals.

Moderators: James Wilder, US Fish & Wildlife Service; Colleen Matt, CAMatt

NOTES:

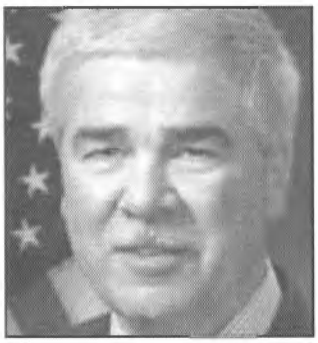
WEDNESDAY Morning

February 9

8:00 a.m. - 8:45 a.m.

MORNING KEYNOTE EVENT

DENNIS MCLERRAN
US Environmental Protection Agency
Regional Administrator
Tikahtnu Ballroom



Details: Please join us for an exceptional Keynote Event with Dennis McLerran at the Alaska Forum on the Environment, 2011.

Dennis McLerran, US Environmental Protection Agency (EPA) Regional Administrator, was appointed by President Barack Obama to serve as the Regional Administrator (RA) for Region 10, leading a staff of 650 employees, with responsibility for an annual budget of $500 million. He was sworn in on February 22, 2010.

As RA, Dennis oversees the implementation and enforcement of the federal environmental rules and regulations in the states of Washington, Oregon, Idaho, and Alaska, including 271 tribal governments in the Pacific Northwest and Alaska.

Before moving to EPA, Dennis served as Executive Director of the Puget Sound Clean Air Agency, a state chartered regional agency that adopts and enforces air quality standards that protect the health of 3.5 million Washington residents. As executive director, he led the development of an innovative strategy to reduce emissions at the ports of Seattle, Tacoma and Metro Vancouver. Prior to that, he served as City Attorney for the City of Port Townsend and Director of the Seattle Department of Construction and Land Use. Dennis has over 20 years experience as an advocate, attorney and administrator.

Dennis received his bachelor's degree from the University of Washington and a J.D. from the Seattle University School of Law.

9:00 a.m. - 10:15 a.m.

Native Voices: Traditional Knowledge & Climate Change (Part 1 of 2)
Kahtnu 2

Details: This session seeks to gather and obtain information from Alaska Native Villagers about their traditional Tribal Ecological Knowledge (TEK), how they are currently coping, and what barriers they face to effectively adapt to these changes. The session will comprise presentations that illustrate the richness and value of TEK, and traditional lifeways and explore tools/systems for gathering and disseminating this information.

Presenters: Carl Wassillie, Alaska's Big Village Network; Rose Kalistook, Orutsararmiut Native Village
Moderator: Don Bantz, Alaska Pacific University

The Arctic Environmental Response Management Application (ERMA)
Tubughnenq' 4

Details: The National Oceanic and Atmospheric Administration is initiating development of the ERMA geospatial decision-support tool to prepare for Arctic oil spill response, assessment, and restoration. The first steps in developing the tool are to identify priority decisions, applications, and users; and then to work with decision makers and stakeholders to identify key data and information needs. This web-based visual tool will combine product output from NOAA sources, as well as data sets agreed upon by stakeholders.

Presenters: Kari Sheets, National Oceanic and Atmospheric Administration; Allison Bailey, NOAA/SoundGIS
Moderator: Tracy Minick-Ross, NOAA/Genwest Systems

US Forest Service Listening Session on Sacred Sites Policy (Part 1 of 2)
Tikahtnu E

Details: In Part 1, US Department of Agriculture and Forest Service officials will provide an overview of their 2011 review of sacred sites policies and procedures. Officials will highlight the existing laws, regulations, policies and practices and the Department's intent to ensure a consistent level of protection for American Indian and Alaska Native sacred sites located on National Forest System lands. The introductory information provided in Port 1 will not be repeated in Part 2.

Presenters: Beth Pendleton and Ruth Monahan, US Forest Service
Moderator: Steve Kessler, US Forest Service

9:00 a.m. - 10:15 a.m. (cont.)

Shipping in Arctic Waters: Implications of Climate Change

Tubughneq' 3

Details: A presentation on how the reduction of Arctic summer sea ice may impact future shipping and coastal communities; learn about the numerous factors that have to be taken into account such as Arctic governance, infrastructure, impacts to communities and the Arctic environment, and how to become involved.

Presenters: Shawna Larson and Colleen Keane, Pacific Environment
Moderator: Shane Montoya, US Coast Guard 17th District

Hydrocarbon Risk Calculator (Part 1 of 2) Concepts, Regulatory Status, Data Needs, Closure Decisions

K'enakatnu Executive Board Room

Details: The Hydrocarbon Risk Calculator (HRC) is an Alaska Department of Environmental Conservation (AEDC) approved tool for calculating human health risks and alternative cleanup levels at hydrocarbon spill sites. The HRC may be used as an alternative Method 3 Calculator and to assist in Method 4 risk assessments for petroleum contaminated sites under 18 AAC 75, allowing Responsible Parties to demonstrate whether sites meet acceptable human health risk levels. An overview of the calculator will be provided, the primary differences between the ADEC online method 3 calculator and the HRC will be highlighted, and the site characterization data used in the HRC will be briefly discussed. The presentation will also include a review of ADEC regulations on developing soil cleanup levels under Methods 1-4, groundwater cleanup levels, and cleanup complete decisions. Examples of the types of sites that may benefit from using the HRC will be discussed.

Presenters: Larry Acomb, Geosphere; Fred Vreeman and John Halverson, Alaska Department of Environmental Conservation
Moderator: Scott Berglund, Federal Aviation Administration

Federal Interagency Coordination on Environmental Justice Issues (Part 1 of 2)

Tikahtnu C

Details: This 2-part session will outline Federal Interagency Coordination on Environmental Justice from the perspective of the Federal Interagency Working Group on Environmental Justice (IWG EJ). Discussions will cover: the current activities of the IWG EJ, the December 2010 White House Forum on Environmental Justice, plans for agencies to create EJ strategies, and plans for regional IWG EJ public sessions. Part 2 will focus on specific work, partnerships and programs of the participating agencies, which tribes and community representatives may find helpful in their efforts to address their environmental, public health and other environmental justice concerns.

Presenters: Lisa Garcia, US Environmental Protection Agency; Willie Taylor, Department of Interior
Moderator: Sherri White, US Environmental Protection Agency

Experiences Needed for Students to Become Environmental Leaders

Kahtnu 1

Details: This session discusses the resources necessary to help make environmental education in Alaska more relevant and visible in our education system by identifying important leaders, organizations, and resources. Experiences from successful programs and tools helpful for students to become environmental leaders in their community will be shared. Participants are asked to share tools and resources that may help programs create positive leadership experiences.

Presenters: Kevin Char, National Oceanic and Atmospheric Administration; Brenda Duffy, Alaska Department of Fish & Game, Project Wild; Daniel Chythlook, Aleknagik Traditional Council Environmental Program
Moderator: Todd Radenbaugh, University Alaska Fairbanks

9:00 a.m. - 4:00 p.m.

Brownfields Tribal Response Program Training

Marriott Hotel

Details: This session is about establishing a Tribal Response Program authorized under 128(a) of CERCLA and funded by EPA under 128(a) Cooperative Agreements. The TRP is intended to address the releases of hazardous substances, pollutants and contaminants from Brownfields, mine scarred lands, petroleum, and other sites and sources. This session will be primarily intended for those Tribes that would like to establish a TRP, are in the early stages of establishing a TRP or are part of a TRP consortium.

Presenter: Mickey Hartnett, Midwest Assistance Center
Moderator: Mary Goolie, US Environmental Protection Agency

10:30 a.m. - 11:45 a.m.

US Forest Service Listening Session on Sacred Sites Policy (Part 2 of 2)

Tikahtnu E

Details: In part 2, we will listen to participants and record your comments on how to improve sacred sites policies and procedures. After consultation on a draft report this summer, a final report with recommendations will be submitted to the Secretary of Agriculture by November 2011.

Presenters: Beth Pendleton and Ruth Monahan, US Forest Service
Moderator: Steve Kessler, US Forest Service

Contaminants in Subsistence Foods

Tikahtnu D

Details: The presence of heavy metals, persistent, man-made chemicals and natural toxins in the arctic subsistence foods generate concerns about the potential threat to the ecosystem and risks to human health. This presentation will focus primarily upon two toxins of the greatest concern to Alaskans: mercury and paralytic shellfish poisoning (PSP), and how these toxins occur in subsistence diet.

Presenters: Bruce Wright, Knik Tribal Council; David Harrison, Alaska Inter Tribal Council; Joe Sarcone, Agency for Toxic Substances and Disease Registry; Alex James, Yakutat Tlingit Tribe
Moderator: Klaudia Jo Klaudi, Knik Tribal Council

Native Voices: Traditional Knowledge & Climate Change (Part 2 of 2)

Kahtnu 2

Details: This session seeks to gather and obtain information from Alaska Native Villagers about their traditional Tribal Ecological Knowledge(TEK), how they are currently coping, and what barriers they face to effectively adapt to changes. The session will comprise presentations that illustrate the richness and value of TEK and traditional lifeways and explore some tools/systems for gathering and disseminating this information.

Presenters: Colleen Swan, Kivalina; Orville Huntington, Husila
Moderator: Don Bantz, Alaska Pacific University

What is Coastal and Marine Spatial Planning?

Tubughnenq' 3

Details: This session will explore the topic of Coastal and Marine Spatial Planning (CMSP). Under the new National Ocean Policy, CMSP has been emphasized as "an important planning tool for regional ocean governance. CMSP is a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas."

Presenter: Ian Dutton, Alaska SeaLife Center
Moderator: Deborah Rudis, US Fish & Wildlife Service

Hydrocarbon Risk Calculator (Part 2 of 2) Case Studies

K'enakatnu Executive Board Room

Details: The Hydrocarbon Risk Calculator is currently being applied at three Federal Aviation Administration fuel spill sites in Alaska. Examples of preliminary results from the HRC will be compared with results from the Alaska Department of Environmental Conservation on-line method 3 calculator for the same sites. Differences in results will be highlighted and discussed to develop an understanding of the differences between the calculation methods and the calculated differences in risk to human health from each method. Comparisons of sampling methods and their applicability, results and "lessons learned" will be provided.

Presenters: Larry Acomb, Geosphere; Jamie Oakley, AHTNA, Inc
Moderator: Scott Berglund, Federal Aviation Administration

Federal Interagency Coordination on Environmental Justice Issues (Part 2 of 2)

Tikahtnu C

Details: Part 2 of this session will focus on specific work, partnerships, resources, and programs of the participating agencies, which tribes and community representatives may find helpful in their efforts to address their environmental, public health and other environmental justice concerns.

Presenters: Mathy Stanislaus, US Environmental Protection Agency; Melinda Downing, US Department of Energy; David Rivers, Medical University of South Carolina; Bob Furlong, US Department of Defense; Ethan Shenkman, Department of Justice; Merlaine Kruse, US Department of Agriculture
Moderator: Amber Blaha, Department of Interior

must have capacity to respond to worst case scenario / Intl. standards for Arctic Countries

Afternoon

February 9

WEDNESDAY

10:30 a.m. - 11:45 a.m. (cont.)

Drumbeats: Place-Based Environmental Education Certificate for Rural Alaska

Kahtnu 1

Details: Come discover successful ways place based science education is being delivered in rural Alaska. This session presents the best practices employed by four University Alaska Fairbanks certificate programs (Environmental Studies, Ethnobotany, High Latitude Range Management, and Veterinary Science) and will discuss the challenges and rewards of using online tools coupled with a "subsistence science" perspective.

Presenters: Todd Radenbaugh, Suze Nolan, Rose Meier, and Trisha Walters, University of Alaska Fairbanks
Moderator: Elisa Bruns, University of Alaska Fairbanks, US Department of Agriculture

Oil Development in the Arctic

Tubughneq' 4

Details: This session will include presentations and discussions about what research has been done and what is still needed for safe oil production in the Arctic and what response methods will be on hand and available in case of an incident.

Presenters: Marilyn Heiman, US Arctic Program/Oceans North; Ron Morris, Alaska Clean Seas; Dr. Robert Suydam, North Slope Borough
Moderator: Scott Pegau, Oil Spill Recovery Institute

12:00 p.m. - 1:45 p.m.

LUNCH ON YOUR OWN

Alaska Clean Seas — has equipment/wraps most oil co use them
Response cap needed in-vestment
Pew Environment & Climate Change 2x rest of world extreme temps-access issues
Better oversight for spill response/prevention
Better tech/research
Seasonal drilling restrictions
Increase oversight + funding for fed agencies (USCG, NEXT, EPA). Greater community involvement. Science gaps need to be filled in.

2:00 p.m. - 3:15 p.m.

Geographic Information System Rural Alaska

Tikahtnu D

Details: This will be a brief introduction to the concepts and benefits of using a geographic information system (GIS) to manage data within Alaska communities. Topics to be covered include: What is GIS? Visualizing and analyzing your data and GIS applications in Tribal Governments.

Presenters: Adrian Guthrie, Knik Tribal Council; Chester Murphy, Department of Natural Resources
Moderator: Richard Porter, Knik Tribal Council

Community Gardening Benefits in Rural Alaska

Tikahtnu E

Details: This session focuses on community and greenhouse gardening in rural Alaska and the incorporation of Native food use, collection and storage techniques. Besides increased nutrition and economic benefits, gardening has other beneficial side effects such as neighborhood beautification, recreation, exercise and therapy along with opportunities for social interaction and intergenerational and cross-cultural connections.

Presenters: Bruce Wright, Knik Tribal Council; Danny Consenstein and Jim Loiland, US Department of Agriculture; Connie Fredenberg, Marsh Creek; Bob Mikol, University of Alaska Fairbanks
Moderator: Theo Garcia, Knik Tribal Council

Marine Debris Workshop (Part 1 of 2)

Tubughneq' 3

Details: This all-afternoon workshop will review the actions taken on marine debris in the past year, trends seen in ongoing studies, and tools for outreach to communities on marine debris cleanup. Topics for this session will include advancements in sonar work, mapping, large scale projects, and community outreach.

Presenters: Patrick Chandler, Center for Alaskan Coastal Studies; Fritz Klasner, Kenai Fjords National Park; David Gaudet, Marine Conservation Alliance Foundation; Peter Murphy, National Oceanic and Atmospheric Administration Marine Debris Division; Chris Pallister, Gulf of Alaska Keeper
Moderator: Erika Ammann, National Marine Fisheries Service

Lack of infrastructure
Few response vessels only 1 cutter
CG = Kodiak increase capabilities
Boat ramps/airports
equipment on site
maybe off limit areas
smaller lease sales

level of performance needed that is not currently in play

2:00 p.m. - 3:15 p.m. (cont.)

Vapor Intrusion Evaluation Case Studies (Part 1 of 2)

K'enakatnu Executive Board Room

Details: This presentation will describe vapor intrusion investigations conducted at sites in Fairbanks, AK. The effects of temperature and volatile organic compound concentrations will be discussed, along with standard and innovative methods for developing subslab to indoor air attenuation factors.

Presenters: Dr. David Barnes, University of Alaska Fairbanks; Joseph King, US Army; Dennis Shelton and Jeremy Blei, CH2M HILL
Moderator: Janice Wiegers, Alaska Department of Environmental Conservation

Tribal and Community Perspectives on Environmental Justice Issues in Alaska (Part 1 of 2)

Tikahtnu C

Details: In the first portion of this two-part session, tribal and community panelists will present on key environmental justice issues in Alaska. Senior level representatives from various Federal Agencies, including the Environmental Protection Agency (EPA), Department of Energy, Department of Defense, Department of Interior, and Department of Justice will be present to listen and learn. Opening remarks will be provided by EPA's Regional Administrator, Dennis McLerran.

Presenters: Dennis McLerran, US Environmental Protection Agency; Nelson Island Consortium Elder Theresa Abraham; Shawna Larson, Pacific Environment; Millie Hawley, Native Village of Kivalina; George Edwardson, Inupiat Community of the Arctic Slope; Viola Waghiyi, Alaska Community Action on Toxics; Hazel Blackmore, Anchorage Neighborhood Housing Services.
Co-Moderators: Larry Merculieff, 7 Generations Consulting; Wenona Wilson, US Environmental Protection Agency
Translation Coordinators: Tami Fordham and Cathy Villa, US Environmental Protection Agency
Translator: Marie Meade, University of Alaska Anchorage

Daily Meetings / Radio
Unified command
Lightering by helicopter
work group process
Daily situation report

Sustainable Energy in Environmental Education

Kahtnu 1

Details: This session discusses environmental education resources needed to reduce our use of fossil fuel consumption, and how sustainable energy education plays a significant role in solving many energy related problems such as high costs and short supply of fuel. If you want to be a part of the solution, come to this session and learn about sustainable energy educational activities in Alaska. This session will include presentations and discussions on existing efforts, emerging programs, current needs, possibilities for collaboration, and more.

Presenters: Kat Keith, Alaska Center for Energy and Power; Kaarle Strailey, Alaska Center for the Environment; Tom Marsik, University of Alaska Fairbanks
Moderator: Tom Marsik, University of Alaska Fairbanks Bristol Bay Campus Sustainable Energy Program

Lessons Learned: Information Flow – The Selendang Ayu and the Deepwater Horizon Incidents

455, oil
oil spill

Tubughnenq' 4

Details: The Selendang Ayu and the Deepwater Horizon in the Gulf of Mexico had different methods of providing information to the public. Presenters will discuss methods of information dissemination and anticipated changes.

Presenters: Gary Folley, Alaska Department of Environmental Conservation; Kristina Peterson, Communities on the Horizon; Ron Morris, Alaska Clean Seas
Moderator: Joe Banta, Prince William Sound Regional Citizens' Advisory Council

Tracking Backhaul Success

Kahtnu 2

Details: Total Reclaim along with Everts and Kawarek will present on backhauling recyclables, specifically regarding how Kawarek took on the responsibility of accepting materials from outlying villages and subsequently staging, repackaging, and shipping those materials via Everts to Total Reclaim and other recyclers (all within the last year).

The Nome program is good example of utilizing a hub to facilitate the backhaul of potentially harmful materials. Additionally, Total Reclaim will explain the Rural Tracking Program, its benefits, and report on recycling stats for 2010. Further, future projects and goals for 2011 will be discussed.

Presenters: Reilly Kosinski, Total Reclaim; Lacey Whitehead and Sabrina Volstad, Everts Air; Anahma Saito, Kawerak Inc.
Moderator: Larry Zirkle, Total Reclaim

3:30 p.m. - 4:45 p.m.

Area Contingency Planning for Oil Spill Response in Alaska
Tubughneng' 4

Details: This session provides attendees with an overview of the joint Federal/State planning process to update the Subarea Contingency Plans (SCPs) for the North Slope, Northwest Arctic, Bristol Bay, and Western Alaska subareas. Planning team members will describe the types of local/traditional information needed from subarea residents, local governments, and federally-recognized tribes to further improve the plans which address protocols for responding to oil discharges and hazardous substance releases. They will also run through a spill response scenario.

Presenters: Rob Hollinger and Jay Calkins, US Coast Guard; Dale Gardner and Larry Iwamoto, Alaska Department of Environmental Conservation
Moderator: Linda Swiss, Prince William Sound Regional Citizens' Advisory Council

Annual Alaska Mining Report
Kahtnu 2

Details: Alaska mine operators will provide an update on their existing operations, with the focus this year on tailings and waste rock issues.

Presenters: Mike Satre, Council of Alaska Producers; Todd Roth, Sumitomo Metal Mining Pogo Mine; TBA Kinross Fort Knox Mine
Moderators: Jason Brune, Resource Development Council; Thomas Crawford, Department of Natural Resources

Marine Debris Workshop (Part 2 of 2)
Tubughneng' 3

Details: The continuation of this all-afternoon workshop will review the actions taken on marine debris in the past year, trends seen in ongoing studies, and tools for outreach to communities on marine debris cleanup. Topics for this session will include advancements in sonar work, mapping, large scale projects, and community outreach.

Presenters: Patrick Chandler, Center for Alaskan Coastal Studies; Fritz Klasner, Kenai Fjords National Park; David Gaudet, Marine Conservation Alliance Foundation; Peter Murphy, National Oceanic and Atmospheric Administration Marine Debris Division; and Chris Pallister, Gulf of Alaska Keeper
Moderator: Erika Ammann, National Marine Fisheries Service

Vapor Intrusion Evaluation Case Studies (Part 2 of 2)
K'enakatnu Executive Board Room

Details: Pressure-based Dynamics of Vapor Intrusion: Recently collected data will be presented that outlines how dynamic changes in barometric and building interior pressures affect vapor intrusion processes and indoor air quality. Lessons learned and recommended sampling and analysis strategies will be discussed.

Presenter: Patrick Haas, P.E. Haas & Associates
Moderator: Janice Wiegers, Alaska Department of Environmental Conservation

General Assistance Program (GAP) Online
Tikahtnu D

Details: This session will familiarize GAP grantees on how to use GAP Online for Workplan entry and quarterly reporting.

Moderators: Sherry Kimmons and Westley Foster, US Environmental Protection Agency

Baseline Water Quality Monitoring - Lessons Learned
Tikahtnu E

Details: What is a baseline for water quality and how is it established? What's the difference between assessment and monitoring? What is a Quality Assurance Project Plan (QAPP) and why is it needed? What kinds of equipment and supplies are needed to get started? These questions and more will be answered by several speakers who will share their experiences in conducting baseline water quality assessments.

Presenters: Dan Bogan, UAA Environment and Natural Resources Institute; Daniel Chythlook, Aleknagik Tribal Council; Edda Mutter, UAF Water and Environmental Research Center; Leah Mackey, Yukon River Inter-Tribal Watershed Council
Moderator: Mahri Lowinger, US Environmental Protection Agency

WEDNESDAY Afternoon

February 9

3:30 p.m. - 4:45 p.m. (cont.)

Working Together to Address Environmental Justice Issues Identified by Tribal and Community Panelists (Part 2 of 2)

Tikahtnu C

Details: In the second part of this two-part session, all session participants, including panelists and federal agency representatives, will break into working groups to address key environmental justice issues in Alaska. Workgroups will discuss and provide recommendations to the Environmental Justice Interagency Working Group and EPA Region 10. Workgroups will focus on subsistence, resource extraction, transportation impacts, children's health, and other issues identified by the panelists.

Co-Moderators: Larry Merculief, Seven Generations Consulting; Wenona Wilson, US Environmental Protection Agency
Translation Coordinators: Tami Fordham and Cathy Villa, US Environmental Protection Agency

Promoting Rural Workforce Development through Environmental Internships

Kahtnu 1

Details: This session highlights successful internship programs offered across rural Alaska by federal, state and private agencies, and links the importance of place based rural internships with workforce development. Discussions will be led by both mentors and student interns.

Presenters: Chris Czarnecki, Alaska Conservation Foundation; Candice Bressler, Alaska Department of Fish & Game; Kim Seybert Bristol Bay Native Association; Paul Liedberg, US Fish & Wildlife Service Togiak Wildlife Refuge
Moderators: Paul Liedberg, US Fish & Wildlife Service Togiak Wildlife Refuge; Dr. Todd Radenbaugh, University of Alaska Fairbanks

5:00 p.m. - 7:00 p.m.

EVENING EVENT

Regional Tribal Operations Committee Social

Tikahtnu Ballroom

Details: Come and enjoy appetizers at an evening social event hosted by the Regional Tribal Operations Committee, and gain the opportunity to interact with the RTOC Advisory members. Keynote presentations are to be announced. The annual Ellanak Environmental Excellence Award will also be presented.

Moderated by RTOC Co-Chairs: Violet Yeaton, Port Graham Tribal Council; Rose Kalistook, Orutsaramiut

NOTES:

8:00 a.m. - 8:45 a.m.

MORNING KEYNOTE EVENT

LYNN PAULSON
"As Within, So Without"
Tikahtnu Ballroom

Details: Please join us for an exceptional Morning Keynote at the Alaska Forum on the Environment, 2011.

Dr. Lynn Paulson is a teacher, personal development coach, motivational speaker and writer. She has lived in Anchorage, Alaska since 1993.

Lynn's work is focused on human emotional and spiritual well-being as the foundation for all efforts aimed at sustainability. A healthy world requires healthy inhabitants who practice an ethic of care that includes the self, fundamentally.

Lynn's message is that we have a responsibility to heal ourselves so that we can make our greatest possible contribution to larger causes that concern us all. Her goal is to motivate clients, listeners and readers to make positive changes to their lives now.

Her keynote address for the Alaska Forum, "As Within, So Without," stresses the importance of developing habits and practices that sustain us as human beings and move us to create lives that support our well-being and effectiveness. Making loving self-care a priority creates more balanced lives and balanced people, who are more positive, healthy and effective in their lives and in their communities.

Before creating Flying Heart Industries and developing her career in life coaching and motivational speaking, Dr. Lynn Paulson, Ph.D, spent over 25 years teaching and writing about various topics in communication, social interaction and culture, first at the University of Nebraska, at Lincoln, and then at Alaska Pacific University in Anchorage, Alaska.

8:00 a.m. - 11:45 a.m.

Statement of Cooperation Executive Steering Committee Meeting - By Invitation Only
K'enakatnu Executive Board Room

Details: This session is a closed session of the steering committee.

9:00 a.m. - 10:15 a.m.

How to Organize a Household Hazardous Waste Collection Program
Tubughneq' 4

Details: Come and learn how to set up a household hazardous waste collection program in your community, and options for shipping these wastes out of your community.

Presenter: Terry Berger, Mat-Su Borough
Moderator: Cory Hinds, CH2M HILL

Hazard Communication Standard
Tikahtnu E

Details: The Hazard Communication Standard is also known as "the worker right to know."

Presenter: Chuck Mitchell, University of Washington
Moderator: Klaudia Jo Klaudi, Knik Tribal Council

Native American Lands Environmental Mitigation Program
Tikahtnu D

Details: This session is an overview of the Department of Defense's environmental program including eligibility criteria, Cooperative Agreements and the selection process.

Presenters: Theo Garcia, Knik Tribal Council; Alex James, Yakutat Tlingit Tribe; Valerie Palmer, Department of Defense, US Army Corps of Engineers; Terri Kelley, Keres Consulting
Moderator: Richard Porter, Knik Tribal Council

Climate Science in the Arctic and What it Means to Alaskans
Kahtnu 2

Details: A discussion on the implications of Arctic science and what it means to the daily lives of Alaskans. This session will include a discussion of the work of the Arctic Council and the Sustaining the Arctic Observing Network, and climate change activities of Indigenous People in the local, national and international arenas.

Presenters: John Calder, National Oceanic and Atmospheric Administration/Sustaining the Arctic Observing Networks; Victoria Gofman, Arctic Council Representative; Patricia Cochran, Alaska Native Science Commission
Moderator: David Guest, US Environmental Protection Agency

9:00 a.m. - 10:15 a.m. (cont.)

The National Environmental Policy Act De-Mystified
Tubughneng' 3

Details: Taking the "Scary" out of the National Environmental Policy Act (NEPA): A fun, interactive session including "NEPA Jeopardy" with PRIZES! The very basics of NEPA including the purpose and intent of the law and overview of the Council on Environmental Quality's implementing regulations will be covered. NEPA is not just for mining activities; other resource extraction including woody biomass can trigger the NEPA process. This session is designed for individuals wishing to learn more about NEPA and when it applies and for agency representatives that implement NEPA. Participants will learn the foundations of a NEPA analysis, basics of public involvement, factors used to determine significant effects and the types of documents used by Federal agencies during the NEPA process. Agency participants will gain insight on the general level of knowledge of the NEPA process and where their assistance is needed most.

Presenters: Betsy Rickards, US Forest Service; Izetta Chambers, University of Alaska Bristol Bay
Moderator: Bud Rice, National Park Service

How to Perform a Village-Based Dump Site Assessment: A Scammon Bay Case Study
Tikabtnu C

Details: In the spring of 2010 the Native Village of Scammon Bay partnered with the Agency for Toxic Substances and Disease Registry to explore concerns regarding the possible impact of the village dumpsite on a nearby subsistence stream. Over the course of three days a village based dumpsite assessment process developed which resulted in a detailed assessment report that could be shared with others. The process included a number of steps: establish the purpose for an assessment, provide/receive exposure pathways training, visit the site to get the overall picture, brainstorm to identify the needed exposure pathway details (where, what, how much, how far from ,etc.), develop a site investigation form unique to the site, perform fact finding/research including conduct a detailed inspection of the site and surroundings, develop a report outline and write the assessment report. The Scammon Bay case study was a learning experience for all involved and hopefully will be useful to others in their villages.

Presenters: Josh Akerelrea, Native Village of Scammon Bay; Joe Sarcone, Agency for Toxic Substances and Disease Registry
Moderator: Santina Gay, US Environmental Protection Agency

Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 1 of 2)
Kahtnu 1

Details: This is a two-part session. Discussion of the respective regulatory roles of the US Environmental Protection Agency and the Federal Aviation Administration regarding leaded aviation gasoline, activities by the Federal government to date and their next steps.

Presenters: Marion Hoyer and Kathryn Sargeant, US Environmental Protection Agency; Mark Orr, Federal Aviation Administration
Moderator: John Pavitt, US Environmental Protection Agency

9:00 a.m. - 4:00 p.m.

Brownfields Tribal Response Program Training
Marriott Hotel

Details: Part 2 of this session is about enhancing an existing CRECLA 128(a) Tribal Response Program (TRP) funded by the US Environmental Protection Agency under a 128(a) Cooperative Agreement. The TRP is intended to address the releases of hazardous substances, pollutants and contaminants from brownfields, mine scarred lands, petroleum, and other sites and sources. This session will be primarily intended for those tribes or villages that have some experience in establishing a TRP, either directly or as part of a TRP consortium, and now are seeking ways to enhance and further develop their TRP.

Presenter: Mickey Hartnett, Midwest Assistance Center
Moderator: Mary Goolie, US Environmental Protection Agency

NOTES:

10:30 a.m. - 11:45 a.m.

Impacts of Poor Solid Waste Management on Village Health
Tubughnenq' 4

Details: Come participate in this roundtable discussion on the impacts of poor solid waste management practices. There will be a brief introduction presentation about hazardous substances in your community and exposure pathways.

Presenters: Jennifer Williams, Institute for Tribal Environmental Professionals; Joe Sarcone Agency for Toxic Substances and Disease Registry
Moderator: Greg Goodale, Mat-Su Borough

Environmental Issues Associated with Meth Lab Cleanup
Tikahtnu D

Details: The hazards associated with the making, selling and use of Methamphetamine and other health issues including environmental concerns. This course is designed ONLY as an awareness program.

Presenter: Chuck Mitchell, University of Washington
Moderator: Theo Garcia, Knik Tribal Council

Climate Change in Northern Communities: Canadian Federal and Municipal Perspectives
Kahtnu 2

Details: This panel will feature strategies for addressing climate change on both a federal and municipal level in Canada; featuring Yellowknife Mayor and Federation of Canadian Municipalitites Board Member Gordon VanTighem and Consul Jennifer Loten of the Consulalte of Canada, Anchorage exploring ideas from your neighbor to the West.

Presenters: Jennifer Loten, Consulate of Canada-Anchorage; Gordon VanTighem, Federation of Canadian Municipalities
Moderator: Shane Montoya, US Coast Guard 17th District

Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 2 of 2)
Kahtnu 2

Details: Discussion continues of the respective regulatory roles of the US Environmental Protection Agency and Federal Aviation Agency regarding leaded aviation gasoline, activities by the Federal government to date, and their next steps.

Presenters: Barbara Trost, Alaska Department of Environmental Conservation; Troy Ritter, Alaska Native Tribal Health Consortium; Tom George, Aircraft Owners and Pilots Association; Susan Flensburg, Bristol Bay Native Association
Moderator: John Pavitt, US Environmental Protection Agency

New Landscape Conservation Cooperatives in Alaska to Address Climate Change
Tubughnenq' 3

Details: America's natural systems and landscapes are impacted by increasing land use pressures and widespread resource threats amplified by a rapidly changing climate. These changes are occurring at an unprecedented pace and scale. Landscape Conservation Cooperatives (LCCs) are a network of applied conservation science partnerships between the US Fish & Wildlife Service and other federal agencies, states, tribes, NGOs, universities and stakeholders within a geographically defined area working in unison to ensure the sustainability of America's land, water, wildlife and cultural resources. There are 5 LCCs covering Alaska.

Presenter: Greg Balogh, US Fish & Wildlife Service
Moderator: John Duffy, JD Associates

The National Environmental Policy Act: Tools and Tips
Tubughnenq' 5

Details: The National Environmental Policy Act (NEPA) was implemented to ensure that local communities have a voice in the decision-making process for the utilization and conservation of our natural and cultural resources. NEPA can be a factor in any resource extraction, including woody biomass and any other resource from federal lands or waters. Getting involved, however, can be intimidating and confusing. It can also be challenging for agency representatives implementing NEPA to provide relevant resources for those wishing to become involved. This session offers Alaska based and national resources that can assist individuals and communities become effectively involved in the NEPA process and aid agency representatives in guiding these individuals to relevant and appropriate sources of information.

Presenters: Izetta Chambers, University of Alaska Bristol Bay; Meg Burgett, University of Alaska Fairbanks; Pat Reed, US Forest Service
Moderator: Bud Rice, National Park Service

Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues (Part 1 of 2)
Tikahtnu C

Details: In Part 1 of this two part session presenters will summarize current National and Alaska mining issues, including potential regulations being developed by the US Environmental Protection Agency. Participants will have the chance to discuss these issues and other topics about mining in Alaska. Most of the discussion time will occur in Part 2.

Presenters: Patty McGrath and Mathy Stanislaus, US Environmental Protection Agency
Moderator: Tami Fordham, US Environmental Protection Agency

THURSDAY Afternoon

February 10

12:00 p.m. - 1:45 p.m.

KEYNOTE EVENT

FRAN ULMER
Chancellor University of Alaska Anchorage
Tikahtnu Ballroom

Details: Fran Ulmer is chancellor of Alaska's largest public university, the University of Alaska Anchorage (UAA).

In addition to serving as UAA's Chancellor, Ms. Ulmer was appointed by President Barack Obama in June 2010 to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. The commission is charged with investigating the causes of the explosion and oil spill, and recommending changes to prevent future disasters from occurring.

Prior to her appointment to the oil spill commission, Ms. Ulmer was a member of the Aspen Institute's Commission on Arctic Climate Change and held Board positions with the Alaska Nature Conservancy, the National Parks Conservation Association and the Union of Concerned Scientists. Appointed Chancellor in 2007, Ms. Ulmer previously was a Distinguished Visiting Professor of Public Policy and Director of the Institute of Social and Economic Research at UAA.

During her more than 30 years of work in public service on the local, state and national level, Ms. Ulmer has helped to shape both public and environmental policy.

2:00 p.m. - 3:15 p.m.

Rural Development Water and Environmental Program Overview and Application Process (Part 1 of 2)

Tubughneng' 5

Details: This session will provide an overview of the US Department of Agriculture Rural Development Water and Environmental Programs, which provides loans, grants, and loan guarantees for drinking water, sanitary sewer, and solid waste in rural communities throughout Alaska. Find out which applications may apply to your community's needs. During this session participants will have time to walk-through the application process with USDA staff and may ask specific questions about potential projects.

Presenter: Misty D. Hull, US Department of Agriculture Rural Development
Moderator: Cory Hinds, CH2M HILL

Burn Unit Pilot Project

Tikahtnu E

Details: Mr. Lance Jackson, the Principle of Tuluksak High School, will give an account of an innovative approach to construction of a burn unit for the community by recycling existing materials, as in using an old 3,000 gallon fuel tank. This was a hands on student project with a curriculum involving welding, geography, science, math and writing.

Presenter: Lance Jackson, Tuluksak High School.
Moderator: Richard Porter, Knik Tribal Council

NEPA in the Courtroom: Case Law

Tubughneng' 3

Details: The National Environmental Policy Act (NEPA) court decisions in Alaska have shaped how NEPA is applied today. Of particular interest is recent court decisions about when it is a federal action and when NEPA applies.

Presenter: Jeff Parker, Environmental Law Attorney
Moderator: Dick Anderson, National Park Service

2:00 p.m. - 3:15 p.m. (cont.)

Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues (Part 2 of 2)

Tikahtnu C

Details: Participants will have the chance to discuss National and Alaska mining issues presented in Part 1 as well as other mining related topics.

Presenters: Patty McGrath and Mathy Stanislaus, US Environmental Protection Agency
Moderator: Tami Fordham, US Environmental Protection Agency

GAP Solid Waste Solutions

Kahtnu 1

Details: This session will be an open format session provided to General Assistant Program recipients on potential solutions for addressing solid waste issues in rural Alaska, such as banning plastic bags/styrofoam, illegal dumps, landfill permitting, backhaul and recycling.

Moderators: Ted Jacobson, RurAL CAP; Doug Huntman, Alaska Department of Environmental Conservation; Santina Gay, US Environmental Protection Agency

2:00 p.m. - 4:45 p.m.

Coastal America Alaska Regional Implementation Team Meeting

K'enakatnu Executive Board Room

Details: Annual meeting of the Coastal America Alaska Regional Implementation Team and Regional Principals.

Co-chairs: Jon Kurland, National Marine Fisheries Service; Doug Mutter, US Department of the Interior

NOTES:

3:30 p.m. - 4:45 p.m.

Alaska Youth and Climate Change: Building a Program that Works
Kahtnu 2

Details: This session will focus on how to develop a strong youth environmental program.

Presenters: MaryAnn Porter, Yakutat Tlingit Tribe; Brenda Trefon, Kenaitze Indian Tribe; Charlie Ess, RurALCAP
Moderator: Michelle Davis, US Environmental Protection Agency

Landfill Alternatives/Resource Recovery
Kahtnu 1

Details: Come find out about the Reduce part of Reduce-Reuse-Recycle. Participants will learn about alternatives to landfilling solid waste and how to set up a resource recovery and reuse program in their community.

Presenters: Ted Jacobsen, US Environmental Protection Agency; Doug Huntman, Alaska Department of Environmental Conservation
Moderator: Cory Hinds, CH2M HILL

Rural Development Water and Environmental Program Overview and Application Process (Part 2 of 2)
Tubughnenq' 5

Details: Overview continues of the US Department of Agriculture Rural Development Water and Environmental Programs, which provides loans, grants, and loan guarantees for drinking water, sanitary sewer, and solid waste in rural communities throughout Alaska. Find out which applications may apply to your community's needs. During this session participants will have time to walk-through the application process and may ask specific questions about potential projects.

Presenter: Misty D. Hull, US Department of Agriculture Rural Development

National Environmental Policy Act, Marine Fisheries, and Public Participation
Tubughnenq' 3

Details: A presentation and panel discussion on how the National Environmental Policy Act process fits into North Pacific Marine Fisheries decisions, and how the public can participate in the process. Tribal consultation and federal fisheries management will also be discussed.

Presenters: Izetta Chambers, Alaska Sea Grant; John Sky Starkey, Alaska Native subsistence and tribal rights; Michael Sloan, Nome Eskimo Community
Moderator: Heather Brandon, World Wildlife Fund

General Assistance Program (GAP) Peer Assistance Providers Open Working Session for Grants Management Assistance and GAP Proposal Development
Tikahtnu C

Details: If you work for a Tribe and are interested in improving the financial and administrative systems in your office, or are a new General Assistance Program recipient who may have questions about policies and procedures, this opportunity will allow you to meet with a Peer Assistance Provider. Participants are also welcome to bring their draft FY 2012 GAP proposals for assistance with revisions.

Presenters: Don Wedll, AVCP; Klaudia Klaudi, Knik Tribal Council; Mike Grunberg, Yukon River Inter-Tribal Watershed Council; Leilani Knight, CCTHITA; Roxanna Kashetok, APIA; Violet Yeaton, Port Graham Village Council;
Moderators: Mahri Lowinger, Sherry Kimmons and Westley Foster, US Environmental Protection Agency

FILM FESTIVAL: People of the Seal
Tubughnenq' 4

Details: Award winning film, with introduction by Aquilina Lestenkoff, Aleut Community of St. Paul Island Tribal Government, Tanax^ ~ Unaag^im Maqax^singin Office- Cultural Affairs.

8:00 a.m. - 5:00 p.m.

HAZWOPER 8-Hour Refresher Course

Kahtnu 1 & 2

Details: This training applies to those who engage in hazardous waste/substance operations, hazardous materials emergency response, and who have previously completed either 24-hour or 40-hour hazardous waste site training. This course satisfies the Occupational Safety and Health Administration (OSHA) 8-hour annual refresher training requirements for employees conducting hazardous waste operations as specified under 29 Code of Federal Regulations (CFR) 1910.120. Participants wanting to take this session must pre-register or sign up in advance at the main conference registration desk.

Additional Information: You need to be a paid Alaska Forum on the Environment (AFE) Conference registrant to take this annual 8-hour HAZWOPER refresher class.

Topics covered, as recommended under 29 CFR 1910.120(e)(8) will include: safety plan development and site entry procedures, chemical hazards, biohazards, nature of radiation/radiation protection methods, selecting appropriate personal protective equipment (PPE), air monitoring, decontamination, and hazard communications. Please ensure that you add your name to the sign-up list for this session event by selecting the online or paper registration form.

Instructors: Chuck Mitchell, University of Washington

8:15 a.m. - 1:30 p.m.

Oil Spill Recovery Institute Advisory Board Meeting

K'enakatnu Executive Board Room

Details: Semi-annual meeting of the Prince William Sound Oil Spill Recovery Institute Advisory Board. The Oil Spill Recovery Institute was established by the Oil Pollution Act of 1990 to fund and carry out research and development and education on Arctic and sub-Arctic oil spills; spill response technologies; and the assessment of impacts to the environment, economy and lifestyles of Alaskans.

Presenter: Nancy Bird, Oil Spill Recovery Institute

8:30 a.m. - 10:15 a.m.

GAP: Topics in Environmental Education & Outreach

Tikahtnu C

Details: An exciting sampling of projects that are geared toward environmental education in Alaska, including a look at on line resources.

Presenters: Ray Paddock, Jr, CCTHITA; Lance Simons, Ketchican Indian Community; Lynn Zender, Zender Environmental; Brenda Duty, Project WILD, Alaska Department of Fish and Game; Charlene Dubay from Telida Tribal Council
Moderator: Mahri Lowinger, US Environmental Protection Agency

8:30 a.m. - 2:30 p.m.

FILM FESTIVAL

Tubughneng' 4

"Unraveling the Story of Trash in Rural Alaska" video contest winners

Details: Rural Community Assistance Corporation (RCAC) with support from U.S. Department of Agriculture Rural Development, and in cooperation with the Alaska Department of Environmental Conservation and Solid Waste Association of North America – Alaska Chapter, presents the winner of the first annual "Unraveling the story of trash in rural Alaska" video contest. Contestants were asked to share the realities of dealing with trash in their rural community by putting together a three minute video and submit it via You-Tube. Prizes will be awarded to all videos that meet the criteria of this contest. This session highlights the contest and shows the winning video.

Moderators: Jim Wilson, Rural Community Assistance Corporation; Doug Huntman, Alaska Department of Environmental Conservation

"Understanding the Healing Hands of the Maniilaq Tribal Doctors: A Training Video"

Details: All images in this video are from the 1983 recordings of the Maniilaq Health Services. The original videos are referred to generally as "the Della Keats" collection. These recordings were edited under a 2009 National Library of Medicine award into this introductory program to help explain the types of traditional Inupiaq practices employed in northwestern Alaska to enhance or restore well-being. Commentary is included from an Osteopathic Physician providing initial attempts at forging a common vocabulary of the techniques utilized. [32:40 min]

"Play Again"

Details: At a time when children play more behind screens than outside, PLAY AGAIN explores the changing balance between the virtual and natural worlds. Is our connection to nature disappearing down the digital rabbit hole? This emotionally moving and humorous documentary follows six teenagers who, like the "average American child," spend five to fifteen hours a day behind screens. PLAY AGAIN unplugs these teens and takes them on their first wilderness adventure - no electricity, no cell phone coverage, no virtual reality.

"The Bering Sea: An Ecosystem in Crisis"

Details: The MY Esperanza made a two month long voyage into the Bering Sea to visit some 20 Tribal Communities to collect information about their concerns relating to the Bering Sea. George Pletnikoff, Alaska Oceans Campaigner for Greenpeace speaks to and interviews Tribal Leaders and Members to see where Greenpeace might be able to help solve some of these very serious problems. [12 min]

"Eye to Eye with Ivan"

Details: The Cold War was not fought on any conventional battlefield, and the members of the Alaska National Guard were far from a conventional unit. Native Alaskans stood guard and engaged with the Soviet Union along our nation's western frontier for 50 years. Paul Gray's film provides a thoughtful approach to the complicated issues of cultural contact involving the US and USSR, and Alaskan

8:30 a.m. - 2:30 p.m. (cont.)

villagers within the dramatically changing times in America during the second half of the 20th century. Through stories, photographs, and archival film clips, the men of the Alaska National Guard recall a time when, while the rest of the country was learning how to duck and cover, they were standing on the shores of the Bering Sea, where the Cold War was the coldest.

"Wild Salmon Universe: People and Tradition on the Nushagak River in Alaska's Bristol Bay"

Details: Alaska's Bristol Bay is home to 51 percent of the planet's wild sockeye salmon. The Nushagak River, the subject of this short film, along with the Kvichak River, are alone responsible for 25 percent of the Earth's wild salmon. With such a remarkable resource borne of its lakes and rivers, it's no surprise that nature runs on salmon in Bristol Bay. And all across this corner of Alaska, families and livelihoods depend on salmon, too. This short film is produced in the form of a "photographer's notebook" that is narrated by Alaska photographer Clark James Mishler. In telling about his travels along the Nushagak River, Mishler shares photos and stories of the people he meets in several villages, including Koliganek, New Stuyahok, Ekwok, and Dillingham. Everywhere he goes, whether traveling by skiff or floatplane, or walking the beaches of Bristol Bay, Mishler's camera captures people who hold a deep respect for wild salmon. This film is produced by Dustin Solberg of The Nature Conservancy in Alaska with the iMovie video editing program and relies exclusively on still images. [4:16 min]

"Increase your Bottom Line – Be Energy Smart"

Details: The film summarizes the journey of four diverse Anchorage businesses which have undergone energy efficiency improvements and have reaped the benefits. Businesses that have completed energy efficiency retrofits have lowered operating costs, lowered energy bills, lowered maintenance costs, increased return on investments and increased economic competitiveness. The film tells the unique story of each business and addresses questions business owners should know about energy efficiency. Now is the time for Alaska State Legislation to incentivize private commercial businesses, non-profit organizations and churches to improve their energy efficiency. The commercial sector must be involved to reach Alaska's goal of increasing energy efficiency by fifteen percent by year 2020. Length: 30min.

Moderator: Doug Huntman, ADEC Solid Waste Program

8:30 a.m. - 4:00 p.m.

Climate Change and the National Environmental Policy Act Class

Tubughneng' 3

Details: This class will focus on incorporating climate change considerations into National Environmenntal Policy Act documents and will discuss recent Council on Environmental Quality and Department of the Interior guidance on this topic.

Instructors: Ted A. Boling, US Department of the Interior; Michael Smith, ICF International

9:00 a.m. - 10:15 a.m.

Introduction to Class III Landfills and Top 10 Problems

Tubughneng' 5

Details: Come listen to a review of the Top 10 problems at rural landfills, then stick around to find better ways to manage solid waste in your community.

Presenters: Ted Jacobsen, US Environmental Protection Agency; Doug Huntman, Alaska Department of Environmental Conservation
Moderator: Jeff Raun, Colorado State University - Joint Base Elmendorf-Richardson

10:30 a.m. - 11:45 a.m.

Best Practices for Solid Waste Management in Rural Alaska

Tubughneng' 5

Details: Come learn about best management practices for solid waste management from our local experts.

Presenters: Kit Persson, Alaska Department of Environmental Conservation; Sandra Woods, Alaska Department of Environmental Conservation
Moderator: Jeff Raun, Colorado State University - Joint Base Elmendorf-Richardson

General Assistance Program Tribal Environmental Professionals Community Building Session and Conference Wrap Up

Tikahtnu C

Details: Closing session for all General Assistance Program conference participants. Talking Circle to share how tribal representatives are answering environmental issues at home, and what take home messages came out of the conference this week. Drawing of donated items!

Moderators: Cathy Villa and Tami Fordham, US Environmental Protection Agency

3:30 p.m. - 4:45 p.m.

Resources for Tribal Environmental Advocacy

Tikahtnu D

Details: Panelists share information on their approaches to advocacy and resources for Tribes in environmental program building.

Presenters: Violet Yeaton, Tribal Government of Port Graham; Shawna Larsen, Pacific Environment; David Harrison, Alaska Inter-Tribal Council; Ole Lake, Hooper Bay
Moderator: Richard Porter, Knik Tribal Council

Monday, February 7

3:30 p.m. - 4:45 p.m.
Alaska GAP Peer Assistance Provider Network Activities
Tikahtnu C

Details:This is a closed meeting of the GAP Peer Assistance Network representatives

Moderator: Mahri Lowinger, US Environmental Protection Agency

Wednesday, February 9

9 a.m. - 4 p.m.
Brownfields Tribal Response Program Training
Marriott Hotel

Details: This is a required training for Brownfields grant recipients. This training will be held at the Marriott. Tribal representatives will receive training on Brownfields topics.

Presenter: Mickey Hartnett, Midwest Assistance Center
Moderator: Mary Goolie, US Environmental Protection Agency

Thursday, February 10

8 a.m. - 11:45 a.m.
Statement of Cooperation Executive Steering Committee Meeting
K'enakatnu Executive Board Room

Details: By invitation only. This is a closed session of the steering committee.

9 a.m. - 4 p.m.
Brownfields Tribal Response Program Training
Marriott Hotel

Details: This is a required training for Brownfields recipients. During Day 2 of this two-day training, tribal representatives will receive training on Brownfields topics.

Presenter: Mickey Hartnett, Midwest Assistance Center
Moderator: Mary Goolie, US Environmental Protection Agency

2 p.m. - 4:45 p.m.
Coastal America Alaska Regional Implementation Team Meeting
K'enakatnu Executive Board Room

Details: Annual meeting of the Coastal America Alaska Regional Implementation Team and Regional Principals.

Co-chairs: Jon Kurland, National Marine Fisheries Service; Doug Mutter, US Department of the Interior

Thursday, February 10 (cont.)

3:30 p.m.-4:45 pm
Red Devil Tribal Meeting
Tikahtnu E

Details: This is a closed meeting.

Presenter: Mathy Stanislaus, US Environmental Protection Agency

Friday, February 11

8:15 a.m. - 1:30 p.m.
Oil Spill Recovery Institute Advisory Board Meeting
K'enakatnu Executive Board Room

Details: Semi-annual meeting of the Prince William Sound Oil Spill Recovery Institute Advisory Board. The Oil Spill Recovery Institute was established by the Oil Pollution Act of 1990 to fund and carry out research and development and education on Arctic and sub-Arctic oil spills; spill response technologies; and the assessment of impacts to the environment, economy and lifestyles of Alaskans.

Presenter: Nancy Bird, Oil Spill Recovery Institute

2 p.m. - 4 p.m.
SWANA Alaska Chapter Quarterly Business Meeting
Tubughnenq' 5

Details: The Alaska Chapter of Solid Waste Association of North America (SWANA) will hold their quarterly business meeting. This is a session reserved for Chapter members.

NOTES:

CLEAN UP & REMEDIATION

Monday, February 7
10:30 a.m. - 11:45 a.m.
- ❒ Case Studies: Pore Water Issues at Two Contaminated Sites *Kahtnu 1*

2 p.m. - 3:15 p.m.
- ❒ Cutting PCB Cleanup Costs at Remote Sites: A Case Study of Grain Size Separation *Kahtnu 1*

3:30 p.m. - 4:45 p.m.
- ❒ Environmental and Public Health Agencies: Their Roles and How They Partner to Address Public Health Concerns at Contaminated Sites *Kahtnu 1*

Tuesday, February 8
9 a.m. - 10:15 a.m.
- ❒ Environmental Analysis and Decision Making Processes *Tikahtnu E*
- ❒ Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 1 of 2) *Tikahtnu C*

10:30 a.m. - 11:45 a.m.
- ❒ Environmental Restoration Efforts at Federal Sites in Alaska *Tikahtnu E*
- ❒ Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 2 of 2) *Tikahtnu C*

2 p.m. - 3:15 p.m.
- ❒ Amchitka Underground Nuclear Test Site Monitoring Program *Tikahtnu E*
- ❒ Solid Waste and Contaminants in Alaska: A Talking Circle (Part 1 of 2) *Tikahtnu C*

3:30 p.m. - 4:45 p.m.
- ❒ Solid Waste and Contaminants in Alaska: A Talking Circle (Part 2 of 2) *Tikahtnu C*
- ❒ Federal Site Remediation Roundtable *Tikahtnu E*

Wednesday, February 9
9 a.m. - 10:15 a.m.
- ❒ Hydrocarbon Risk Calculator (Part 1 of 2) – Concepts, Regulatory Status, Data Needs, Closure Decisions *K'enakatnu Executive Board Room*

10:30 a.m. - 11:45 a.m.
- ❒ Hydrocarbon Risk Calculator (Part 2 of 2) - Case Studies *K'enakatnu Executive Board Room*

2 p.m. - 3:15 p.m.
- ❒ Vapor Intrusion Evaluation Case Studies (Part 1 of 2) *K'enakatnu Executive Board Room*

Thursday, February 10
9 a.m. - 10:15 a.m.
- ❒ Native American Lands Environmental Mitigation Program *Tikahtnu D*

CLIMATE CHANGE

Monday, February 7
2 p.m. - 3:15 p.m.
- ❒ Recent Advances in Climate Science in Alaska *Tubughneq' 5*

3:30 p.m. - 4:45 p.m.
- ❒ Toward a Coordinated Response to Climate Adaptation in Alaska *Tubughneq' 5*

Tuesday, February 8
10:30 a.m. - 11:45 a.m.
- ❒ Climate Adaptation and Environmental Justice *Tubughneq' 5*

3:30 p.m. - 4:45 p.m.
- ❒ Energy and Climate Action in Alaskan Communities: Resources, Examples and Discussion *K'enakatnu Executive Board Room*
- ❒ Tribal Climate Change Training and Technical Assistance Efforts *Kahtnu 2*

Wednesday, February 9
9 a.m. - 10:15 a.m.
- ❒ Native Voices: Traditional Knowledge & Climate Change (Part 1 of 2) *Kahtnu 2*
- ❒ Shipping in Arctic Waters: Implications of Climate Change *Tubughneq' 5*

10:30 a.m. - 11:45 a.m.
- ❒ Native Voices: Traditional Knowledge & Climate Change (Part 2 of 2) *Kahtnu 2*

Thursday, February 10
9 a.m. - 10:15 a.m.
- ❒ Climate Science in the Arctic and What it Means to Alaskans *Kahtnu 2*

10:30 a.m. - 11:45 a.m.
- ❒ Climate Change in Northern Communities: Canadian Federal and Municipal Perspectives *Kahtnu 2*
- ❒ New Landscape Conservation Cooperatives in Alaska to Address Climate Change *Tubughneq' 3*

Friday, February 11
8:30 a.m. - 4 p.m.
- ❒ Climate Change and the National Environmental Policy Act Class *Tubughneq' 3*

ENERGY

Monday, February 7
10:30 a.m. - 11:45 a.m.
- ❒ Tribal Mining Review in Lower 48 *Tubughneq' 4*
- ❒ Oil Drilling Basics for On-Shore and Off-Shore Exploration *Tubughneq' 5*

2 p.m. - 3:15 p.m.
- ❒ Is Small Scale Nuclear Energy An Option for Alaska? *Tubughneq' 4*

3:30 p.m. - 4:45 p.m.
- ❒ Human Health Implications of Coal Combustion in Alaska *Tubughneq' 4*

Agenda by Subject

ENERGY (CONT.)

Tuesday, February 8
9 a.m. - 10:15 a.m.
❒ Susitna Hydro Project *Tubughneng' 4*
❒ The Living Building Challenge and Net Zero Energy *Kahtnu 1*

10:30 a.m. - 11:45 a.m.
❒ Teaching Alaska's Miners About Alaska's Fisheries *Tubughneng' 4*
❒ Using Natural Resources for Solving Energy Problems *K'enakatnu Executive Board Room*

2 p.m. - 3:15 p.m.
❒ Energy Efficiency Opportunities in Alaska *Tubughneng' 4*

3:30 p.m. - 4:45 p.m.
❒ North Slope Methane Hydrates and Carbon Dioxide Exchange *Tubughneng' 4*

ENVIRONMENTAL EDUCATION & TRAINING

Wednesday, February 9
9 a.m. - 10:15 a.m.
❒ Experiences Needed for Students to Become Environmental Leaders *Kahtnu 1*

10:30 a.m. - 11:45 a.m.
❒ Drumbeats: Place-Based Environmental Education Certificate for Rural Alaska *Kahtnu 1*

2 p.m. - 3:15 p.m.
❒ Sustainable Energy in Environmental Education *Kahtnu 1*

3:30 p.m. - 4:45 p.m.
❒ Promoting Rural Workforce Development through Environmental Internships *Kahtnu 1*

ENVIRONMENTAL JUSTICE

Tuesday, February 8
10:30 a.m. - 11:45 a.m.
❒ Climate Adaptation and Environmental Justice *Tubughneng' 5*

Wednesday, February 9
9 a.m. - 10:15 a.m.
❒ Federal Interagency Coordination on Environmental Justice Issues (Part 1 of 2) *Tikahtnu C*

10:30 a.m. - 11:45 a.m.
❒ Contaminants in Subsistence Foods *Tikahtnu D*
❒ Federal Interagency Coordination on Environmental Justice Issues (Part 2 of 2) *Tikahtnu C*

2 p.m. - 3:15 p.m.
❒ Tribal and Community Perspectives on Environmental Justice Issues in Alaska (Part 1 of 2) *Tikahtnu C*

ENVIRONMENTAL JUSTICE (CONT.)

Wednesday, February 9
3:30 p.m. - 4:45 p.m.
❒ Working Together to Address Environmental Justice Issues Identified by Tribal and Community Panelists (Part 2 of 2) *Tikahtnu C*

ENVIRONMENTAL REGULATIONS

Monday, February 7
3:30 p.m. - 4:45 p.m.
❒ Freshwater and Coastal Surveys by the Alaska Department of Environmental Conservation *Tikahtnu E*

Tuesday, February 8
9 a.m. - 10:15 a.m.
❒ Renovate Right: Important Lead Hazard Information for Families, Child Care Providers and Schools *Tubughneng' 5*

2 p.m. - 3:15 p.m.
❒ Fugitive Dust - What is it? Why should I care? *Tubughneng' 5*

3:30 p.m. - 4:45 p.m.
❒ Department of Environmental Conservation Water Quality, Permits and Communications *Tubughneng' 5*

Thursday, February 10
9 a.m. - 10:15 a.m.
❒ Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 1 of 2) *Kahtnu 1*

10:30 a.m. - 11:45 a.m.
❒ Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues (Part 1 of 2) *Tikahtnu C*
❒ Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 2 of 2) *Kahtnu 1*

2 p.m. - 3:15 p.m.
❒ Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues (Part 2 of 2) *Tikahtnu C*

FEDERAL FACILITIES

Tuesday, February 8
9 a.m. - 10:15 a.m.
❒ Environmental Analysis and Decision Making Processes *Tikahtnu E*

10:30 a.m. - 11:45 a.m.
❒ Environmental Restoration Efforts at Federal Sites in Alaska *Tikahtnu E*

2 p.m. - 3:15 p.m.
❒ Amchitka Underground Nuclear Test Site Monitoring Program *Tikahtnu E*

FEDERAL FACILITIES (CONT.)

3:30 p.m. - 4:45 p.m.
❒ Federal Site Remediation Roundtable
Tikahtnu E

FISH, WILDLIFE & HABITAT

Monday, February 7
10:30 a.m. - 11:45 a.m.
❒ Dealing with Invasive Plants: Strategies, Outreach and Success in Alaska *Tubughneng' 3*

2 p.m. - 3:15 p.m.
❒ Marine Invasive Species in Alaska *Tubughneng' 3*

3:30 p.m. - 4:45 p.m.
❒ An Overview of Invasive Species in Alaska *Tubughneng' 3*

Tuesday, February 8
9 a.m. - 10:15 a.m.
❒ Endangered Species Research in Glacier Bay National Park and Preserve *Tubughneng' 3*

10:30 a.m. - 11:45 a.m.
❒ Candidates for Listing as Threatened/Endangered Species in Alaska *Tubughneng' 3*

2 p.m. - 3:15 p.m.
❒ Workshop on the Conservation/Recovery Plan for Polar Bears in Alaska (Part 1 of 2) *Tubughneng' 3*

3:30 p.m. - 6 p.m.
❒ Workshop on the Conservation/Recovery Plan for Polar Bears in Alaska (Part 2 of 2) *Tubughneng' 3*

Wednesday, February 9
10:30 a.m. - 11:45 a.m.
❒ What is Coastal and Marine Spatial Planning? *Tubughneng' 3*

2 p.m. - 3:15 p.m.
❒ Marine Debris Workshop (Part 1 of 2) *Tubughneng' 3*

3:30 p.m. - 4:45 p.m.
❒ Marine Debris Workshop (Part 2 of 2) *Tubughneng' 3*

Thursday, February 10
10:30 a.m. - 11:45 a.m.
❒ New Landscape Conservation Cooperatives in Alaska to Address Climate Change *Tubughneng' 3*

GENERAL ASSISTANCE PROGRAM

Monday, February 7
10:30 a.m. - 11:45 a.m.
❒ Effective and Meaningful Tribal Consultation: Perspectives and Experiences *Tikahtnu C*
❒ 7 Generations Training: A Tool for Tribes *Tikahtnu D*

2 p.m. - 3:15 p.m.
❒ Tools for Tribal Governments on Environmental Planning *Tikahtnu D*
❒ Alaska Natives and Climate Change: Reactivating Indigenous Perceptions *Tikahtnu E*
❒ Cultural Sustainability in Environmental Program Development *Tikahtnu C*
❒ Alaska GAP Peer Assistance Provider Network Activities *Tikahtnu C*

3:30 p.m. - 4:45 p.m.
❒ Tribal Perspectives on Planning For Climate Change *Tikahtnu D*

Tuesday, February 8
9 a.m. - 10:15 a.m.
❒ Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 1 of 2) *Tikahtnu C*
❒ Success Stories in Alaska Small Demonstration Projects *Tikahtnu D*

10:30 a.m. - 11:45 a.m.
❒ Alaska Brownfields Topics: Tribal, State, and US Environmental Protection Agency Response Programs (Part 2 of 2) *Tikahtnu C*

2 p.m. - 3:15 p.m.
❒ Environmental Protection Agency Civil/Criminal Enforcement Procedures for Environmental Violations *Tikahtnu D*
❒ Solid Waste and Contaminants in Alaska: A Talking Circle (Part 1 of 2) *Tikahtnu C*

3:30 p.m. - 4:45 p.m.
❒ Solid Waste and Contaminants in Alaska: A Talking Circle (Part 2 of 2) *Tikahtnu C*

Wednesday, February 9
9 a.m. - 10:15 a.m.
❒ Federal Interagency Coordination on Environmental Justice Issues (Part 1 of 2) *Tikahtnu C*

10:30 a.m. - 11:45 a.m.
❒ Federal Interagency Coordination on Environmental Justice Issues (Part 2 of 2) *Tikahtnu C*

2 p.m. - 3:15 p.m.
❒ Tribal and Community Perspectives on Environmental Justice Issues in Alaska (Part 1 of 2) *Tikahtnu C*

GENERAL ASSISTANCE PROGRAM (CONT.)

3:30 p.m. - 4:45 p.m.
- ❒ General Assistance Program (GAP) Online *Tikahtnu D*
- ❒ Baseline Water Quality Monitoring - Lessons Learned *TIkahtnu E*
- ❒ Working Together to Address Environmental Justice Issues Identified by Tribal and Community Panelists (Part 2 of 2) *Tikahtnu C*

Thursday, February 10
9 a.m. - 10:15 a.m.
- ❒ How to Perform a Village-Based Dump Site Assessment: A Scammon Bay Case Study *Tikahtnu C*
- ❒ Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 1 of 2) *Kahtnu 1*

10:30 a.m. - 11:45 a.m.
- ❒ Environmental Protection Agency's Updates in National Mining Policy and Regulatory Development (Part 1 of 2) *Tikahtnu C*
- ❒ Federal Actions and Next Steps on Leaded Aviation Gasoline (Part 2 of 2) *Kahtnu 1*

2 p.m. - 3:15 p.m.
- ❒ Environmental Protection Agency's Update and Listening Session on Alaska and National Mining Issues *Tikahtnu C*
- ❒ GAP Solid Waste Solutions *Kahtnu 1*

3:30 p.m. - 4:45 p.m.
- ❒ Alaska Youth and Climate Change: Building a Program That Works *Kahtnu 2*
- ❒ General Assistance Program (GAP) Peer Assistance Providers Open Working Session for Grants Management Assistance and GAP Proposal Development *Tikahtnu C*
- ❒ FILM FESTIVAL: People of the Seal film *Tubughneq' 4*
- ❒ Resources for Tribal Environmental Advocacy *Tikahtnu D*

Friday, February 11
8:30 a.m. - 10:15 a.m.
- ❒ GAP: Topics in Environmental Education and Outreach *Tikahtnu C*

8:30 a.m. - 12 p.m.
- ❒ FILM FESTIVAL: Film event *Tubughneq' 4*

10:30 a.m. - 11:45 a.m.
- ❒ General Assistance Program Tribal Environmental Professionals Community Building Session and Conference Wrap Up *Tikahtnu C,D,E & F*

GREEN BUILDING/GREEN INFRASTRUCTURE

Tuesday, February 8
9 a.m. - 10:15 a.m.
- ❒ The Living Building Challenge and Net Zero Energy *Kahtnu 1*

10:30 a.m. - 11:45 a.m.
- ❒ Breaking the Barriers to Green Building *Kahtnu 1*

2 p.m. - 3:15 p.m.
- ❒ Introduction to Conservation Subdivisions *Kahtnu 1*

3:30 p.m. - 4:45 p.m.
- ❒ Case Studies: Conservation Subdivisions in Alaska *Kahtnu 1*

HUMAN POPULATION

Monday, February 7
10:30 a.m. - 11:45 a.m.
- ❒ Human Overpopulation: Root Cause of Environmental Degradation *Tikahtnu E*

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

Thursday, February 10
9 a.m. - 10:15 a.m.
- ❒ The National Environmental Policy Act De-Mystified *Tubughneq' 3*

10:30 a.m. - 11:45 a.m.
- ❒ The National Environmental Policy Act: Tools and Tips *Tubughneq' 5*

2 p.m. - 3:15 p.m.
- ❒ NEPA in the Courtroom: Case Law *Tubughneq' 3*

3:30 p.m. - 4:45 p.m.
- ❒ National Environmental Policy Act, Marine Fisheries and Public Participation *Tubughneq' 3*

Friday, February 11
8:30 a.m. - 4 p.m.
- ❒ Climate Change and the National Environmental Policy Act Class *Tubughneq' 3*

OIL SPILL PLANNING & RESPONSE

Wednesday, February 9
9 a.m. - 10:15 a.m.
- ❒ The Arctic Environmental Response Management Application (ERMA) *Tubughneq' 4*

10:30 a.m. - 11:45 a.m.
- ❒ Oil Development in the Arctic *Tubughneq' 4*

2 p.m. - 3:15 p.m.
- ❒ Lessons Learned: Information Flow Comparison – The Selendang Ayu and the Deepwater Horizon Incidents *Tubughneq' 4*

OIL SPILL PLANNING & RESPONSE (CONT.)

3:30 p.m. - 4:45 p.m.
- ❒ Area Contingency Planning for Oil Spill Response in Alaska *Tubughneng' 4*

RURAL ISSUES

Wednesday, February 9
9 a.m. - 10:15 a.m.
- ❒ US Forest Service Listening Session on Sacred Sites Policy (Part 1 of 2) *Tikahtnu E*

10:30 a.m. - 11:45 a.m.
- ❒ US Forest Service Listening Session on Sacred Sites Policy (Part 2 of 2) *Tikahtnu E*
- ❒ Contaminants in Subsistence Foods *Tikahtnu D*

2 p.m. - 3:15 p.m.
- ❒ Geographic Information System Rural Alaska *Tikahtnu D*
- ❒ Community Gardening Benefits in Rural Alaska *Tikahtnu E*

Thursday, February 10
9 a.m. - 10:15 a.m.
- ❒ Hazard Communication Standard *Tikahtnu E*
- ❒ Native American Lands Environmental Mitigation Program *Tikahtnu D*
- ❒ How to Perform a Village-Based Dump Site Assessment: A Scammon Bay Case Study *Tikahtnu C*

10:30 a.m. - 11:45 a.m.
- ❒ Environmental Issues Associated with Meth Lab Cleanup *Tikahtnu D*

2 p.m. - 3:15 p.m.
- ❒ Burn Unit Pilot Project *Tikahtnu E*

SCIENCE & TECHNOLOGY

Wednesday, February 9
9 a.m. - 10:15 a.m.
- ❒ Hydrocarbon Risk Calculator (Part 1 of 2) – Concepts, Regulatory Status, Data Needs, Closure Decisions *K'enakatnu Executive Board Room*

10:30 a.m. - 11:45 a.m.
- ❒ Hydrocarbon Risk Calculator (Part 2 of 2) - Case Studies *K'enakatnu Executive Board Room*

2 p.m. - 3:15 p.m.
- ❒ Vapor Intrusion Evaluation Case Studies (Part 1 of 2) *K'enakatnu Executive Board Room*

3:30 p.m. - 4:45 p.m.
- ❒ Vapor Intrusion Evaluation Case Studies (Part 2 of 2) *K'enakatnu Executive Board Room*

SOLID WASTE & RECYCLING

Thursday, February 10
9 a.m. - 10:15 a.m.
- ❒ How to Organize a Household Hazardous Waste Collection Program *Tubughneng' 4*
- ❒ How to Perform a Village-Based Dump Site Assessment: A Scammon Bay Case Study *Tikahtnu C*

10:30 a.m. - 11:45 a.m.
- ❒ Impacts of Poor Solid Waste Management on Village Health *Tubughneng' 4*

2 p.m. - 3:15 p.m.
- ❒ Rural Development Water and Environmental Program Overview and Application Process (Part 1 of 2) *Tubughneng' 5*
- ❒ Burn Unit Pilot Project *Tikahtnu E*
- ❒ GAP Solid Waste Solutions *Kahtnu 1*

3:30 p.m. - 4:45 p.m.
- ❒ Landfill Alternatives/Resource Recovery *Kahtnu 1*
- ❒ Rural Development Water and Environmental Program Overview and Application Process (Part 2 of 2) *Tubughneng' 5*

Friday, February 11
9 a.m. - 10:15 a.m.
- ❒ Introduction to Class III Landfills and Top 10 Problems *Tubughneng' 5*

10:30 a.m. - 11:45 a.m.
- ❒ Best Practices for Solid Waste Management in Rural Alaska *Tubughneng' 5*

YOUTH

Monday, February 7
10:30 a.m. - 11:45 a.m.
- ❒ Youth Environmental Program Showcase *Kahtnu 2*

2 p.m. - 3:15 p.m.
- ❒ Alaskan Youth Environmental Engagement: A Poster Session *Upper Lobby 3rd Floor*

3:30 p.m. - 4:45 p.m.
- ❒ Recipe for Creating a Successful Youth-Led Program *Kahtnu 2*

Tuesday, February 8
9 a.m. - 10:15 a.m.
- ❒ Youth Environmental Summit (Part 1 of 2) *Kahtnu 2*

10:30 a.m. - 11:45 a.m.
- ❒ Youth Environmental Summit (Part 2 of 2) *Kahtnu 2*

2 p.m. - 3:15 p.m.
- ❒ Youth and Adult Partnerships Showcase *Kahtnu 2*

Attention Rural Landfill Operators and Administrators!

Solid Waste Administration (SWA) & Rural Alaska Landfill Operator (RALO)

2011 TRAINING SCHEDULE

RALO	March 15-17	Anchorage
	May 10-12	Anchorage
RALO	April 12-14	Bethel
SWA	May 24-26	Anchorage

Alaska Forum, ITEP, and SWANA are pleased to offer two solid waste training courses designed for landfill operators in Rural Alaska communities. Courses are offered at no cost to the communities, thanks to supporting grants from the USDA and EPA OSWER.

Course Description: RALO

The Rural Alaska Landfill Operator (RALO) course is for the designated village landfill operator and administrator managing a Class III landfill or open dump and focuses on the duties of the landfill operator, personal safety, and the safety of the village. Participants will learn about landfill regulations and requirements, household hazardous waste, waste separation and screening, waste reduction and segregation, recycling, personal protection equipment, and much more. These courses are hosted by AK Forum, Inc. with trainers and expertise provided in cooperation with Solid Waste Administration of North America (SWANA), Alaska Chapter. Total Reclaim will demonstrate packaging, staging, and shipping hazardous waste for recycling. Also, Manny Masony of Evert's Air Cargo will address backhauling hazardous waste by aircraft and Peter Melde of AK Forum will discuss a funding opportunity that can support community efforts to purchase personal safety equipment and hazardous waste storage and shipping materials through a USDA Technical Assistance and Training (TAT) grant administered by AK Forum.

For RALO applications and information:
Website: www.akforum.org Email: info@akforum.org Phone/Fax (toll free): (888) 301-0185

Course Description: SWA Identifying Hazards and Developing Solutions in Rural Alaska

This course is specifically designed for community leaders, solid waste managers, and other decision makers in Alaska native villages who are working with on-going solid waste management programs.

Course Highlights: Solid Waste Administration

- Identifying Hazardous Materials That Should NOT Go Into Your Landfill and Burn Boxes
- How to Collect, Stage, Recycle/Dispose of Household Hazardous Waste
- Outreach Techniques on Environmental and Health Issues
- Regional, Municipal, and Tribal Collaboration
- Developing Fee Systems and Collection Programs
- C&D Waste Disposal Options
- Preparing Action Plans, Grants, and Proposals

For SWA applications and information:
Call Jennifer Williams 907-250-3826 email: jennifer.williams@nau.edu website: www.nau.edu/itep

The Alaska Forum will provide a limited number of (up to) $500 reimbursement scholarships for qualified attendees' travel expenses (lodging and airfare) per training, through grant support from the USDA. Participants must be pre-approved. See course information for requirements.

Participants must make their own travel arrangements and should plan to arrive before 8:00 am on the first morning of class and plan to leave after 5:00pm on the final day of class.

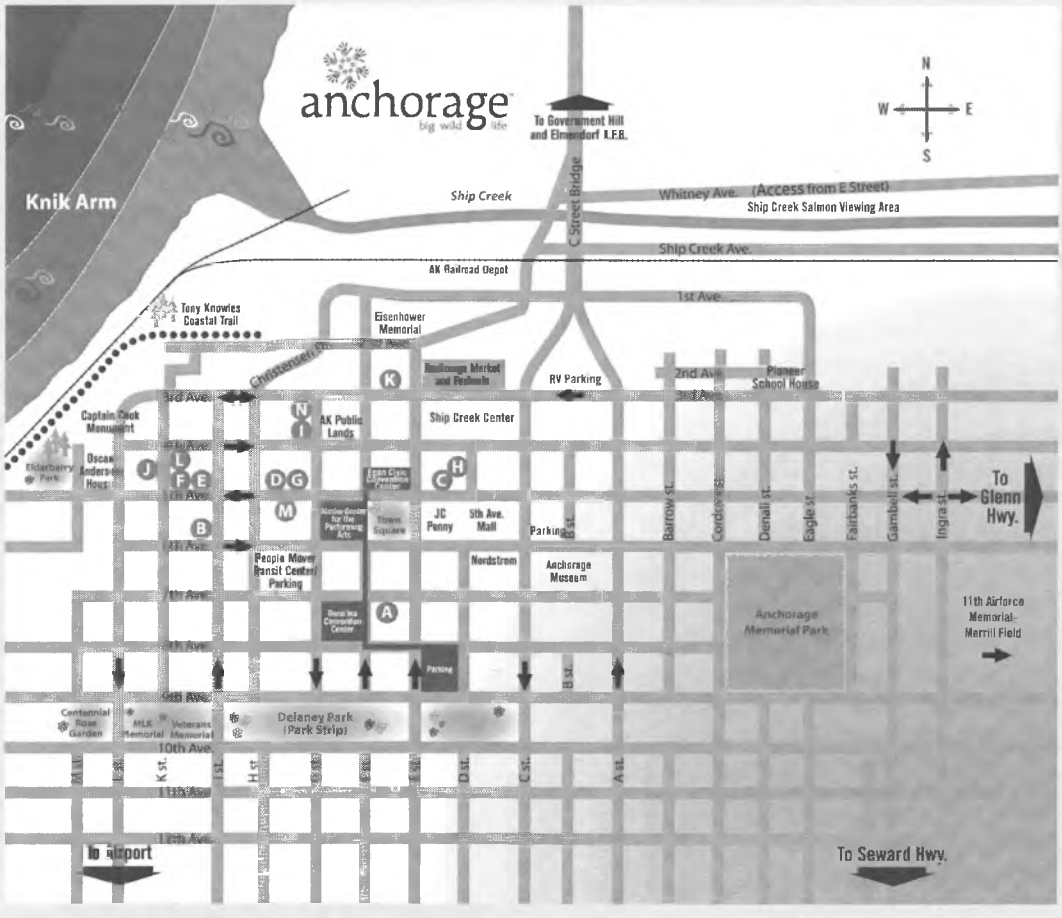
Conference Maps

A. Anchorage Marriott Downtown
820 W. 7th Ave Anchorage, AK 99501

B. Dena'ina Convention Center
600 W. Seventh Ave Anchorage, AK 99510

Welcome to the Alaska Forum on the Environment

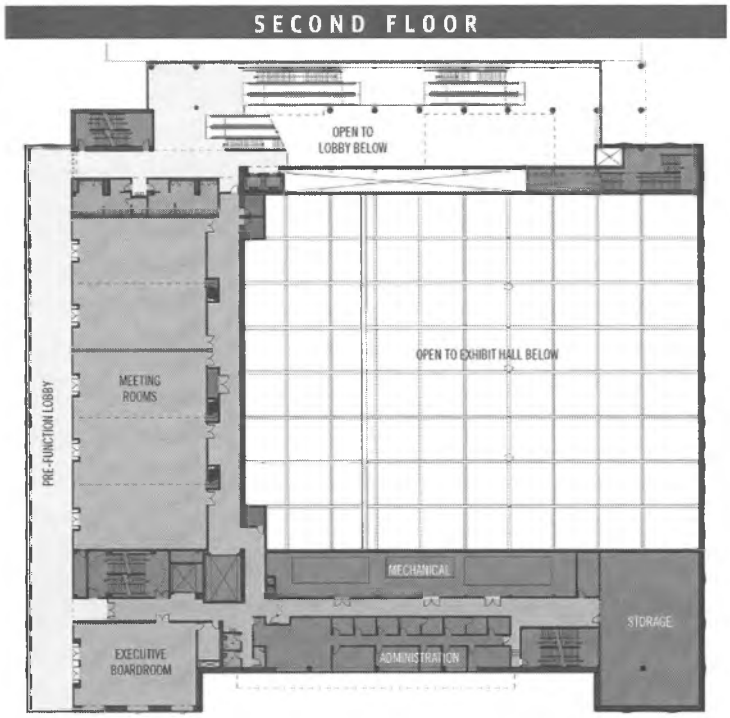
Downtown Anchorage Restaurant Map



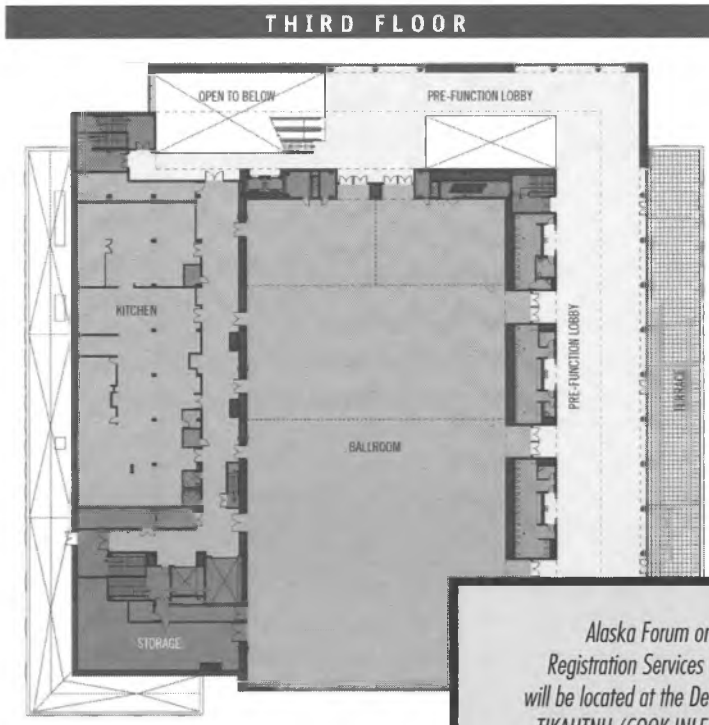
- **A** Dianne's Restaurant
  907.279.7243 / 550 W 7th Ave
  Homemade soups, breads and desserts
- **B** Geno and Sal's Famous New York Grill at Platinum Jaxx
  907.344.5900 / 901 W 6th Ave
  Informal lunch & dinner
- **C** Ginger
  907.929.3680 / 425 W 5th Ave
  Asian fusion/Pacific Rim
- **D** Glacier Brewhouse
  907.274.2739 / 737 W 5th Ave
  Brewpub lunch & dinner
- **E** Fletcher's / Hotel Captain Cook
  907.343.2218 / 939 W 5th Ave
  Classic pub fare
- **F** Whale's Tail / Hotel Captain Cook
  907.343.2220 / 939 W 5th Ave
  Lunch, dinner and small plates
- **G** ORSO
  907.222.3232 / 737 W 5th Ave
  Italian lunch & dinner
- **H** Phyllis' Seafood Cafe and Salmon Bake
  907.274.6576 / 436 D St
  Alaskan seafood; lunch, dinner
- **I** Sacks Cafe and Restaurant
  907.276.3546 / 328 G St
  Creative lunch & dinner
- **J** Simon and Seafort's Saloon and Grill
  907.274.3502 / 420 L St
  Creative Alaskan cuisine
- **K** Sizzlin' Cafe
  907.929.5400 / 523 W 3rd Ave
  Homestyle lunch
- **L** Snow City Cafe
  907.272.2489 / 1034 W 4th Ave
  Gourmet breakfast & lunch
- **M** Solstice Bar and Grill
  907.276.7676 / 720 W 5th Ave
  Global taste with local flair
- **N** Urban Greens
  907.276.0333 / 304 G St
  Subs & salads with ethnic flair

DENA'INA CENTER FLOORPLANS

2nd FLOOR: KAHTNU (KENAI) - MEETING ROOMS 1 & 2
TUBUGHNENQ' (TYONEK) - MEETING ROOMS 3, 4 & 5
K'ENAKATNU (KNIK) EXECUTIVE BOARD ROOM



3rd FLOOR: TIKAHTNU (COOK INLET) - BALLROOM



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Registration Services and all Keynote Events
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TIKAHTNU (COOK INLET) BALLROOM, 3rd Floor

2011

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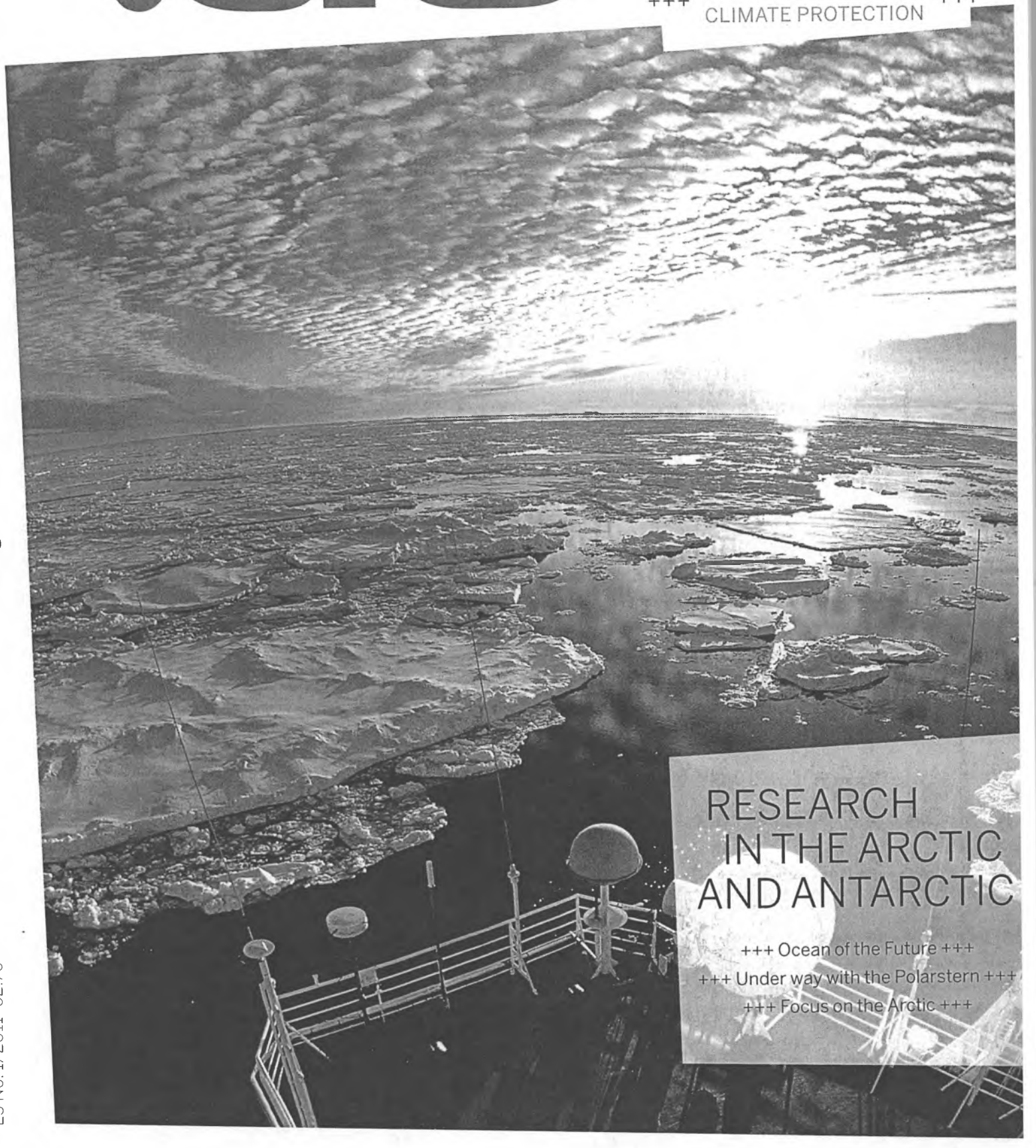
+++ MARINE RESEARCH AND CLIMATE PROTECTION +++



RESEARCH IN THE ARCTIC AND ANTARCTIC

+++ Ocean of the Future +++
+++ Under way with the Polarstern +++
+++ Focus on the Arctic +++

EDITORIAL & CONTENTS

"Globalization of Enlightenment"

"What we are witnessing at present in Egypt, but not only there, is a turning point, a historic watershed. We don't know how the situation in Egypt, in the Arab world countries or in North Africa will develop. However, it's already clear that nothing will be as it was before." These were the words Federal Foreign Minister Guido Westerwelle used in early February to begin his speech to the German Bundestag about the situation in Egypt. Fascinated and spellbound, people in Germany followed developments in Tunis, Cairo and other cities. And, naturally, during those days the images of the year 1989 came back into people's minds – memories of the peaceful revolution of the people in Dresden, Leipzig and East Berlin that ended with German unification. Freedom and democracy. People in the Arab world also want to be accepted as free individuals, want human rights, want opportunities and to take part in what the Federal Foreign Minister calls "a globalization of enlightenment, a globalization of values and a globalization of civil liberties". The community of states is thinking about how it can support and accompany the transformation process that will bring the Near and Middle East both stability and peace (see page 6).

For very different grounds another region of the world is also in the limelight: the Arctic. Its geopolitical importance is growing for various reasons. Here, too, many questions have to be solved jointly and intergovernmentally. Experts on the Arctic will be gathering in Berlin in mid-March for a major conference. Discover more in our special feature on the subject (from page 40).

I wish you all a pleasurable read,
Peter Hintereder, Editor-in-Chief

Cover: Polarstern, the research ship of the Alfred Wegener Institute, is on course

Polar adventure: a ship under way in the Arctic Ocean. The geopolitical importance of the region has been increasing because of its resources, trade routes and climate change

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Following the changes in the Arab world, Germany supports the democratic transformation

08 Bundeswehr Reform
Small, more effective, better adapted to new challenges – the German armed forces are facing an ambitious reorganization

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Dieter Graumann, the new president of the Central Council of Jews in Germany, would like to see a self-confident culture of debate

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Economics professor Karl-Heinz Paqué argues for national debt limits and a new European industrial policy

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Climate change is moving the Arctic into the focus of scientific and geopolitical interest. A special feature on marine, polar and climate research

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German polar research has an excellent international reputation. It is interdisciplinary and international – and still a fascinating adventure

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Kotzebue Meeting, July 7, 2011

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NWTF Meeting

Kotzebue

July 7th, 2011

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Univ of the Arctic – Mike Sfraga

4 Chukchi Sea Program Update
Shell Oil – Colleen McCarthy

5 Subsistence Mapping in NWAB
NWAB – Tom Okleasik

6 State/Federal Oil Spill Planning & Response
AKDEC – Larry Dietrick

7 Arctic Pollution Response
US Coast Guard – CPT Adam Shaw

8 Oil Spill Prevention & Response in the US Arctic
The Pew Foundation – Marilyn Heiman

9 Lessons Learned from the Deep Water Horizon
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1
Agenda

Alaska Northern Waters Task Force (ANWTF)
Agenda for Kotzebue and Nome Meetings: July 6-9, 2011

KOTZEBUE:

July 7th[th], Thursday, Northwest Arctic Borough Assembly Chambers

Presenters on the following resource development topics:

- **8:30 to 9 a.m. UAF Workshop Findings: Arctic Marine Shipping Assessment Presentation: Mike Sfraga, University of Alaska Fairbanks, Vice-Chancellor**
- **9 to 9:30 a.m. Presentation by Shell on Arctic off shore development plans: Colleen McCarthy, Communications Manager, Shell Oil and Wayne Leighty, Commercial Regulatory Analyst, Shell Oil**
  9:30 to 10 a.m. Presentation by Tom Okleasik, Planning Director, Northwest Arctic Borough, Subsistence mapping

-15 minute break-

- **10:15 to 11:15 a.m. Presentation on oil spill response capabilities and cooperative agreements with other Arctic nations:**
  - **Department of Environmental Conservation, Larry Dietrick, Director of Division of Spill Prevention and Response**
  - **U.S. Coast Guard, Captain Adam Shaw**

Lunch break from 11:30 to 1 p.m.

- **1:15 to 2 p.m. PEW Environment Group/Marilyn Heiman, Director Pew Environment Group, U.S. Arctic Program**
- **2 to 3 p.m. Lessons Learned Deep Water Horizon: Fran Ulmer, Chair, U.S. Arctic Research Commission**
- **3:30-5:30 Presentation by Rep. Joule on Northern Waters Task Force followed by public testimony on Northern Waters Issues**

Flight from Kotzebue to Nome: Flt. 153 departing at 7:29 pm landing at 8:11 pm

2
Presenters

NORTHERN WATERS TASK FORCE
PRESENTERS JULY 7th, 2011
KOTZEBUE, ALASKA

Mike Sfraga, University of Alaska Fairbanks, Vice-Chancellor:

Mike Sfraga assumed responsibilities as vice chancellor for students in January 2010. As vice chancellor, he oversees a broad range of departments that serve UAF's students, including admissions, the registrar's office, financial aid, student activities and residence life.

Sfraga's career at the university has spanned nearly 25 years. During that time, he has served in a variety of student services and academic positions, from his first job at UAF as a residence hall director to associate vice president for student and enrollment services at UA statewide. Most recently he served as director of the UA Geography Program and associate dean of the School of Natural Resources and Agricultural Sciences.

Sfraga earned his bachelor's degree and a doctoral degree in geography and northern studies from UAF. He also holds a master's degree from Bowling Green State University. Sfraga's areas of academic concentration are in polar geography, exploration, geography of the circumpolar North, geography of Alaska and the history of field science. He is the author of *Bradford Washburn: A Life of Exploration* (2004), the first comprehensive biography of celebrated American explorer and photographer Bradford Washburn.

He is currently the co-director of the University of the Arctic's Institute for Applied Circumpolar Policy and associate editor of *Polar Geography*. Sfraga also serves on numerous nonprofit boards including the Denali Education Center, the Alaska Geographic Association and the Institute of the North.

Colleen McCarthy, Communications Manager, Shell Oil:

Colleen McCarthy is a Communications Manager for Shell Oil. She previously served as the Community Relations Director for ConocoPhillips, the Industrial Business Development Lead for CH2MHILL and has twenty years experience with the federal government in Alaska working for the Mineral Management Services and the Bureau of Land Management. Colleen is a graduate of Montana College of Mineral Science and Technology and holds a bachelor's degree in geological engineering.

Wayne Leighty, Commercial Regulatory Analyst, Shell Oil:

Wayne Leighty was born and raised in Juneau and has worked in Alaska as a wilderness guide, scientific researcher, General Manager in the tourism industry, and Chief of Staff in the Legislature. Wayne has studied Alaska's natural systems and energy industry extensively, publishing papers on carbon sequestration in the Tongass National Forest, electricity conservation in Juneau, and the impacts of tax policy on economically optimal oil production from the North Slope. He has also earned bachelors degrees in environmental science and economics, masters degrees in resource economics, transportation technology, and business administration, and a doctorate from the sustainable transportation energy program at UC Davis. Wayne previously worked for Shell in the downstream business (chemicals) and is now a commercial regulatory analyst with Shell's Alaska Venture.

Larry Dietrick, Director, Spill Prevention and Response Prevention, Department of Environmental Conservation:

Larry Dietrick is the Director of the Division of Spill Prevention and Response for the Alaska Department of Environmental Conservation. The Division was created in response to the 1989 Exxon Valdez oil spill and is responsible for coordinating and implementing oil and hazardous substance spill prevention, preparedness and response in Alaska. The Division has been instrumental in implementing the recommendations made by the Alaska Oil Spill Commission in follow up to the catastrophic spill in Prince William Sound and major legislative initiatives passed by the Alaska State Legislature in cooperation with other state and federal response agencies, response action contractors, citizen's oversight committees, industry and the public. The Division has developed and pioneered many of the response tools that enable Alaska to have one of the most advanced oil spill safety nets in the nation. Mr. Dietrick has worked for the Department since 1976 and has served in numerous capacities related to oil spill planning, preparedness and response. In addition he served with the Ohio Environmental Protection Agency prior to his work in Alaska. Mr. Dietrick has extensive experience in environmental programs and a strong foundation in the technical requirements, procedural aspects and legal framework of oil spill response. He has a good working knowledge of oil and gas exploration in Alaska including the Trans-Alaska Pipeline System and North Slope oil and gas development. His prior experience also includes participation in the application and design review of the Alaska Natural Gas Transportation System from 1978 – 1982, which produced a complete design package and right of way alignment for a large diameter chilled gas pipeline from the North Slope to the Canadian border. He has also participated in development of the initial requirements for offshore oil and gas exploration in Alaska's Arctic and was a member of the Incident Specific Preparedness Review for the BP Deepwater Horizon Oil Spill. Mr. Dietrick has completed graduate studies at the University of Cincinnati, Ohio State University and received a Master of Science degree in Environmental Quality Science from the University of Alaska in 1975.

Captain Adam J. Shaw, United States Coast Guard:

Captain Shaw of San Jose, California, graduated from the United States Coast Guard Academy, earning a Bachelor's of Science degree in Management and Economics. He also earned a Master's of Public Administration degree from the University of Alaska. He holds a Merchant Mariner's License and is certified in the National Incident Management System. His Coast Guard career covers a broad range of assignments, including: coordinating Search and Rescue and Law Enforcement missions in the Gulf of Alaska; supervising a multi-million dollar acquisition project for the replacement of inland buoy tenders; managing inland waterways and aids to navigation for the entire California coast; and conducting International Port Security assessments in Africa, Europe and the Middle East. Captain Shaw also served on several Coast Guard Cutters (four as the Commanding Officer), conducting Law Enforcement, Oil Spill Response, Drug Interdiction, Search and Rescue, and Aids to Navigation missions. Captain Shaw is currently assigned to Juneau, Alaska where he is responsible for Maritime safety and security of Alaskan waters. Captain Shaw has three children with his Christine Shaw from Fremont, California.

Fran Ulmer, Chair, U.S. Arctic Commission:

Fran Ulmer is the Chair of the U.S. Arctic Research Commission. She recently retired as Chancellor of the University of Alaska Anchorage. In June 2010 she was appointed by President Barack Obama to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. The commission was charged with investigating the causes of the explosion and oil spill, and recommending changes to prevent future disasters from occurring. Prior to her appointment to the commission, Ms. Ulmer was a member of the Aspen Institute's Commission on Arctic Climate Change and held Board positions with the Alaska Nature Conservancy, the National Parks Conservation Association and the Union of Concerned Scientists. Prior to being appointed Chancellor in 2007, Ms. Ulmer was a Distinguished Visiting Professor of Public Policy and Director of the Institute of Social and Economic Research at UAA. Ms. Ulmer served as an elected official for 18 years as the mayor of Juneau, a state representative and as Lieutenant Governor of Alaska. As Director of Policy Development for the State of Alaska, Ms. Ulmer managed multiple Programs and served as the first Co-Chair of the Alaska Coastal Policy Council. At the national level, Ms. Ulmer served (for more than 10 years) on the North Pacific Anadromous Fish Commission; as a member of the Federal Communications Commission's State and Local Advisory Committee and the Federal Elections Commission's State Advisory Committee; and co-chaired the National Academy of Science's Committee on State Voter Registration Databases. Ms. Ulmer earned a J.D. cum laude from the University of Wisconsin Law School, and has been a Fellow at the Institute of Politics at the Kennedy School of Government.

Marilyn Heiman, Director Pew Environment Group, U.S. Arctic Program:

Marilyn Heiman joined the Pew Environment Group in January 2009 as director of the U.S. Arctic Program, which works to protect the U.S. Arctic Ocean and its marine life from rapid industrialization made possible by the warming climate and the melting ice cap.

Before joining Pew, Heiman was campaign manager for the International Boreal Conservation Campaign, which works to protect one of the largest forest ecosystems on Earth. She served as the Secretary of Interior's Alaska policy advisor during the Clinton administration. In that capacity, she coordinated activities of the Bureau of Land Management, the Minerals Management Service, the National Park Service, the Bureau of Indian Affairs, the U.S. Fish and Wildlife Service and the U.S. Geological Survey in Alaska. As Alaska representative to the Secretary of Interior, she served on the six-person Exxon Valdez Oil Spill Trustee Council.

Previously, she was special assistant on natural resources and oceans for Alaska Gov. Tony Knowles and was director of his statewide transition team after his election in 1994. Prior to that she worked as an aide to the House Resources Committee in the Alaska legislature during the Exxon Valdez oil spill and was staff to the Exxon Valdez Oil Spill Commission. Heiman holds a bachelor's degree from the University of California, Berkeley.

Tom Okleasik, Planning Director, Northwest Arctic Borough:

Ukallaysaaq / Duk'aan / Tom Okleasik is the planning director of the Northwest Arctic Borough. He is a proud *Inupiaq Qawairaqmiut* who was born and raised in Sitnasuaq (Nome, Alaska). He was also given a Tlingit name of *Duk'aan* from the honorable *Lw'ooghu* Amy Nelson – the past clan mother of the Kiks'adi Clan of the Raven moiety. Ukallaysaaq graduated with honors from California Lutheran University with a Bachelor of Science degree in Business Administration. His wife is *Igluguq* Dianne Okleasik, originally from Kotzebue, and his stepsons are Ivik and Qaulluq Henry.

Career experience includes planning director for the Northwest Arctic Borough, principal consultant of Northwest Planning and Grants Development, senior trainer for Native American Management Services – Alaska Training Center, vice-president of Kawerak Inc. Community Service Division, project director of Central Council of Tlingit and Haida's Vocational Training and Resource Center, and business manager of the Northwest Campus, UAF.

As the planning director, Ukallaysaaq has worked jointly with the North Slope Borough to re-organize joint planning commission meetings, update village comprehensive plans, continue collaborative relationships with industry for permitting and community outreach, and started a community engagement e-mail list serve to help keep residents informed.

3

Arctic Marine Shipping Assessment

NORTHERN WATERS TASK FORCE
THE ARCTIC MARINE SHIPPING ASSESSMENT ~ ROADMAP FORWARD
JULY 7, 2011

Considering A Roadmap Forward: The Arctic Marine Shipping Assessment

University of the Arctic
Institute for Applied Circumpolar Policy

UAF Workshop
October 22-24, 2009

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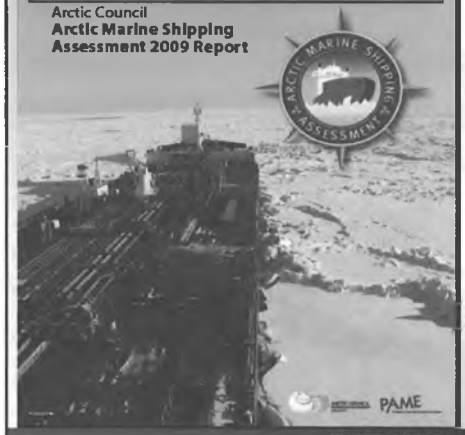
Arctic Ministers' Approval 29 April 2009 ~ Negotiated Text



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- History
- Governance
- Current Use/Database
- Scenarios to 2020 & 2050
- Human Dimensions
- Environmental Impacts
- Infrastructure

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ARCTIC MARINE SHIPPING ASSESSMENT

Arctic Council ~ Intergovernmental Forum
AMSA Lead Countries for PAME ~ Canada, Finland & USA
AMSA Focus ~ Marine Safety & Marine Environmental Protection
13 Major Workshops & 14 Town Hall Meetings
Key Challenge ~ Many Non-Arctic Stakeholders

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U.S. Geological Survey Report ~ July 2008

"Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle"

- 13% Undiscovered Oil
- 30% Undiscovered Natural Gas
- 20% Undiscovered Natural Gas Liquids

http://pubs.usgs.gov/fs/2008/3049/

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Future Convoy Requirements?
ARCTIC EXPRESS
Icebreaking (Double Acting) Container Ship
Norilskiy Nickel in the Kara Sea
March 2006
Aker Arctic

LNG
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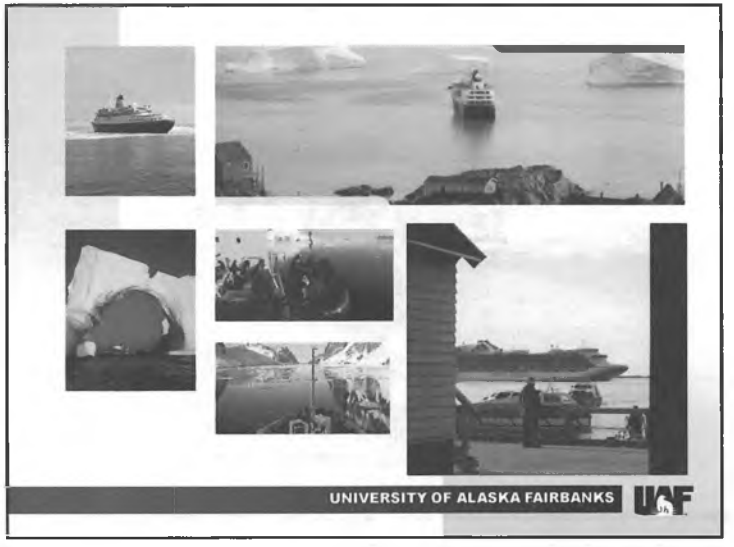
UAF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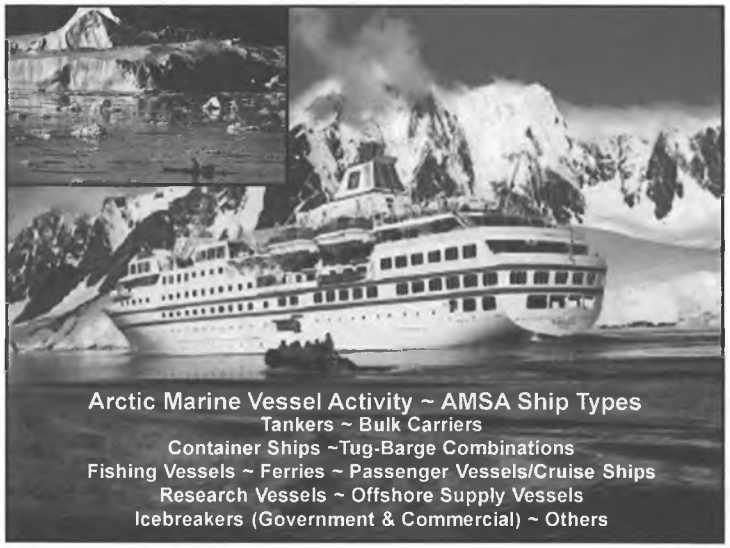
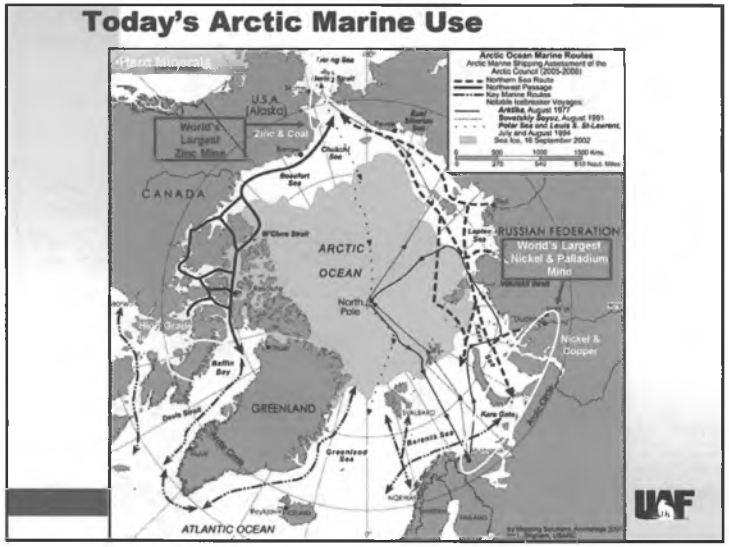

Arctic Marine Vessel Activity ~ AMSA Ship Types
Tankers ~ Bulk Carriers
Container Ships ~Tug-Barge Combinations
Fishing Vessels ~ Ferries ~ Passenger Vessels/Cruise Ships
Research Vessels ~ Offshore Supply Vessels
Icebreakers (Government & Commercial) ~ Others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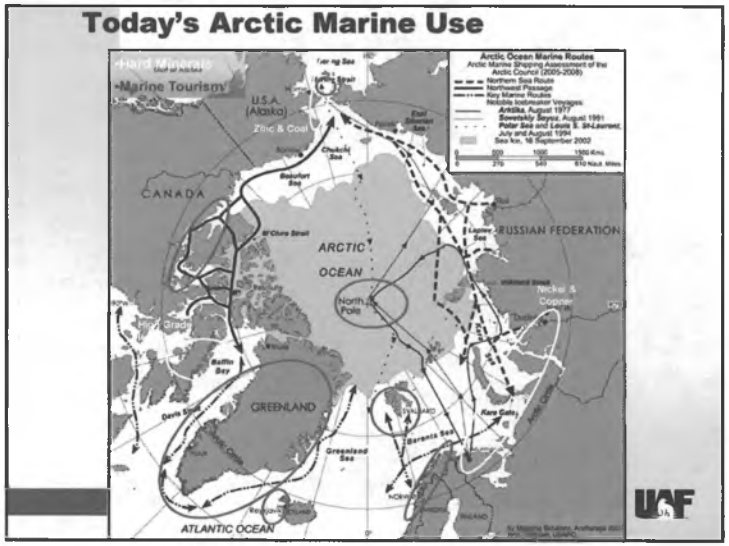
Zinc & Coal
CANADA
RUSSIAN FEDERATION
World's Largest Nickel & Palladium Mine
ARCTIC OCEAN
North Pole
Nickel & Copper
GREENLAND
ATLANTIC OCEAN


Today's Arctic Marine Use
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North Pole
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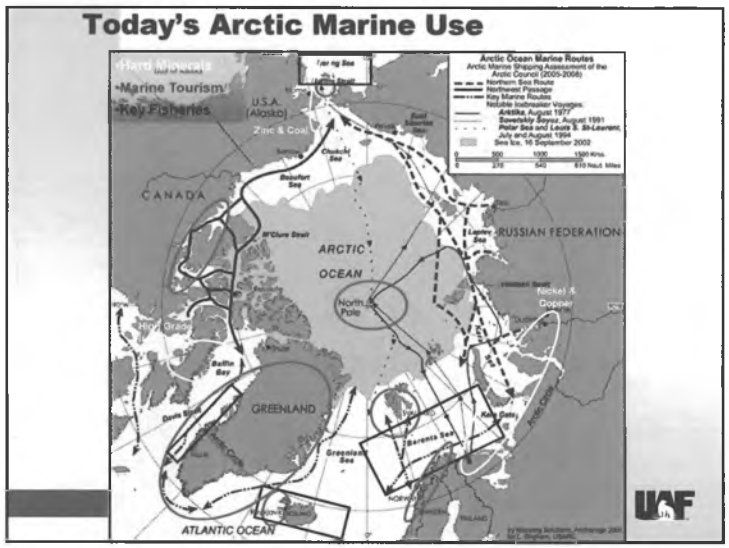
Today's Arctic Marine Use
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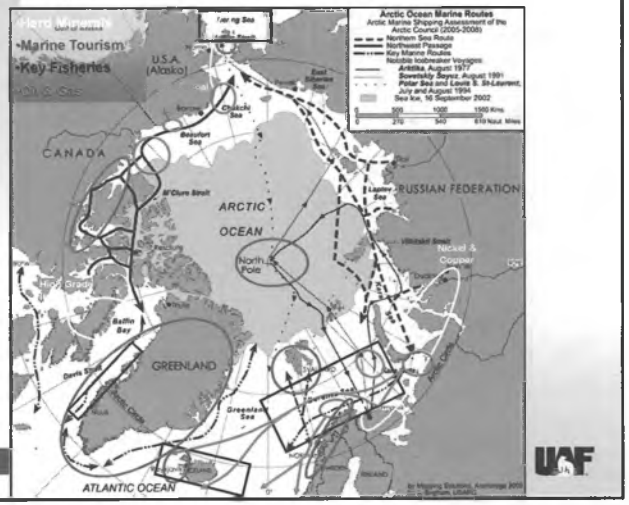

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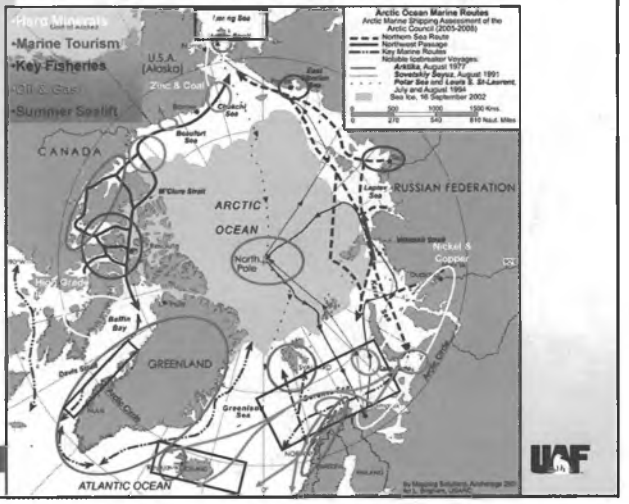

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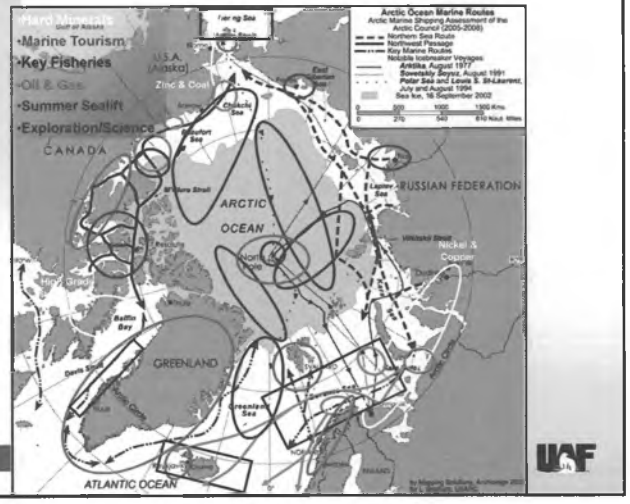
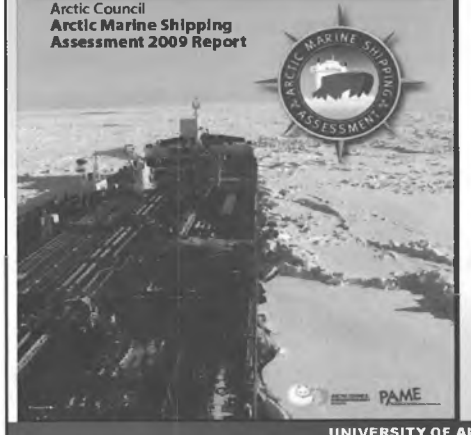


Arctic Ministers' Approval 29 April 2009 ~ Negotiated Text

Arctic Council
Arctic Marine Shipping Assessment 2009 Report



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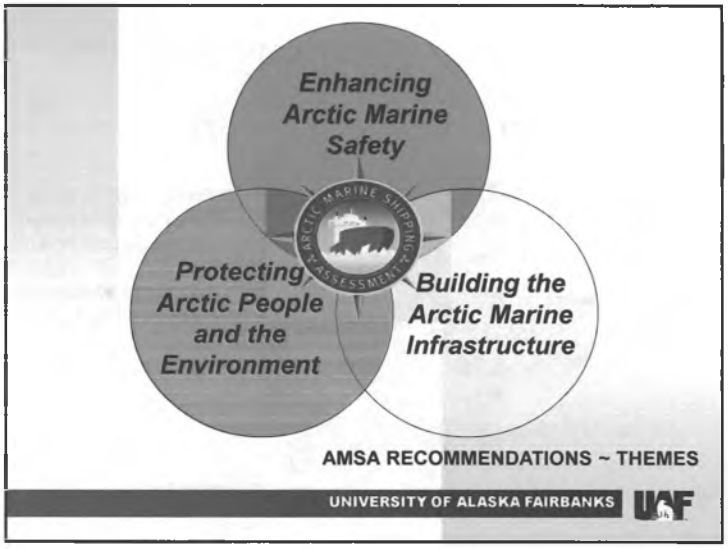
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Protecting Arctic People and the Environment
Building the Arctic Marine Infrastructure
AMSA RECOMMENDATIONS ~ THEMES
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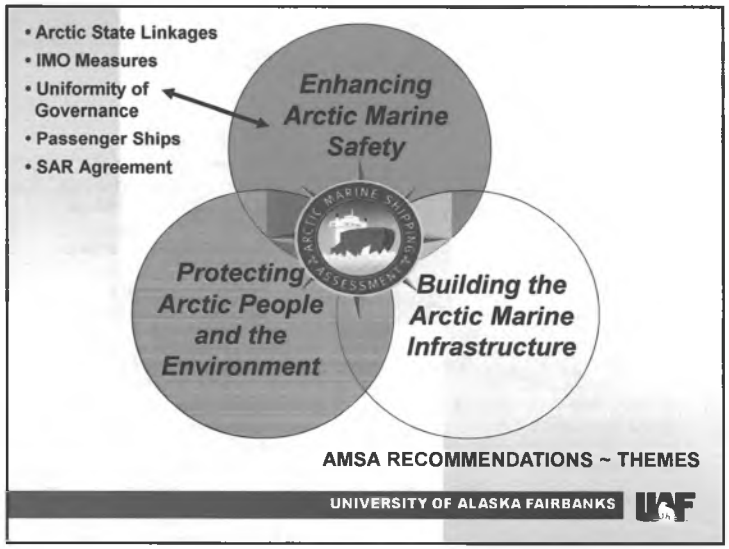
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• IMO Measures
• Uniformity of Governance
• Passenger Ships
• SAR Agreement
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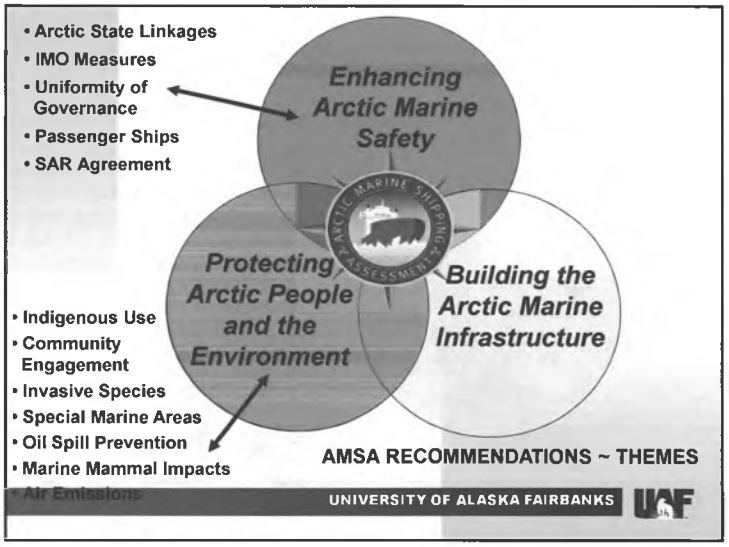
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• Special Marine Areas
• Oil Spill Prevention
• Marine Mammal Impacts
• Air Emissions
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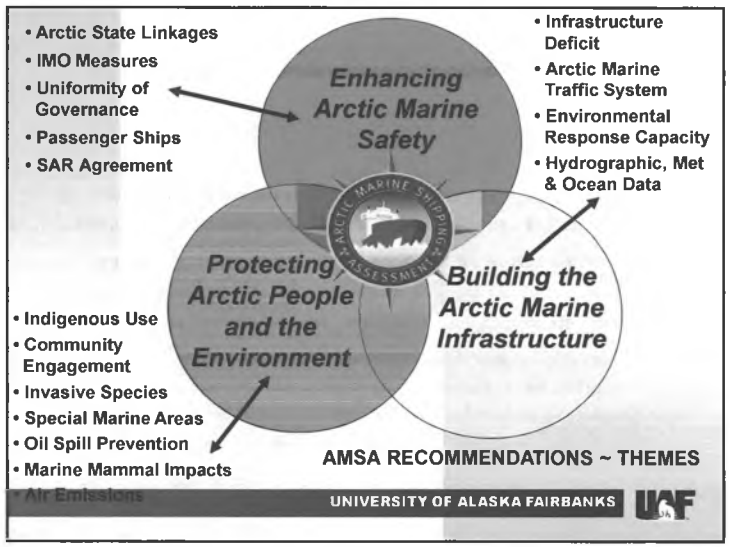
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• Arctic Marine Traffic System
• Environmental Response Capacity
• Hydrographic, Met & Ocean Data
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AMSA RECOMMENDATIONS ~ THEMES
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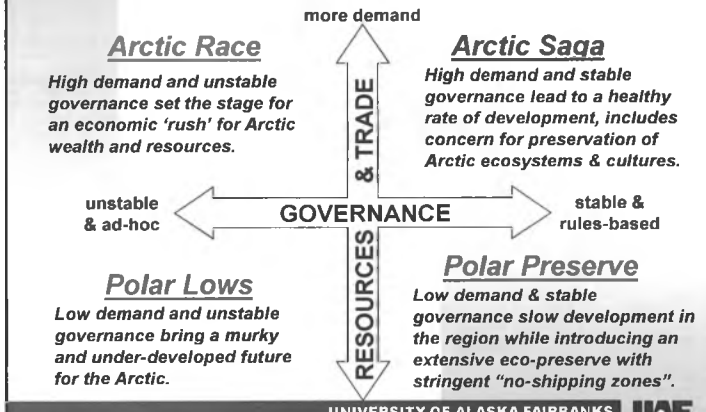
Scenarios on the Future of Arctic Marine Navigation in 2050



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CONSIDERING A ROADMAP FORWARD: THE ARCTIC MARINE SHIPPING ASSESSMENT

University of Alaska Fairbanks

Dartmouth College

University of the Arctic
Institute for Applied Circumpolar Policy

Fairbanks Workshop
October 22-24, 2009

UNIVERSITY OF ALASKA FAIRBANKS

Introduction and Background

- Second workshop of the University of the Arctic Institute for Applied Circumpolar Policy
- Topic: Policy review of the recommendations from the Arctic Council's 2009 Arctic Marine Shipping Assessment
- 60 experts from broad array of stakeholders and actors
- Sponsors: UAF Chancellor's Office, Holland America Lines, U.S. Arctic Research Commission, University of the Arc
- AMSA can be viewed as:
  - Baseline assessment of marine activity in the Arctic
  - Strategic guide for Arctic nations and peoples
  - Negotiated policy document of the Arctic Council

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Guidance to Working Groups

Working Groups:

- Enhancing Arctic Marine Safety
- Protecting Arctic People and the Environment
- Building the Arctic Marine Infrastructure

Tasks:

- Identify Stakeholders
- Develop Roadmap and Key Issues
- Funding Issues & Timelines

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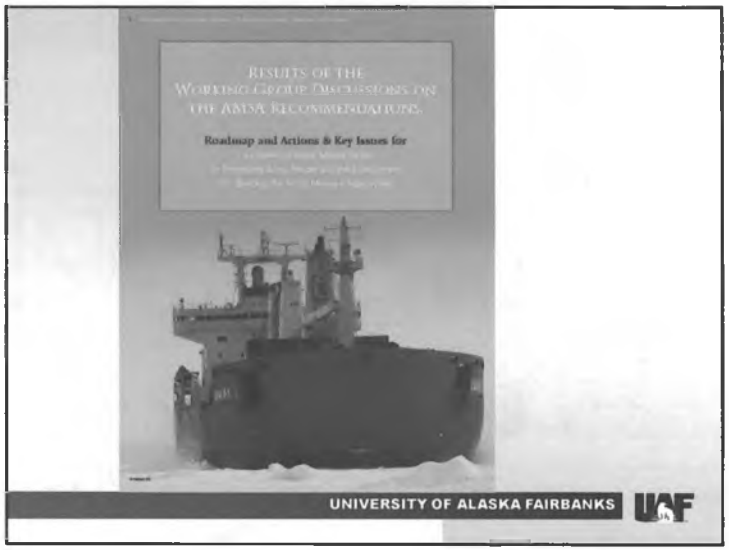
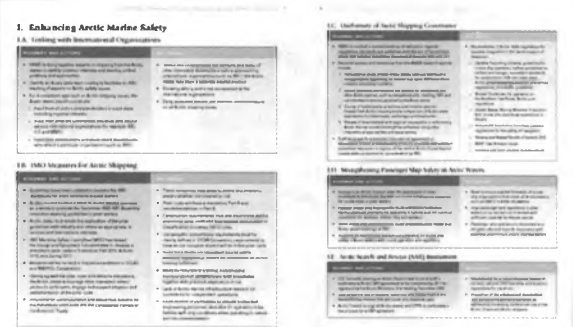
Identifying Stakeholders and Actors

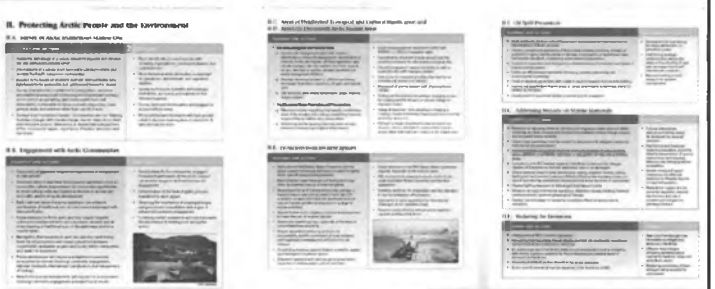
- Sovereign States
- Indigenous Groups
- International Governmental Organizations
- Maritime Industry
- Marine Insurers
- Private/Independent



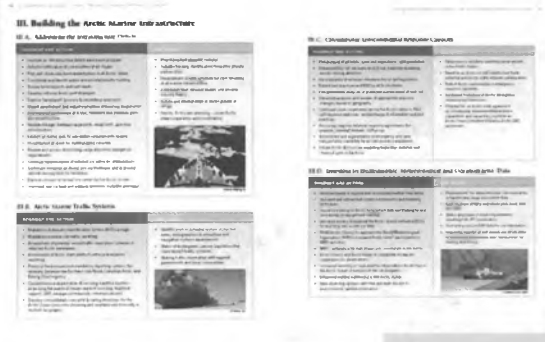
Enhancing Arctic Marine Safety



Protecting Arctic People and the Environment



Building the Arctic Marine Infrastructure



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Funding Issues

- Indigenous Marine Use Surveys
- Marine Infrastructure Elements
- Liability and Compensation Challenges

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Summary ~ Key Policy Issues Ahead

Highest Priority

- Mandatory Polar Code
- Full Tracking and Monitoring of Commercial Ships (Mandatory AIS)
- Arctic Search and Rescue (SAR) Agreement
- Indigenous Marine Use Surveys
- Circumpolar Response Capacity Agreement
- Arctic Observing Network Implementation

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CONSIDERING A ROADMAP FORWARD: THE ARCTIC MARINE SHIPPING ASSESSMENT

University of Alaska Fairbanks

Dartmouth College

University of the Arctic
Institute for Applied Circumpolar Policy

Fairbanks Workshop
October 22-24, 2009

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Thank You

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THE FOLLOWING DOCUMENT

HAS NOT BEEN FILMED BUT IS

AVAILABLE IN THE ORIGINAL FILE

Considering a Roadmap Forward: The Arctic Marine Shipping Assessment

WORKSHOP REPORT

University of Alaska Fairbanks
October 22-24, 2009

University of the Arctic ~ Institute for Applied Circumpolar Policy

Editors: Lawson W. Brigham and Michael P. Sfraga

University of Alaska Geography Program
School of Natural Resources & Agricultural Sciences

4

Chukchi Sea Program Update Shell Oil

#2

Northern Waters Task Force

Shell Camden Bay and Chukchi Sea Program Update

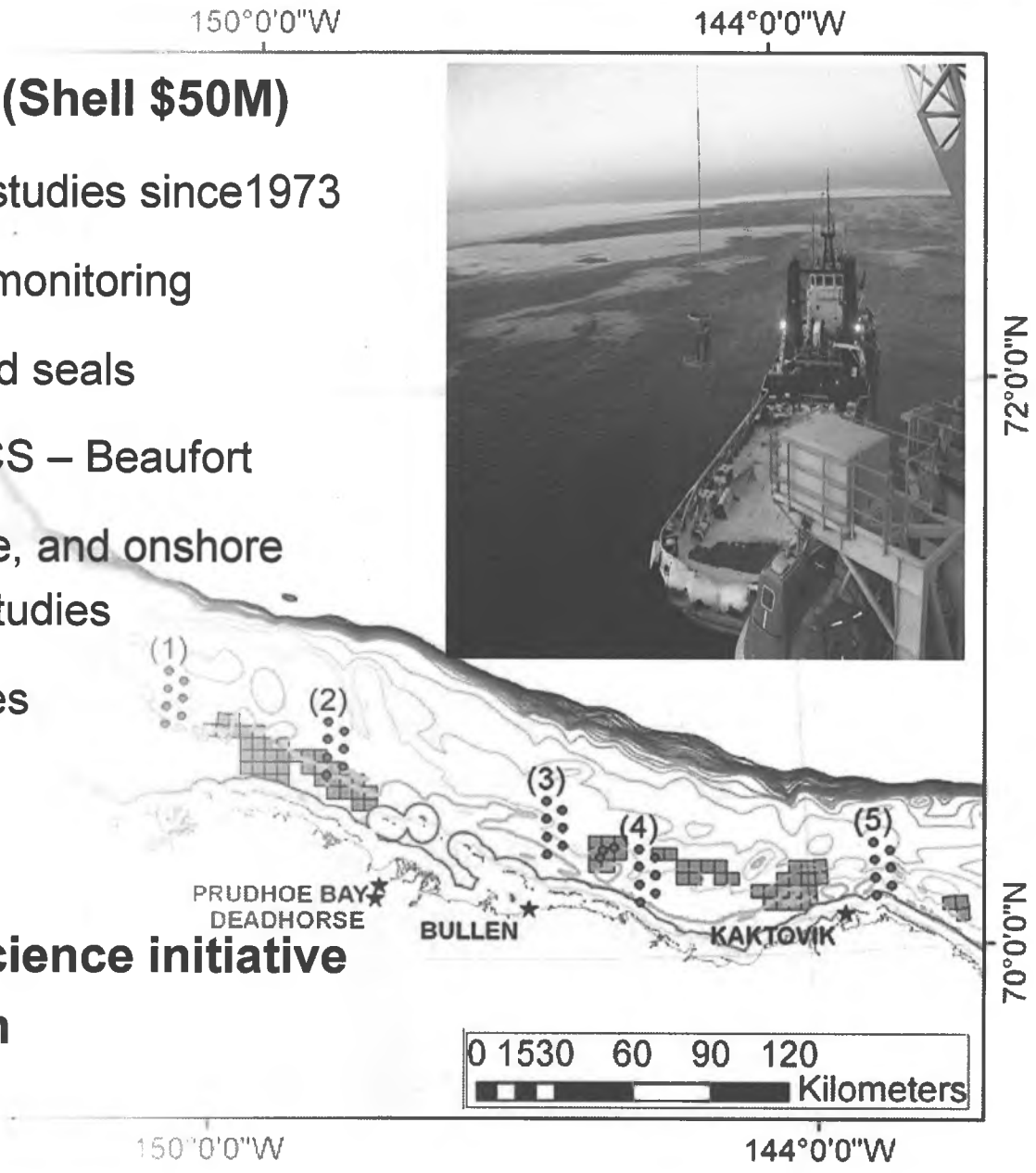
July 2011

2011 Shell Proposed Operations

- **Shell 2011 program:**
  - Marine mammal and bird observations
  - Traditional Knowledge and Archeology
  - Zooplankton and Fisheries
  - Physical Oceanography
  - Benthic and Sediment Chemistry Studies
  - Acoustic Recorders and Ice and Metocean buoys
  - UAV Montoring and Upward Looking Sonar
  - Coastal Stability, Hydrology and Habitat Assessment

Baseline Science Supports Exploration In Alaska

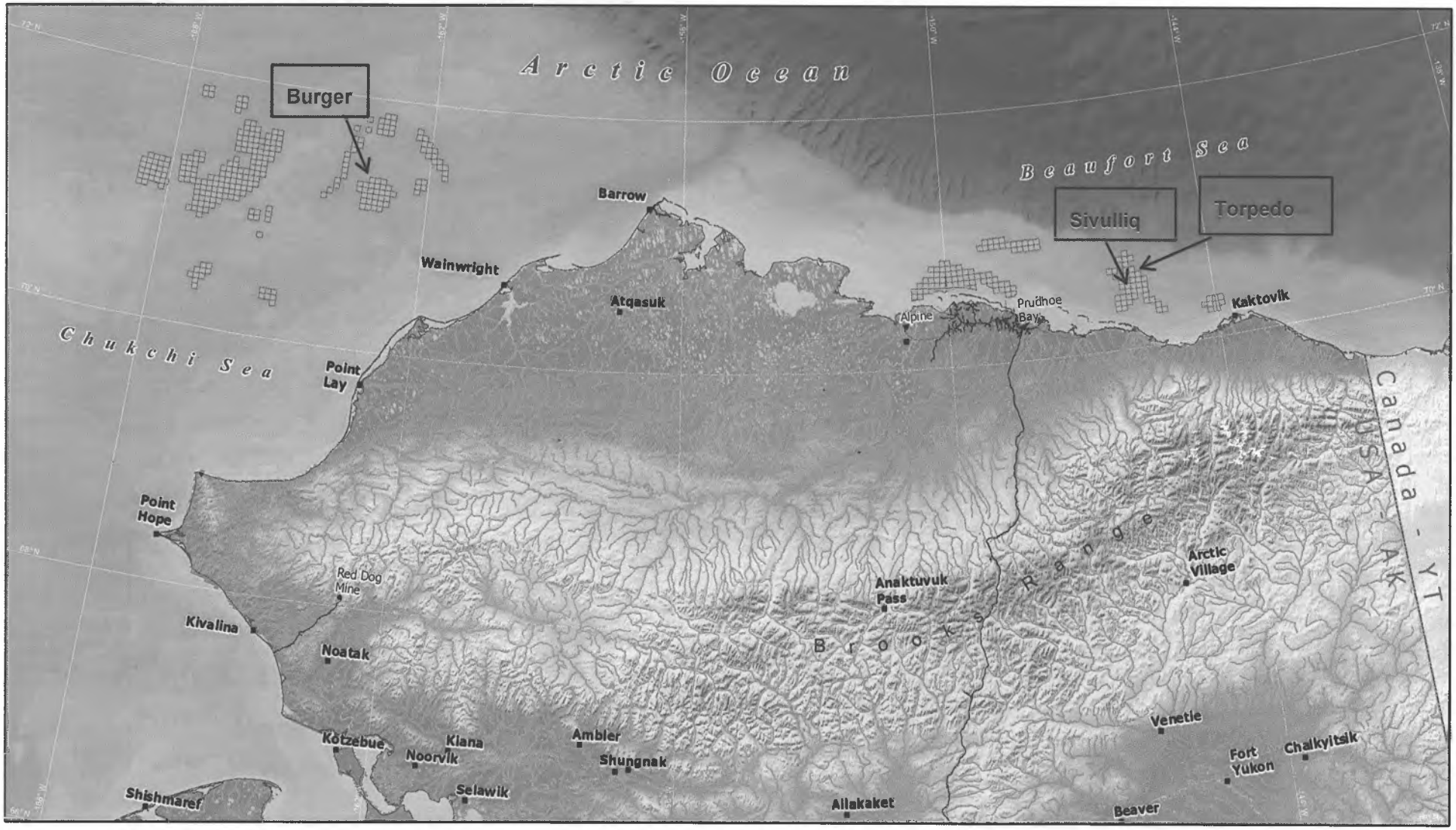
- **$500 Million and growing (Shell $50M)**
  - 5000 independent scientific studies since1973
  - 6 years of marine mammal monitoring
  - Tagging studies – walrus and seals
  - First air quality station in OCS – Beaufort
  - Ongoing offshore, nearshore, and onshore ecological characterization studies
  - Traditional knowledge studies
  - Health impact assessments
- **Up to $5 million annual science initiative with North Slope Borough**



NSB Collaborative Science Agreement

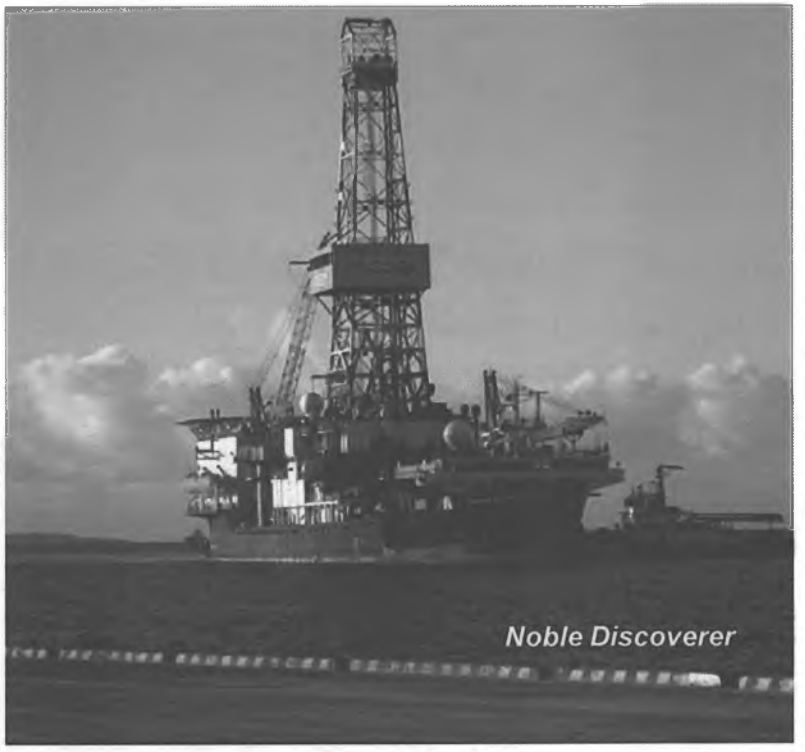
- Objective: To enable community members in coastal villages of the Chukchi and Beaufort Seas to participate and prioritize science being conducted related to the potential effects and impacts of oil and gas exploration and development in the outer continental shelf (OCS).
- Signed Sept. 24, 2010
- Funded annually by Shell for an initial term of five years, and administered by the NSB Mayor's Office
- 14-Member Steering Committee
  - Coastal Villages
  - NSB Wildlife Department and Mayor's Office
  - Independent Scientists
  - Shell

Chukchi and Beaufort Seas



2012-13 Proposed Operations

- Drill up to three wells per year in Chukchi Seas during open water drilling season (July-October)
- Drill up to two wells per year in Beaufort Sea during open water drilling season (July-October)



- Continuation of Shell's long-term ecological characterization offshore and onshore

Mitigation Shell has committed to

- Communication Plan for avoiding conflicts with subsistence users
- Collaboration and Communication with Whaling Associations, Walrus, Nanuq and Seal Commissions beluga
- Commitment to hire Subsistence Advisors
- Marine Mammal Observers on all vessels
- Robust Marine Mammal Monitoring Protocol
- Real time Ice and Weather Forecasting
- Crew change by helicopter and collaboration on routes to and from operations
- Deadhorse, Wainwright and Barrow shore bases
- No transiting, including within polynya zone, without communicating

Commitments

- **Prevention Is the First Priority and Can Be Accomplished**
- **Blow Out Preventers – testing and enhancements**
  - **Testing every 7 days instead of every 14 days**
  - **Use of second set of shear rams**
  - **Sub-sea remote operating panel relocation**
  - **Remotely Operated Vehicle/Diver options on and near site**
- **Arctic Cap and Containment System**
- **Full OSR capabilities for each sea**
- **Second rig relief well capability**

Alaska Arctic Cap and Containment System

Arctic Response Options

Offshore:

Mechanical

In-situ Burning

Dispersants
(under select conditions)

Nearshore:

Mechanical

In-situ Burning

Onshore:

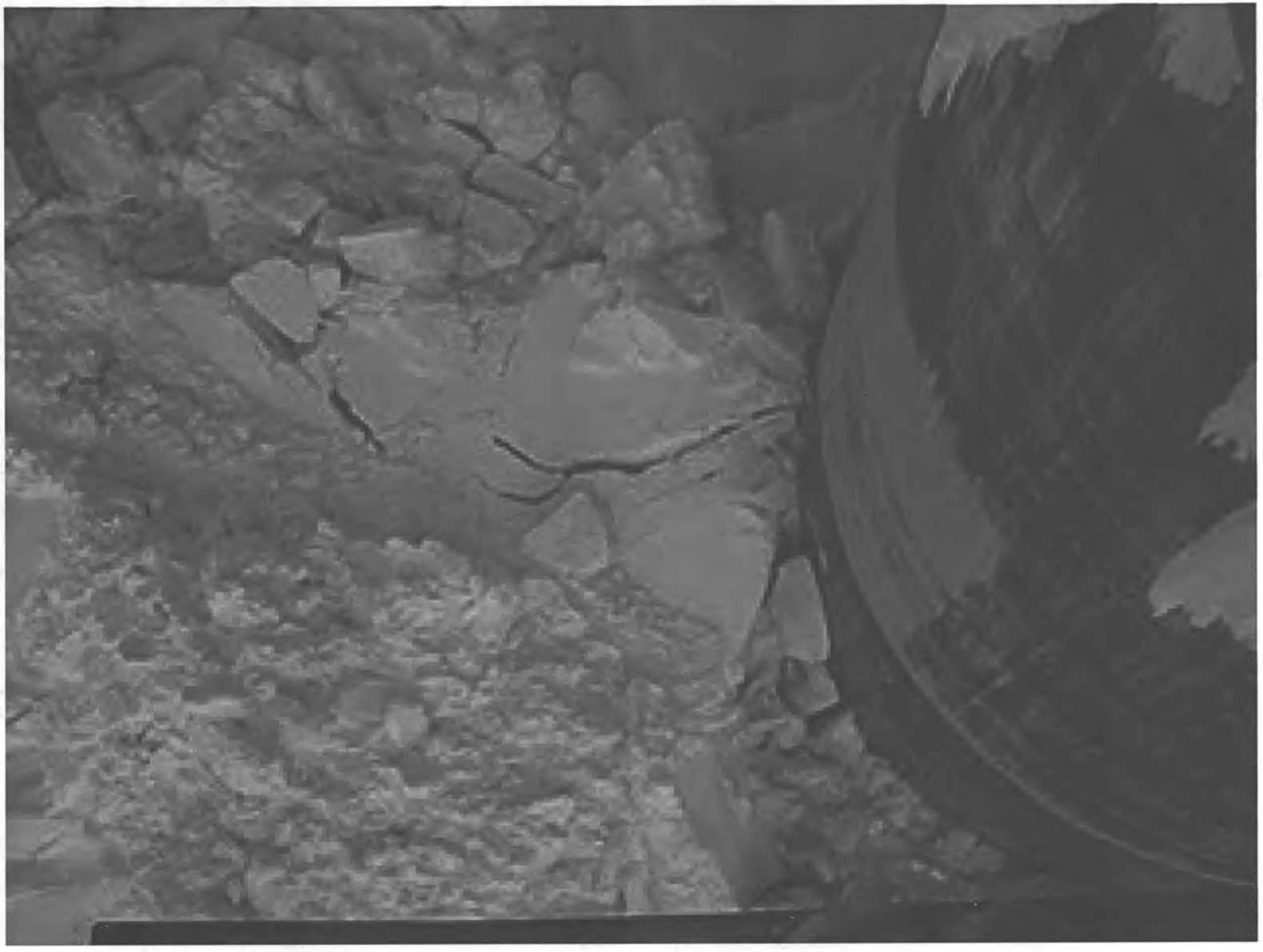
Mechanical

In-situ Burning

Brent 'B' production platform photographed in stormy weather.

The photograph shows the ferocity of the wind and waves during a storm in the North Sea. Winds of more than 100 mph produced waves reaching up to the underside of the deck which is 75 ft above sea level. Platform on calm day shown at bottom.

Ice Against Platform Legs - video



Shell's History in Alaska

- Shell operated in Alaska for 50 years until 1998
- 1st Royalty Payer to State of Alaska
- Extensive experience and operations in Cook Inlet
- Previous drilling in Beaufort and Chukchi Seas

Historical Drilling Activities

Cook Inlet									Gulf of Alaska										Bering and Beaufort Sea					Chukchi Sea		
1964	▸	▸	▸	▸	▸	▸	▸	▸	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991			

Shell in Alaska Today

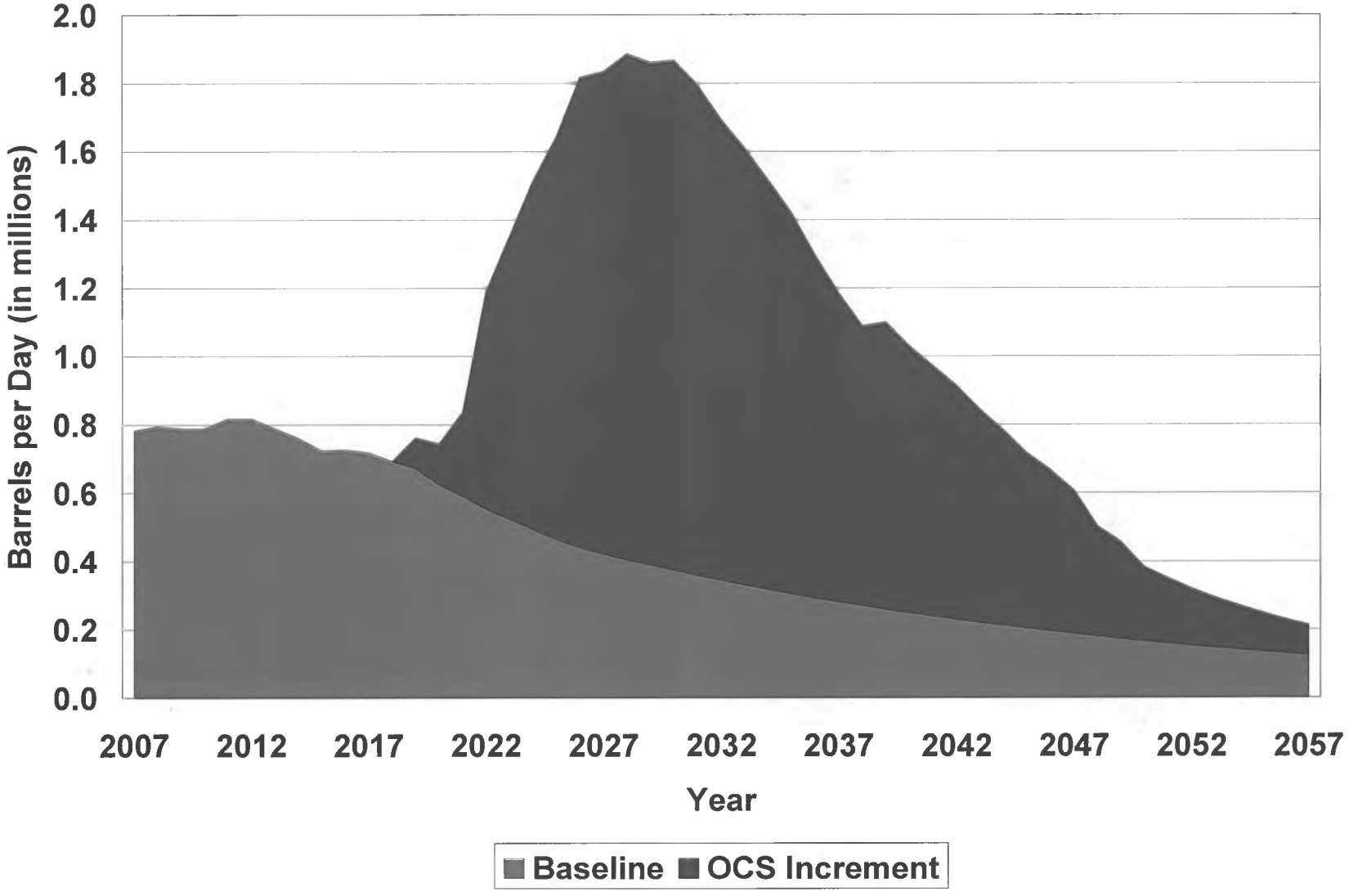
- Arctic potential: roughly ¼ of undiscovered hydrocarbons, with ¼ of that in Alaska OCS – mostly oil
- Has attracted multiple operators
- 137 Beaufort leases - $84M
- 275 Chukchi leases - $2.1 Billion
- Total investment to date: $3.75 billion
- Conservative estimates: 25 billion barrels of oil and 120 TCF of gas in Alaska Arctic (mean estimate)
- Most material OCS hydrocarbon outside of Deepwater GOM OCS
- Exceeds east/west coast OCS resources combined
- Domestic energy security

Alaska Offshore: Vital To Alaska & Our National Economy

- Over 54,000 new jobs nationwide each year for 50 years of project life*
- Amounts to $145 billion in payroll*
- New Federal, State & local government revenue would total over $193 billion at $65/bbl or over $300 billion at current prices.
- Extends the life of Trans Alaska Pipeline
- Opens up "stranded" resources in National Petroleum Reserve – Alaska (NPRA)
- Clear link from OCS projects to new energy prospects, new job development and longevity of the Trans Alaska Pipeline
- Reinforces development of a gas pipeline

*2011 Northern Economics/ ISER Economics Study

The Future of Trans-Alaska Pipeline



Thank-you

5
Subsistence Mapping in the Northwest Arctic Borough

#3

Subsistence Mapping in the Northwest Arctic Borough

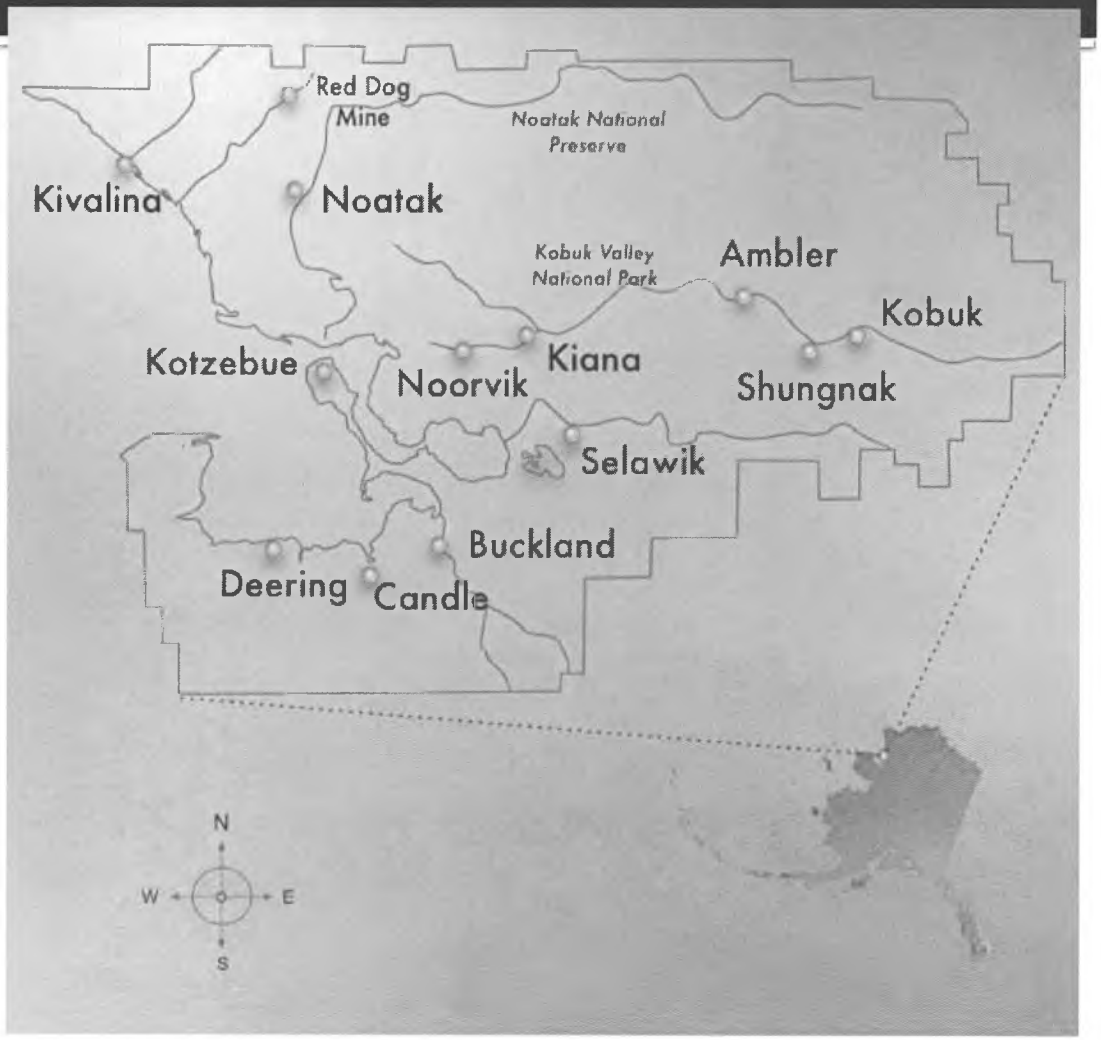
Planning Department
T: 907-442-2500
Fax: 907-442-3740

Northwest Arctic Borough
PO Box 1110
Kotzebue, AK 99752

Northwest Arctic Borough Overview

- Municipal home-rule government located in Northwest Alaska above the Arctic Circle.
  - Over 35,000 square miles of land and over 4,700 square miles of water along the Chukchi Sea, Kotzebue Sound & Noatak, Selawik & Kobuk Rivers.
- Residents 90% Iñupiaq

Northwest Arctic Borough Overview



Northwest Arctic Borough Overview

- Subsistence is key to Economy & Culture
  - Way of Life: hunting & gathering natural resources from land & water
- Human Connection to the Environment
  - Wildlife: caribou, birds, wolves, foxes, musk ox, moose
  - Fish: salmon, shee fish, trout, herring, pike, cod, smelt
  - Marine life: crab, seals, beluga whales , bowhead whales, walrus
  - Plants: blue berries, salmon berries, greens, roots, tea, leaves

Borough Comprehensive Plan Goals

- Maintain the Iñupiaq culture
- Promote & Maintain subsistence and the traditional way of life
- Protect the NWAB environment
- Support the viability of existing communities
- Support & Help develop local self-determination
- Foster appropriate economic development
- Raise the standard of living for Borough residents
- Facilitate implementation & activities & programs by villages, and regional institutions within the NWAB
  - ***Northwest Arctic Borough, Comprehensive Plan, March 1993***

Project Need

- Climate Change
- Endangered Species Listings
- Balancing Resource Development & Subsistence
  - Offshore Oil and Gas Development
  - Expanded Mining Interest
  - Arctic Marine Transportation
  - Commercial Fisheries Expansion
  - Growing Sport Hunting

- Cooperation of State & Federal Government, but lack scientific data (in their eyes) for backing their decisions

Project Need

- A foundation of
  - Science,
  - Local and traditional knowledge,
  - & Planning
- Ensure **economic activities** in the region will be conducted sustainably with healthy ecosystems.
- Developers need additional/updated information to guide decisions with communities on how development can be conducted responsibly, including when, where and how conducted.

Overall Project Goal

- Protect subsistence and promote compatible development by integrating traditional knowledge and western science to document and map important subsistence uses and habitats.
  - Key philosophy: traditional knowledge at the same level as western science.
  - Areas not fully understood by western science, & traditional knowledge often oral and not documented / both working together in project.

Objectives

- To create a secure place for collecting existing data, maps, traditional knowledge and studies that are incorporated into a geographic information system (GIS) database and ensure the database will be updated with most recent scientific information.

Objectives

- To engage borough communities in the documentation of traditional knowledge through community-based focus groups and incorporate it into the GIS database.

Objectives

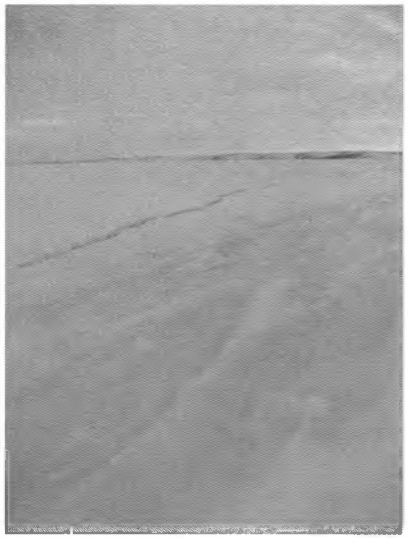
- To complete an expert review of the GIS database layers by Elders and experienced subsistence users.

Objectives

- To identify both Important Ecological Areas (IEAs) and Potential Resource Development Areas of the region.

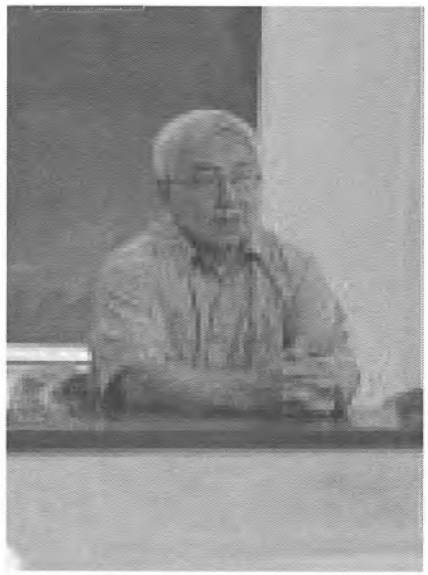
Objectives

- To publish an atlas of identified IEAs and supporting ecological information, and give appropriate staff training to use the atlas and GIS database to address needs of the Borough.



Project Staffing & Partners

- Elders
- Youth
- Residents
- Corporations
- State and federal agencies
- Interested organizations
- NWAB Planning Department
- Glenn Gray and Associates: 3rd party evaluation consultant to assess the effectiveness of the project.



Project Staffing & Partners

- Project Coordinator
- Traditional Knowledge Specialist
- Social Anthropologist
- Project Interns (3) based in Villages
- Managed/Organized within the Planning Department

Project Benefits

- Information used by the Borough in planning and zoning including land use permitting.
- State and federal agencies for implementation of coastal management, agency permitting & land use responsibilities.
- Overall, protect subsistence and promote compatible development.

Contacts

- Ukallaysaaq Tom Okleasik, Planning Director, tokleasik@nwabor.org
- Pamiuqtaq Zach Stevenson, Subsistence Mapping Project Coordinator, zstevenson@nwabor.org
- John Goodwin, Traditional Knowledge Specialist, jgoodwin@nwabor.org
- Brandan Chapman, Social Anthropologist, bchapman@nwabor.org

Closing / Taikuu

Questions/Comments

Northwest Arctic Borough
P.O. Box 1110
Kotzebue, Alaska 99752
USA

6

State/Federal Oil Spill Planning & Response AKDEC

Alaska Northern Waters Task Force
State/Federal Oil Spill Planning and Response in Northwest Alaska
July 7, 2011

#4

Alaska Northern Waters Task Force

State/Federal Oil Spill Planning and Response in Northwest Alaska

July 7, 2011

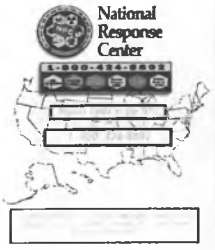
State of Alaska
Department of Environmental Conservation
Spill Prevention and Response Division

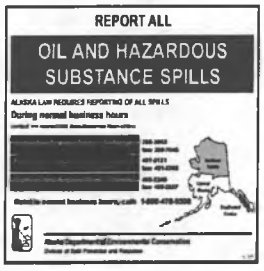
Overview

- Spill Reporting
- Responsible Party
- Spill Response in Alaska
- Spill Planning and Preparedness in Alaska
- Northwest Arctic Subarea Contingency Plan
- Local Response
- Recommendations

2

Spill Reporting - Federal/State Reporting Requirements





Responsible Party

- Spiller is responsible and liable for response, removal and restoration
- The spiller's response is a regulated activity under state and federal law
- USGC, EPA or State of Alaska can augment or take over a spill response if the RP is unwilling or unable

Spill Response in Alaska

- Roughly 2,000 spills per year on the average
- Approximately 750-800 spills require a response
- Approximately 25-30 "significant" spills occur annually

5

The Overall Challenge

570,374 square miles - Alaska
35,600 miles – Alaska coastline
12,383 miles – US coastline
16,780 miles – BC coastline

6

Response Challenges

- Respond to spills in any location within the state at any time in challenging conditions with challenging logistics in remote locations requiring remote operations
- Tsunamis, floods, earthquakes, lahars, ice conditions, sea states, narrow passages and other environmental limitations present unique challenges across the State of Alaska
- Marine vessels are transient, carry a known quantity of oil and have been the source of the largest offshore spills in Alaska
- Offshore drilling occurs in specific geographic areas including 65 wells in the Arctic Ocean, 20 wells in the Bering Sea and 653 wells in Cook Inlet

7

Response Priorities

- Safety
- Protect state resources
- Contain, control and remove
- Mitigate impacts

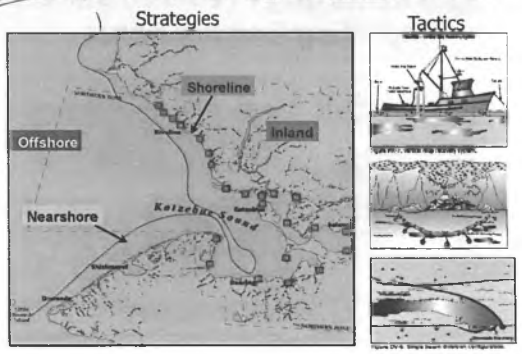
8

Response Strategies and Tactics

- Offshore operations: >three miles
- Near shore operations: Shoreline to three miles
- Shoreline protection
- Inland waters and land

9

Response Strategies and Tactics



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Spill Planning and Preparedness in Alaska – Jurisdictional Authority

- Oil Pollution Act of 1990 requires USCG and EPA to create a National Contingency Plan, plus Regional and Area Plans throughout the country
- Alaska Statute requires ADEC to develop a State Master Plan and Regional Master oil spill response contingency plans
- The planning process includes local government participation
- Government Plans are approved by the state and federal On Scene Coordinators responsible for implementing the response
- Federal and state law also require oil spill contingency plans for certain "regulated" facilities

Alaskan Adaptation

- Under OPA 90, the entire State of Alaska is one federal "Region" which requires its own plan. Three "Area" plans are required for the USCG and one "Area" plan for the EPA
- Under Alaska Statute, ADEC is required to develop one State Master Plan and ten "Regional" Plans
- Working cooperatively, USCG, EPA, and ADEC have created a joint Unified Plan and ten "Subarea" plans that satisfy all federal and State planning requirements
- The USCG and the EPA participate with ADEC in the State-required public review process

Unified Plan for Alaska

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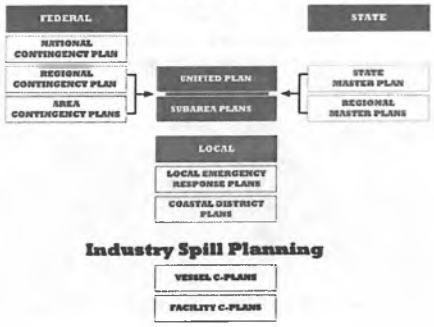
Government Spill Planning



Industry Spill Planning

- VESSEL C-PLANS
- FACILITY C-PLANS

14

DEC's Role in Planning

- Prepare Joint Federal/State Plans for spill response using the Incident Command System (ICS)
- Review and approve Industry Contingency Plans with public review
- Develop and maintain ten Subarea Plans for the State of Alaska
- Update Subarea Plans every five years
- Include local and regional input in subarea spill response planning
- Formalize community response agreements with local government for planning, preparedness and response

15

Government versus Industry Plans

Government Plans

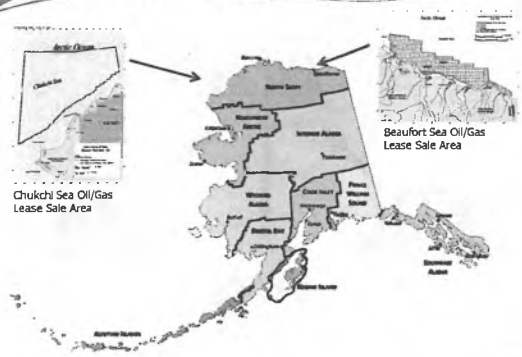
- Required based on a geographic area
- Worst Case Discharge Scenario for the geographic area
- No response planning standards
- Sensitive Areas Information
- Geographic Response Strategies
- Potential Places of Refuge
- Near shore response plans
- No dedicated equipment, trained personnel or response resources to execute tactics and strategies

Industry Plans

- Required based on facility or vessel type including offshore exploration and production, vessels, tank farms, railroad and other regulated facilities
- Worst Case Discharge Scenario for the facility
- Include response planning standards
- Equipment, trained personnel and response resources must be available to meet state/federal response planning standards

16

Alaska's Arctic Subareas



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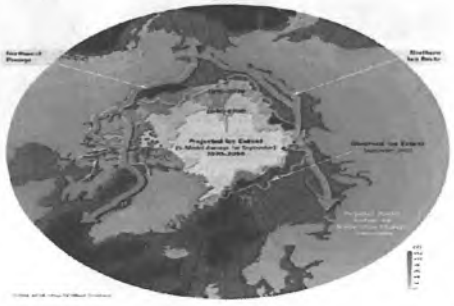
Northern Shipping Routes



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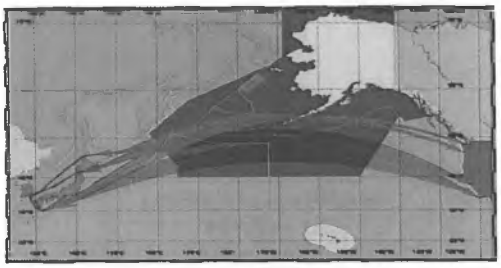
Circumpolar Shipping Routes

Aleutians Risk Assessment



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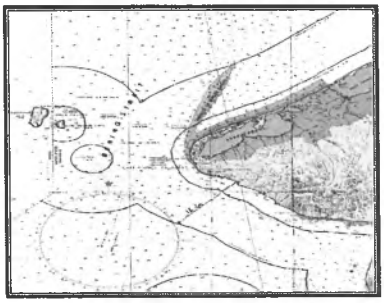
Bering Strait

State Jurisdiction to 3 miles
Federal jurisdiction to 12 miles



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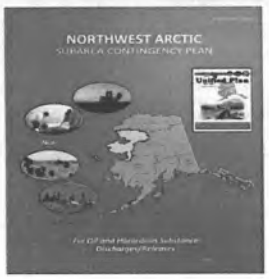
Northwest Arctic Subarea Contingency Plan



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Northwest Arctic Subarea Plan

Major Components

- Response Section
- Resources Section
- Hazmat Section
- Sensitive Areas Section
- Background Section
- Scenarios Section
- Geographic Response Strategies Section
- Potential Places of Refuge Section
- Nearshore response plan

Support Documents

- Local Response Agreements
- Alaska Incident Management System
- Spill Tactics for Alaska Responders Manual
- Tundra Treatment Manual

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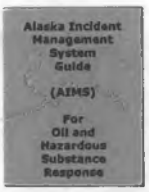
Subarea Plan Supporting Documents



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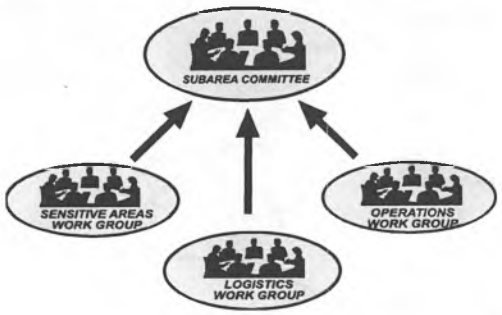
NW Subarea Committee



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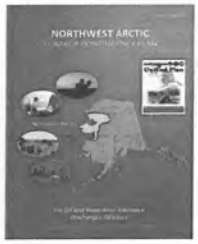
Alaska Northern Waters Task Force
State/Federal Oil Spill Planning and Response in Northwest Alaska
July 7, 2011

NW Arctic Subarea Plan Schedule

- September 2010 - Public Outreach Meetings – (Kotzebue and Nome)
- October – December 2010: Outreach/Consultation
- April-June 2011: Alaska Regional Response Team, Tribal Government Review
- July-October 2011: Public Review
- November 2011: Plan Finalized
- June 2012: Nearshore Operations Response Strategy Incorporated



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Subarea Planning Priorities

- Protect state waters and coastal areas from spill impacts
- Augment subarea planning preparedness from increased risks from Arctic marine vessel traffic and offshore oil and gas development
- Integrate local knowledge, personnel, equipment and resources in planning and response
- Augment local response through Community Response Agreements, drills, training and equipment

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Subarea Response Planning

- Environmentally sensitive areas and resources at risk
- Geographic Response Strategies
- Near shore Response Plans
- Potential Places of Refuge
- Emergency Towing Systems
- Local Response
- Drills

27

Environmentally Sensitive Areas Resources at Risk

28

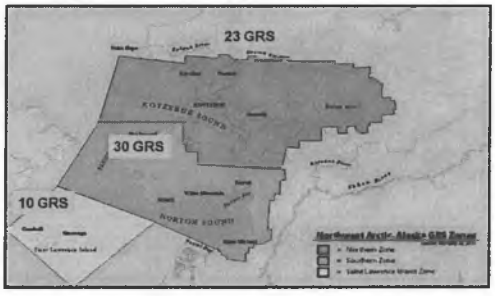
Geographic Response Strategies

63 site specific geographic strategies in the Northwest Arctic Subarea

- Site specific response and protection strategies to protect environmentally sensitive areas and resources at risk
- Pre-identified operational tactics, personnel and equipment

29

Northwest Subarea Geographic Response Strategies



30

State Nearshore Response Planning Initiative

- Protect state waters (0 – 3 miles) and coastal resources from impacts of oil spills
- Develop specific nearshore operations response strategies and tactics

31

State Nearshore Response Planning

- Develop strategies and tactics for detection, containment, control and removal of oil in state waters which extend out to 3 miles from the shoreline

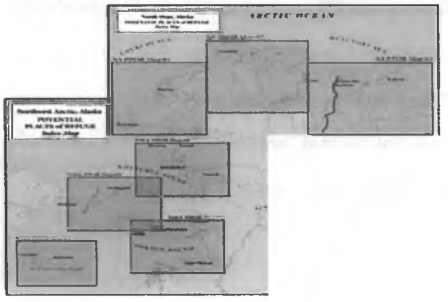
32

State Nearshore Response Plan

- Identify nearshore response zones for the northwest subarea
- Develop nearshore response tactics for each zone for open water and broken ice conditions
- Identify equipment, trained personnel, response resources, staging areas and logistical support
- Develop the Unified Command and control structure for implementation using the incident command system

33

Arctic Potential Places of Refuge



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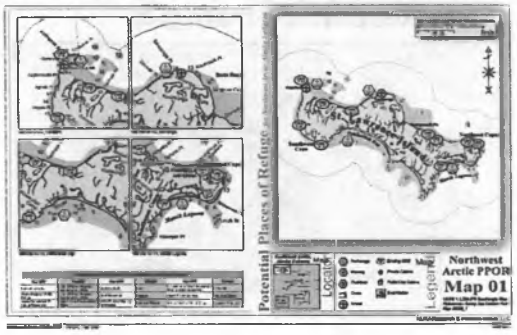
Potential Places of Refuge Document



35

Emergency Towing System

M/V Golden Seas under tow by Tor Viking with ETS
Atka to Dutch Harbor

36

Local Response

- All responses are local
- Local knowledge
- Local response
- Local resources
- Local On-Scene Coordinator
- Drills, training and exercises
- Participation in the Incident Command System

North Slope Borough Village Response Team – GC-2 Spill (March 2006)

Local-Hire Worker – Selendang Ayu Spill (April 2005)

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Community Response Agreements

- Formal agreement between DEC and local community
- Activated by DEC's State On-Scene Coordinator for spills in local area
- Local community reimbursed by DEC for response expenses when activated by the State On Scene Coordinator
- DEC requests CIP funding for local equipment, training and drills

38

State of Alaska Local Response Assets

39

Drills

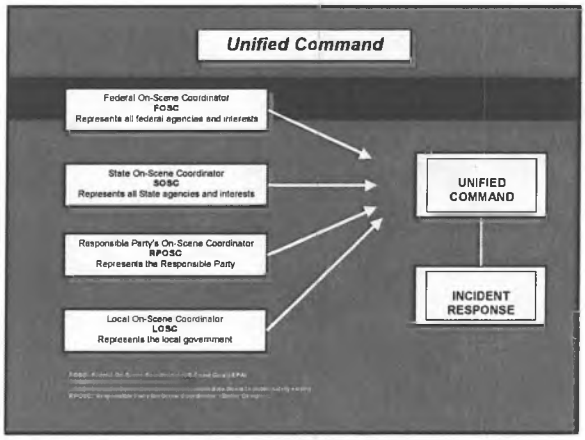
- "If you want to play in the game you have to come to practice....." Thad Allen
- Drills are regularly conducted with government and industry oil spill plans
- DEC provides training to local responders

40

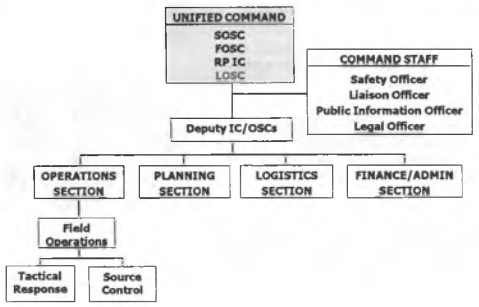
Drills

Local Responders Use Pre-developed GRS and Staged Spill Response Equipment to Protect Critical Coastal Sensitive Areas

41



Unified Command Response Organization



Recommendations

- The State should support national, international and trans-boundary efforts to enhance northern waters spill response planning and preparedness, response capability, infrastructure development and methods to reduce the risk of oil spills from vessels and offshore oil and gas development.
- The State should support improvements to subarea contingency plans to protect northern waters and coastal resources.
- The State should oppose efforts that would duplicate or supplant established state and federal jurisdictional processes for northern waters oil spill response planning and preparedness and insist that any new efforts and initiatives acknowledge and build upon these existing processes.
- The State should support existing Alaska institutions and development of new institutions here in Alaska with a focus on oil spill prevention and response methods and technologies with application to northern waters.

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Recommendations

- The established state/federal jurisdictional process for oil spill planning and preparedness in Alaska should be adequately resourced by state and federal agencies to accommodate Arctic marine vessel traffic and northern waters offshore drilling.
- The adequacy of the states conservation surcharge to support the states spill prevention and response programs should be evaluated to augment northern waters spill prevention, planning and preparedness and incentivize local participation in subarea oil spill planning.
- The State should continue to support local involvement in spill prevention and response and solicit local knowledge and resources for these purposes.
- The State should support efforts to promote research into oil spill prevention, fate and effects, and response strategies and technologies.

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Questions?

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7
Arctic Pollution Response US Coast Guard

Arctic Pollution Response
NWTF - 07 July 2011

Captain Adam Shaw
Chief of Prevention
CCGD17

Oil Pollution Act of 1990 (OPA-90)

Result of the Exxon Valdez oil spill

- Established the Oil Spill Liability Trust Fund
- Requires "spiller pays"
- Created Oil Spill Response Organizations (OSRO)
- Required creation of Area Contingency Plans

Oil Spill Liability Trust Fund

- Created in 1986, but not authorized for use
- OPA-90 Authorized use of the fund
- Consolidation of several different pollution funds
- Funded by a tax on the petroleum industry
- Use delineated by OPA-90

Responsible Parties

A Responsible Party is defined in OPA-90 for the following:

- Tank Vessels
- Onshore Facilities
- Offshore Facilities
- Deepwater Ports
- Pipelines

Responsible Parties are held accountable for spilled oil and hazardous substances.

Oil Spill Response Organizations

- OPA-90 Required submission of response plans by Responsible Parties
- Response plan must identify, among other things, proof that a worst case discharge can be cleaned up by private personnel and equipment
- OSROs were created to make the identification of those resources easier and to assist in meeting oil clean up requirements.

Alaska Unified Plan

The Unified Plan is a comprehensive pollution response doctrine that defines the organizational and procedural framework of the Alaska oil spill response network. USCG, State, & EPA work together to develop the Unified Plan with input from the Alaska Regional Response Team (ARRT).

Ten Sub-Area Plans supplement the Unified Plan and describe geographic specific strategies for a coordinated federal, state and local response.

Sub-Area Plans Address/Identify:
- PPORs
- Response Procedures
- Environmentally Sensitive Areas
- Available Resources
- Notification Procedures
- Geographic Response Strategies

Alaska Regional Response Team (ARRT)

Purpose: To support development of the Unified Plan prior to incidents and provide technical expertise to the UC, if stood up, during a spill.

Composition: The Co-Chairs are USCG and EPA.

Members: ADEC, DOD, GSA, DOI, NOAA, FEMA, DHHS, DOJ, USFS, DOL, DOE & DOT, Tribal Representatives

Alaska Sub-Area's

UNIFIED COMMAND

Scenario: Cruise Ship Runs Around in Vicinity of Barrow with 500,000 gallons of heavy fuel oil (aka 'Bunkers')

Sector Anchorage FOSC, ADEC & RP will stand up a Unified Command in Barrow, AK.

Why? The FOSC makes the determination based on the incident (e.g. multiple agency interest, high visibility, unit overwhelmed or duration).

Where? Depends on the incident and surrounding infrastructure. Typical UC requires adequate communications gear, meeting rooms, & possible lodging.

Who: Unified Command will also work with Federally recognized tribes and stakeholders within the impacted area.

International Partnerships

Canada: MOUs:
- Joint Marine Pollution Contingency Plan
- Arctic Region Marine Spill Response Plan
- SE Alaska: 8 Exercises Since 2000 (CANUSDIX)
- Arctic: Seminar & TTX in 2010 (CANUSNORTH)

Russia: MOUs:
- Joint Contingency Plan on Combating Pollution in the Bering and Chukchi Seas (2001)
- Annual Work Plan to Improve Spill Response in Arctic
- State Marine Pollution Control, Salvage, and Rescue Administration (SMPCSRA)
- BILAT Update at Russian Ministry of Foreign Affairs
- Arctic Council Response Agreement Initial Effort
- Sakahalin Base TTX held in Aug 2003
- International Oil Spill Conference, Portland, OR 2011

Conceptual Response Tool Box

- Mechanical Containment and Recovery
  - USCG Owned
  - ADEC Owned
  - Industry Owned
  - Oil Spill Removal Organizations (OSRO)
- In-Situ Burning
- Chemical Dispersants (not preauthorized within State of Alaska – requires ARRT consultation)

Government Equipment Overview

- United States Coast Guard (USCG)
- Alaska Department of Environmental Conservation (ADEC)
- Navy Supervisor of Salvage (NAVSUPSALV)

Response gear from every agency can be transported via any available military aircraft or vessel or via commercial chartered aircraft, train, truck or vessel

USCG Owned Equipment Caches

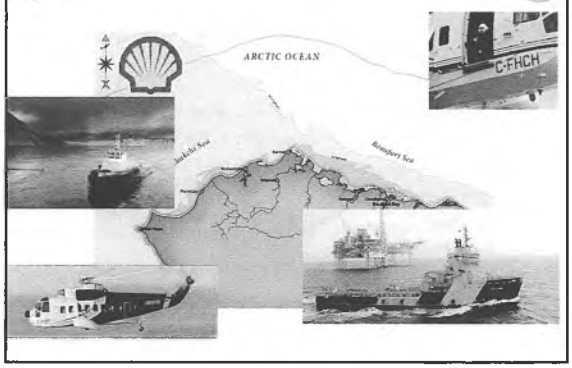
ADEC Owned Equipment Caches

Navy SUPSALV Equipment

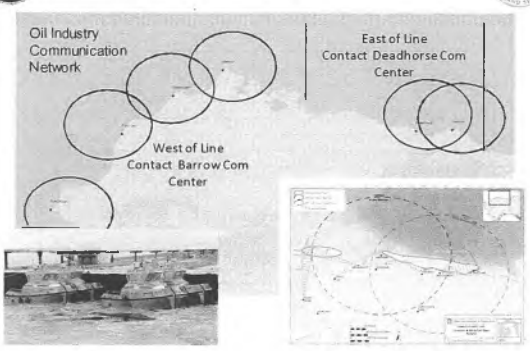
Located at FT. Richardson in Anchorage, AK

- Strong Open Ocean Recovery Capabilities
- Skimmers, Hard Boom, Support Vessels, Vacuum Systems, Storage Bladders, Command Trailer (with Communications Suite), Submersible Pumps, Arctic Oil Recovery System, etc.
- Salvage Equipment, Transfer Systems, Oily Water Separators, Viscous Oil Pumps

Private and Industry Resources



Private and Industry Resources



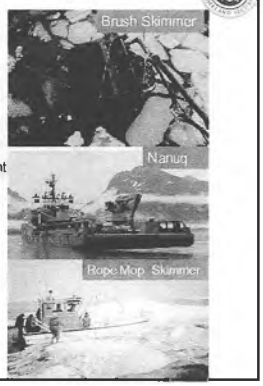
Oil in Ice Response Capabilities in the Arctic

Mechanical Recovery Challenges:

- Containment boom isn't effective
- Brush skimmers often become clogged
- Not effective if ice cover is too great
- Increased oil viscosity in lower temps
- Icing/Freezing of machinery parts
- Limited/difficult access to the oil
- Oil difficult to locate under ice
- CG doesn't own oil in ice recovery equipment

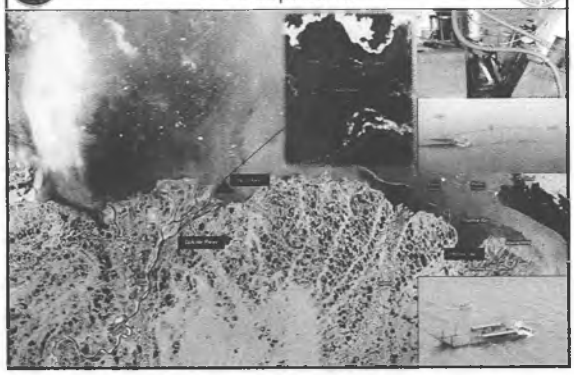
Accomplishments?

- Over 40 years of research conducted
- More response equip. than anywhere in US.
- Brush skimmers, high potential for recovery
- Winterization of equipment reduces freezing
- Vessels equipped with latest technology
- On-scene within 1hr of spill



Oil in Ice Response Capabilities Cont.

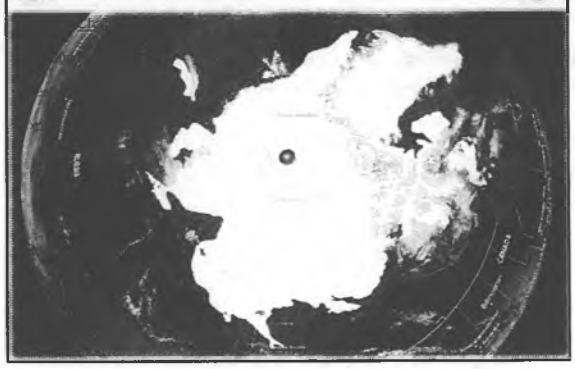
Barge Grounding – Stryker 14 Sept 2010



Oil Spill Response Challenges

- Weather/Season/Temperature/Darkness
- Remote location/Logistics
- Lack of infrastructure/improvising
- Distance of response capabilities/Logistics
- Limits of spill response equipment/Availability
- Safety of Responders (Weather, Bears)
- Joint Training/Coalition Exercises
- Funding
- Agreements/MOU
- International Media Interest/Visibility

Challenges and Goals



UNITED STATES COAST GUARD
17th DISTRICT

8

Oil Spill Prevention & Response in the US Arctic

Pew Foundation

#6

Oil Spill Prevention and Response in the U.S. Arctic Ocean:

Unexamined Risks, Unacceptable Consequences

Marilyn Heiman, Director, U.S. Arctic Program
The Pew Environment Group

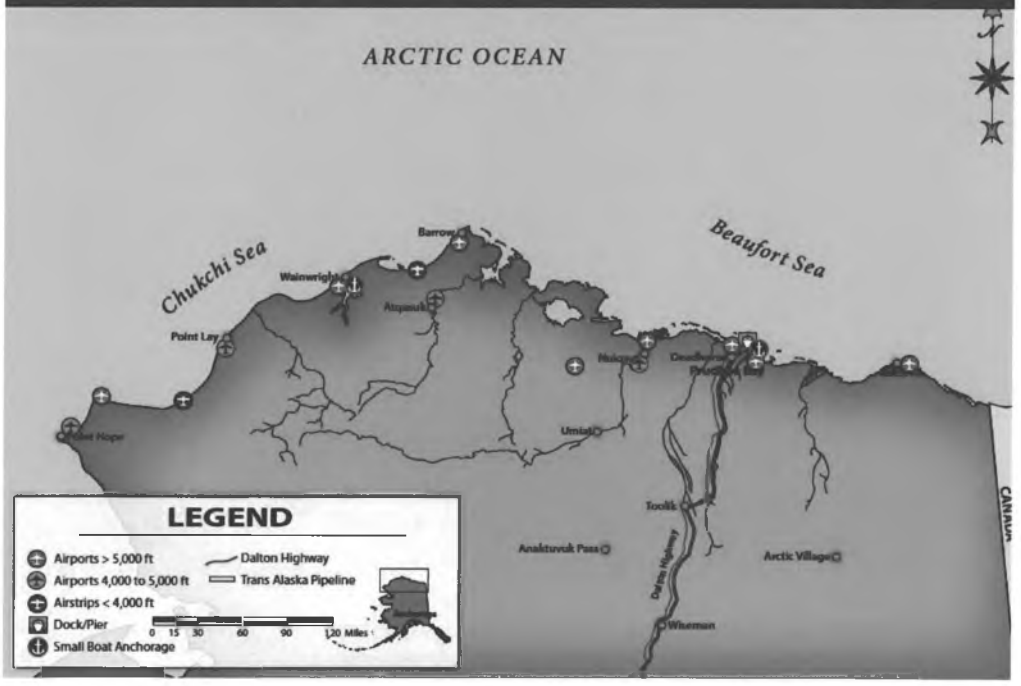
THE PEW CHARITABLE TRUSTS

Report Available at:
www.arcticoilspillreport.org

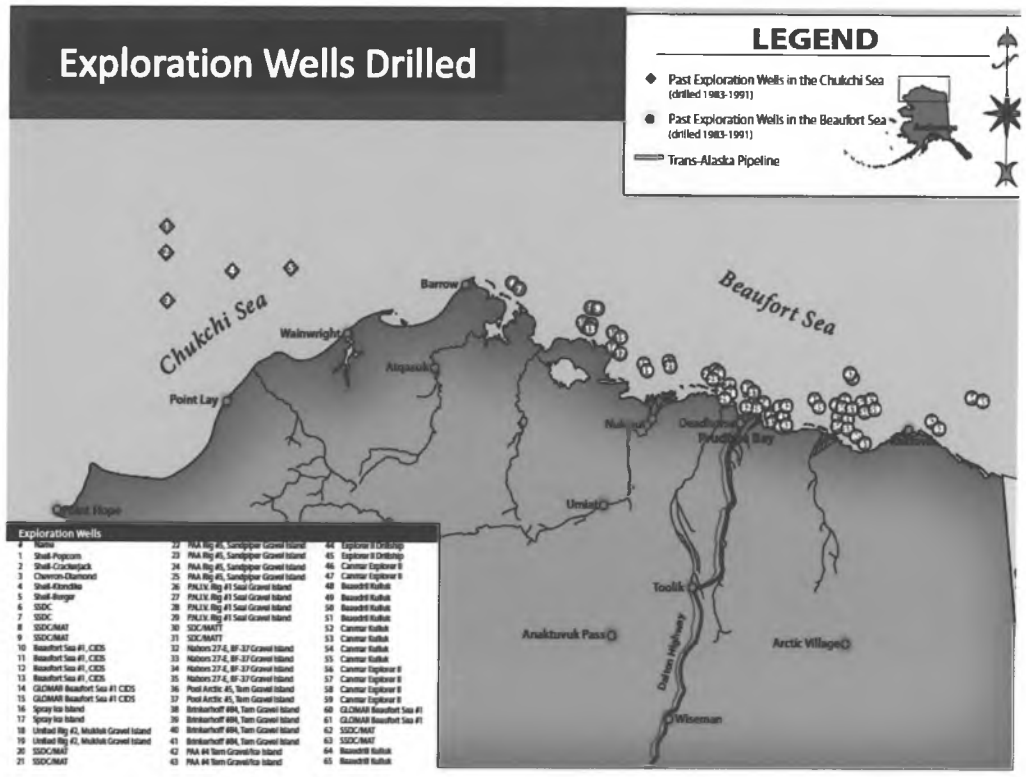
Recommendations from Pew's Oil Spill Report

Report concludes a lack of infrastructure and spill response capability in the U.S. Arctic Ocean

Airstrips, Ports and Roads in the U.S. Arctic



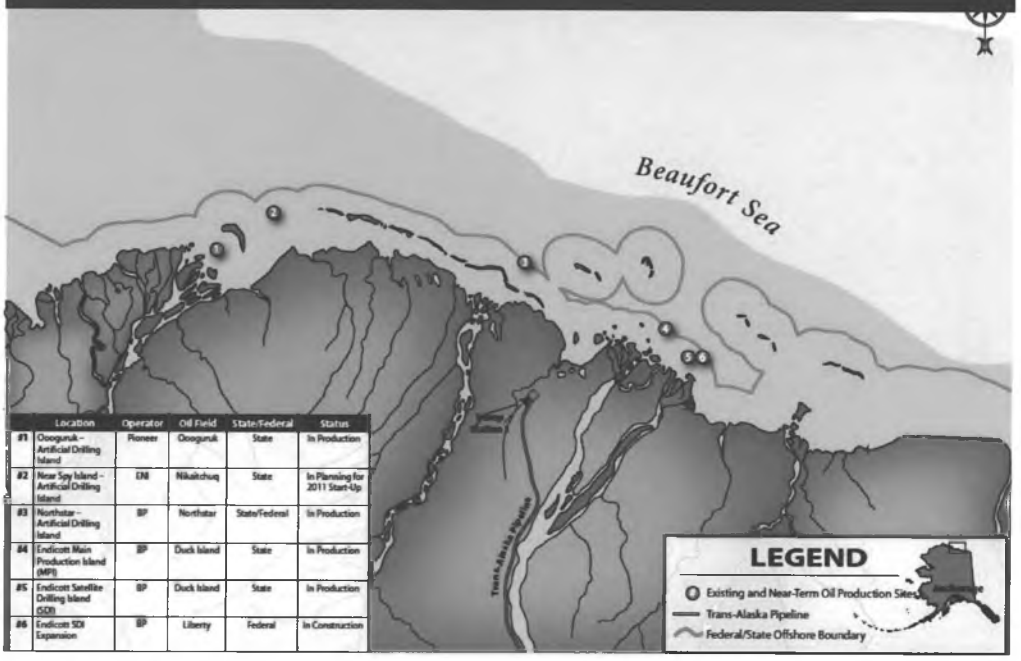
Exploration Wells Drilled



Exploration Wells

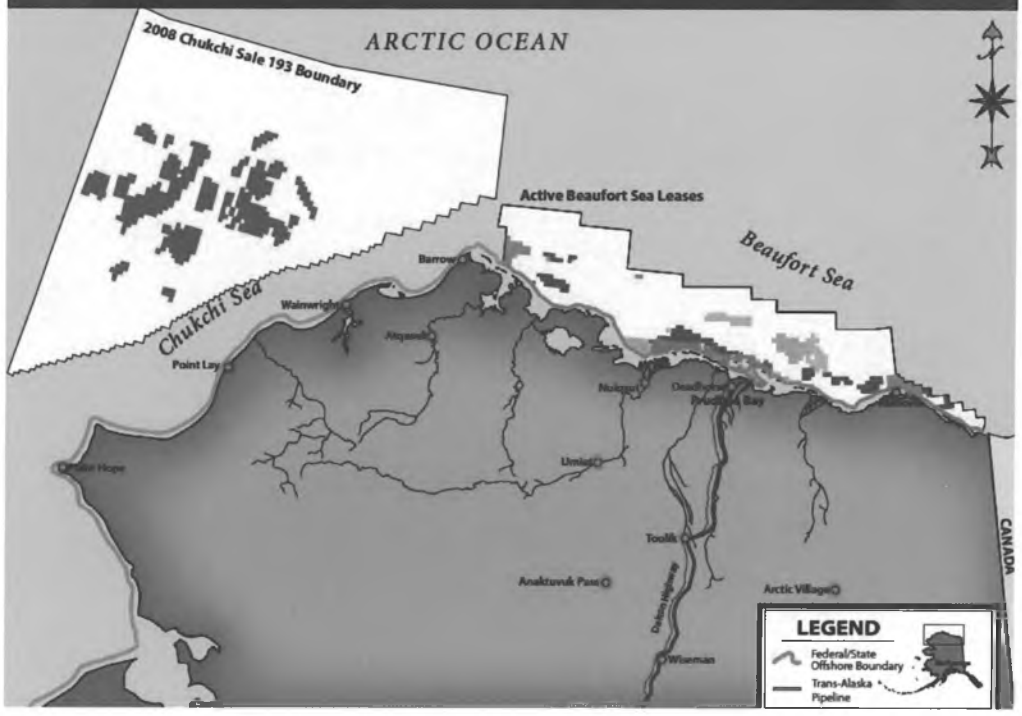
#	Name				
1	Shell-Popcorn	23	PAA Rig #5, Sandpiper Gravel Island	45	Explorer II Drillship
2	Shell-Crackerjack	24	PAA Rig #5, Sandpiper Gravel Island	46	Canmar Explorer II
3	Chevron-Diamond	25	PAA Rig #5, Sandpiper Gravel Island	47	Canmar Explorer II
4	Shell-Klondike	26	PAI,LV. Rig #1 Seal Gravel Island	48	Beaufort Kulluk
5	Shell-Burger	27	PAI,LV. Rig #1 Seal Gravel Island	49	Beaufort Kulluk
6	SSDC	28	PAI,LV. Rig #1 Seal Gravel Island	50	Beaufort Kulluk
7	SSDC	29	PAI,LV. Rig #1 Seal Gravel Island	51	Beaufort Kulluk
8	SSDC/MAT	30	SDC/MATT	52	Canmar Kulluk
9	SSDC/MAT	31	SDC/MATT	53	Canmar Kulluk
10	Beaufort Sea #1, CIDS	32	Nabors 27-E, BF-37 Gravel Island	54	Canmar Kulluk
11	Beaufort Sea #1, CIDS	33	Nabors 27-E, BF-37 Gravel Island	55	Canmar Kulluk
12	Beaufort Sea #1, CIDS	34	Nabors 27-E, BF-37 Gravel Island	56	Canmar Explorer II
13	Beaufort Sea #1, CIDS	35	Nabors 27-E, BF-37 Gravel Island	57	Canmar Explorer II
14	GLOMAR Beaufort Sea #1 CIDS	36	Pool Arctic #5, Tern Gravel Island	58	Canmar Explorer II
15	GLOMAR Beaufort Sea #1 CIDS	37	Pool Arctic #5, Tern Gravel Island	59	Canmar Explorer II
16	Spray Ice Island	38	Brinkerhoff #84, Tern Gravel Island	60	GLOMAR Beaufort Sea #1
17	Spray Ice Island	39	Brinkerhoff #84, Tern Gravel Island	61	GLOMAR Beaufort Sea #1
18	Unified Rig #2, Mukluk Gravel Island	40	Brinkerhoff #84, Tern Gravel Island	62	SSDC/MAT
19	Unified Rig #2, Mukluk Gravel Island	41	Brinkerhoff #84, Tern Gravel Island	63	SSDC/MAT
20	SSDC/MAT	42	PAA #4 Tern Gravel Ice Island	64	Beaufort Kulluk
21	SSDC/MAT	43	PAA #4 Tern Gravel Ice Island	65	Beaufort Kulluk

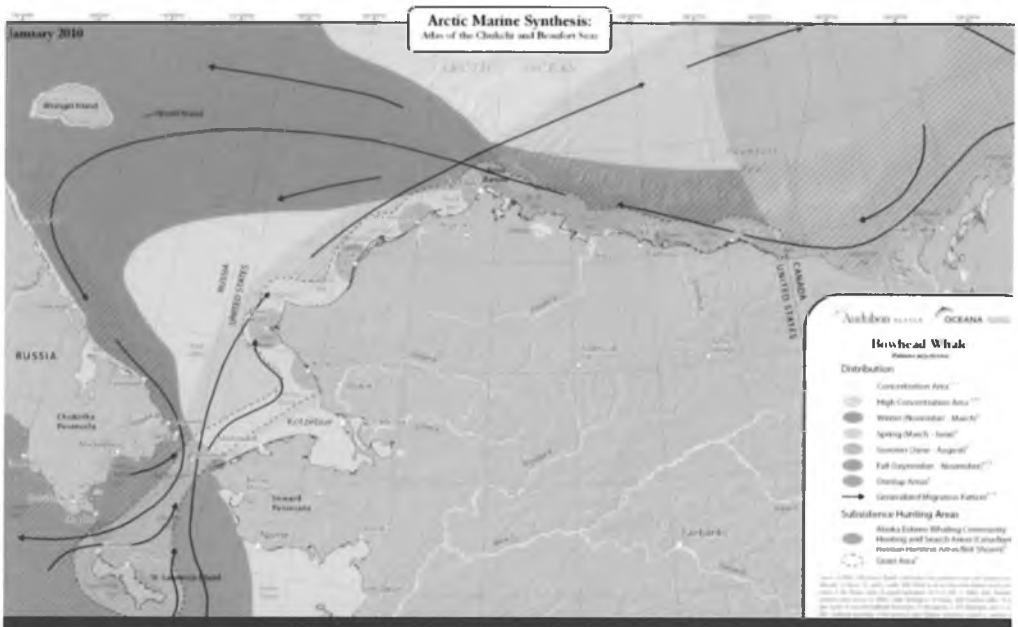
Existing and Near-Future Production in the Beaufort Sea



	Location	Operator	Oil Field	State/Federal	Status
#1	Oooguruk – Artificial Drilling Island	Pioneer	Oooguruk	State	In Production
#2	Near Spy Island – Artificial Drilling Island	ENI	Nikaitchuq	State	In Planning for 2011 Start-Up
#3	Northstar – Artificial Drilling Island	BP	Northstar	State/Federal	In Production
#4	Endicott Main Production Island (MPI)	BP	Duck Island	State	In Production
#5	Endicott Satellite Drilling Island (SDI)	BP	Duck Island	State	In Production
#6	Endicott SDI Expansion	BP	Liberty	Federal	In Construction

Map of Active Lease Areas in the Arctic OCS





1. Resource management agencies must develop and conduct a long-term comprehensive research and monitoring plan.

2. Spill risk assessment and spill prevention technologies must reflect arctic conditions

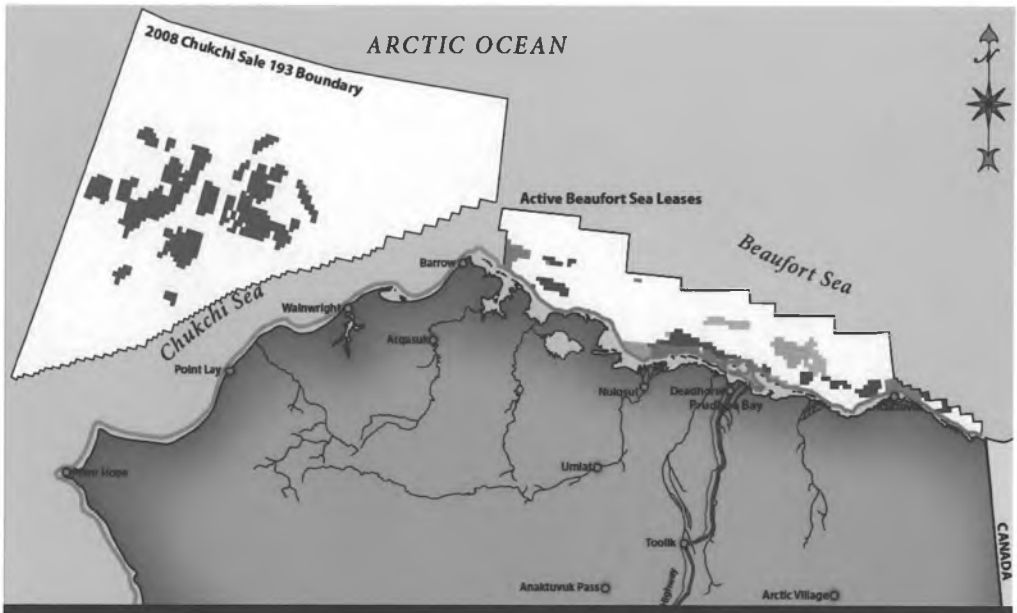
3. Spill response standards must be strengthened and tailored to arctic conditions (BOP, containment system, ice-class vessels)

Table 6-2. Environmental Factors Affecting Operational Limitations in the U.S. Arctic Ocean
(adapted from data at Western Regional Climate Center 2009a & 2009b)

Environmental Factors and Response Gaps (Estimated Percentage of Time When Operating Limits Are Impaired or Exceeded in U.S. Arctic)			
Winter (Jan-March)	**Spring (April-June)**	**Summer (July-Sept)**	**Fall (Oct-Dec)**
Ice Condition: Solid (100%)	Ice Condition: Solid (80%), Broken Ice (20%)	Ice Condition: Broken Ice (60%) Open Water (40%)	Ice Condition: Open Water (20%), Broken Ice (60%), Solid (20%)
Approx. Daylight Hrs 4.5	Approx. Daylight Hrs 19	Approx. Daylight Hrs 21	Approx. Daylight Hrs- 5.5
Avg. # Days Peak Gust >30: 20 (22%)	Avg. # Days Peak Gust >30: 12 (1%)	Avg. # Days Peak Gust >30: 19 (21%)	Avg. # Days Peak Gust >30: 30 (34%)
Avg. # Days of Fog: 51 (57%)	Avg. # Days of Fog: 53 (58%)	Avg. # Days of Fog: 44 (49%)	Avg. # Days of Fog: 51 (57%)
Avg. Ext Min Temp: -49F	Avg. Ext Min Temp: -9F	Avg. Ext Min Temp: 20F	Avg. Ext Min Temp: -32F

Spill prevention should reflect arctic conditions to reduce the risk of a sustained blowout or oil spill

- Containment system, built, tested and proven to work in the Arctic Ocean
- Blowout Preventer redundancy
- Second drilling vessel, designed for operating in arctic conditions, near the drill site for relief well capability
- Realistic worst-case scenario analysis and trajectory model
- Reduce drilling season to open water only, pre-fall whaling



4. Review and oversight of oil and gas drilling must be enhanced

Implement Aleutian Islands Risk Assessment Recommendations in the Arctic Ocean

- Bolster Sub-Area Contingency Planning
- Enhance U.S. Coast Guard Capability
- Establish Restricted Areas and Protective Measures
- Increase Oil Spill Response Capability
- Increase Vessel Monitoring and Reporting

Recommendations to Improve the State's Spill Response Planning and Preparedness

- Identifying and Protecting environmentally sensitive and subsistence use areas
- Pre-staged equipment
- Coastal Protection and Response Strategies – developed and tested with field exercises and drills

CONCLUSION

- Federal Standards specific to arctic offshore energy exploration and development
- Enhanced prevention and response equipment built for the Arctic
- Reduce risk with a summer-only drilling timeline
- Connecting the AIRA recommendations to Arctic preparedness

Report available at www.arcticoilspillreport.org

THE FOLLOWING DOCUMENTS HAVE NOT BEEN FILMED BUT ARE AVAILABLE IN THE ORIGINAL FILE

POLICY RECOMMENDATIONS

Oil Spill Prevention and Response in the U.S. Arctic Ocean

THE PEW ENVIRONMENT GROUP

6

OIL SPILL PREVENTION and RESPONSE IN THE U.S. ARCTIC OCEAN

Unexamined Risks, Unacceptable Consequences

nuka Research & Planning Group, LLC.

9

Lessons Learned from the Deep Water Horizon US Arctic Research Commission

#7

US ARCTIC RESEARCH COMMISSION

ABOUT

The US Arctic Research Commission (USARC) is an independent federal government agency created by the Arctic Research and Policy Act of 1984. The Commissioners are appointed by the President of the United States.

USARC is responsible to both the President and the Congress. Every two years, the Commission develops goals and objectives for the nation's Arctic research program, which has a budget of approximately $400 million per year, and is conducted by approximately 15 US federal agencies and state agencies, local governments, university partners, and private-sector collaborators. The Commission's goals are adopted by an Interagency Arctic Research Policy Committee (IARPC) that develops the national five-year Arctic Research Plan. The Commission is also explicitly tasked with making recommendations on the means for developing international scientific cooperation in the Arctic.

DUTIES

- Develop and recommend a national Arctic research policy
- Assist IARPC in establishing a national Arctic research program plan to implement the policy
- Facilitate cooperation in Arctic research among federal, state, and local governments, and international partners
- Review federal Arctic research programs and recommend coordination improvements
- Recommend improvements in Arctic research logistics
- Recommend improved methods for data sharing among research entities

CONTACT

Washington, DC, Office
4350 N. Fairfax Drive, Suite 510
Arlington, VA 22203
Phone | 703.525.0111

Alaska Office
420 L Street, Suite 315
Anchorage, AK 99501
Phone | 907.271.4577

info@arctic.gov | www.arctic.gov

COMMISSIONERS

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US Arctic Research Commission
Anchorage, Alaska

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Attorney at Law
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Newport, OR

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THE US ARCTIC RESEARCH COMMISSION ENCOURAGES RESEARCH IN FIVE GENERAL AREAS

Environmental Change of the Arctic Ocean and Bering Sea

The Arctic is a clear priority for marine scientific research because the combination of climate change, technological advances, and economic forces make this region increasingly accessible for resource development, transportation, tourism, sovereignty, and security. USARC calls for coordinated research in the Chukchi and Beaufort Seas akin to what was accomplished by the Bering Sea Ecosystem Study. The Study of Environmental Arctic Change (SEARCH), an enduring, interagency effort to understand the nature, extent, and evolution of Arctic environmental change, has grown by the addition of the Arctic Observing Network (AON). The emerging Distributed Biological Observatory (DBO) initiative shows great promise for the Pacific Arctic sector. USARC recommends:

- Increased support for, and broader participation in, AON, DBO, and SEARCH
- Greater integration of Arctic marine research, and support for the strategic action plans being developed by the National Ocean Council

Arctic Human Health

A distinctive approach is required to address health issues of indigenous peoples and to effectively overcome the region's health disparities. US Arctic residents are susceptible to a broad range of physical and behavioral health issues that result in lower life expectancies and higher infant mortality rates than found elsewhere. While the transition from a traditional subsistence lifestyle has brought positive change, it has also increased the prevalence of chronic diseases such as diabetes, hypertension, obesity, and cardiovascular and mental illnesses. Study has just begun on the impact of environmental pollutants and climate change on food safety and health consequences. USARC recommends:

- Developing and implementing an interagency Arctic human health research plan
- A focus on mental and behavioral health issues
- Greater focus on research that would improve access to clean water and improved sanitation systems in rural Alaska

Civil Infrastructure Research

Climate change is impacting civil infrastructure (e.g., roads, buildings, pipelines, ports). Thawing permafrost, increasing coastal erosion, and generally warmer conditions are all contributors. The implications for the Arctic's transportation, communication, energy, and community infrastructure networks are considerable, largely because long-held engineering standards assumed a perpetually stable thermal/permafrost regime. Research is needed to develop new and climate-change-adaptive standards for design, construction, and maintenance. Research and innovative engineering solutions are needed to create new infrastructure to address the demands of an increasingly accessible Arctic, whether by land, sea, or air.

Natural Resource Assessment and Earth Science

As has been clear since the building of the Trans-Alaska Pipeline System, the US Arctic is rich with natural resources from oil and gas, minerals (including rare earth elements), fisheries, lumber, and wildlife ecosystems. Further assessments of living and nonliving resources are needed in the Arctic. Specifically, the US Geological Survey should implement its "Resource Assessment Program" (AMRAP) required by law. Earth science initiatives should continue to incorporate fundamental geophysical and geological research (especially in the Arctic Ocean) so that as a nation, we understand our land, its value, and the extent of our offshore sovereignty beyond the current Exclusive Economic Zone. Emphasis should also be placed on oil-spill prevention and response in the Arctic and sub-Arctic, better Arctic mapping, gas hydrate research, studies of contaminant fluxes and impacts, and long-term funding for the North Slope Science Initiative.

Indigenous Language, Identity, and Culture

Language defines the cultural diversity of our planet, and allows us to separate one population from another. Although critical, language is one of the most vulnerable elements of our cultural heritage. Of the thousands of known languages, fewer than 10 are used by nearly 60 percent of the global population and more than 500 are extinct. In the Arctic, language vulnerability is especially acute, where loss stems from separation of indigenous people from their cultural past. Without a research plan to address Arctic language preservation, the path to language extinction is likely to shorten. This plan should incorporate:

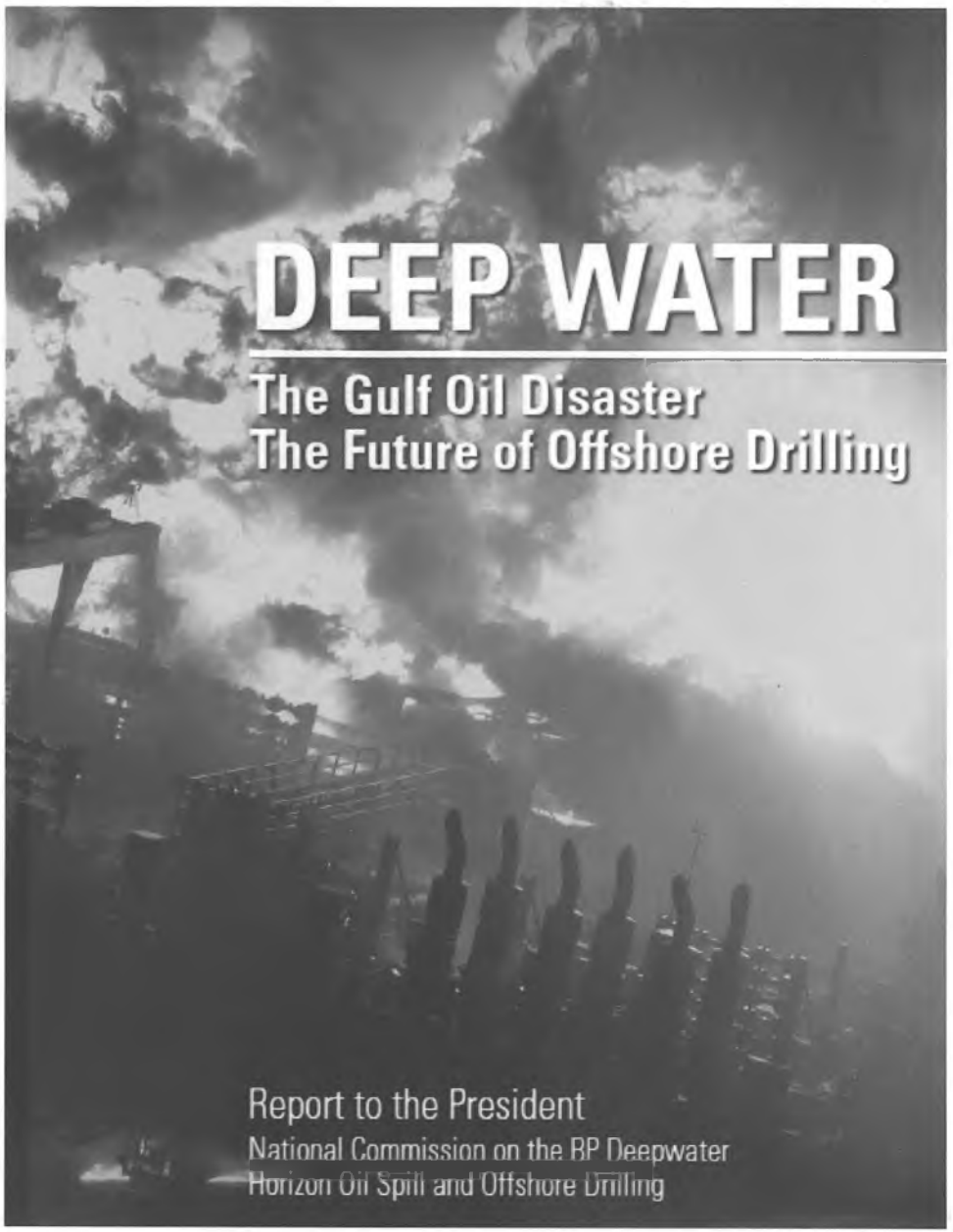
- Regular, permanent census processes to understand the diversity of languages spoken by Arctic people, and the viability of those languages
- Documented procedures to ensure that languages and place names spoken and given by Arctic people are recorded and preserved
- Defined policy options and processes for language preservation that have succeeded in the Arctic, and elsewhere, and are made available to Arctic policymakers and residents

National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling

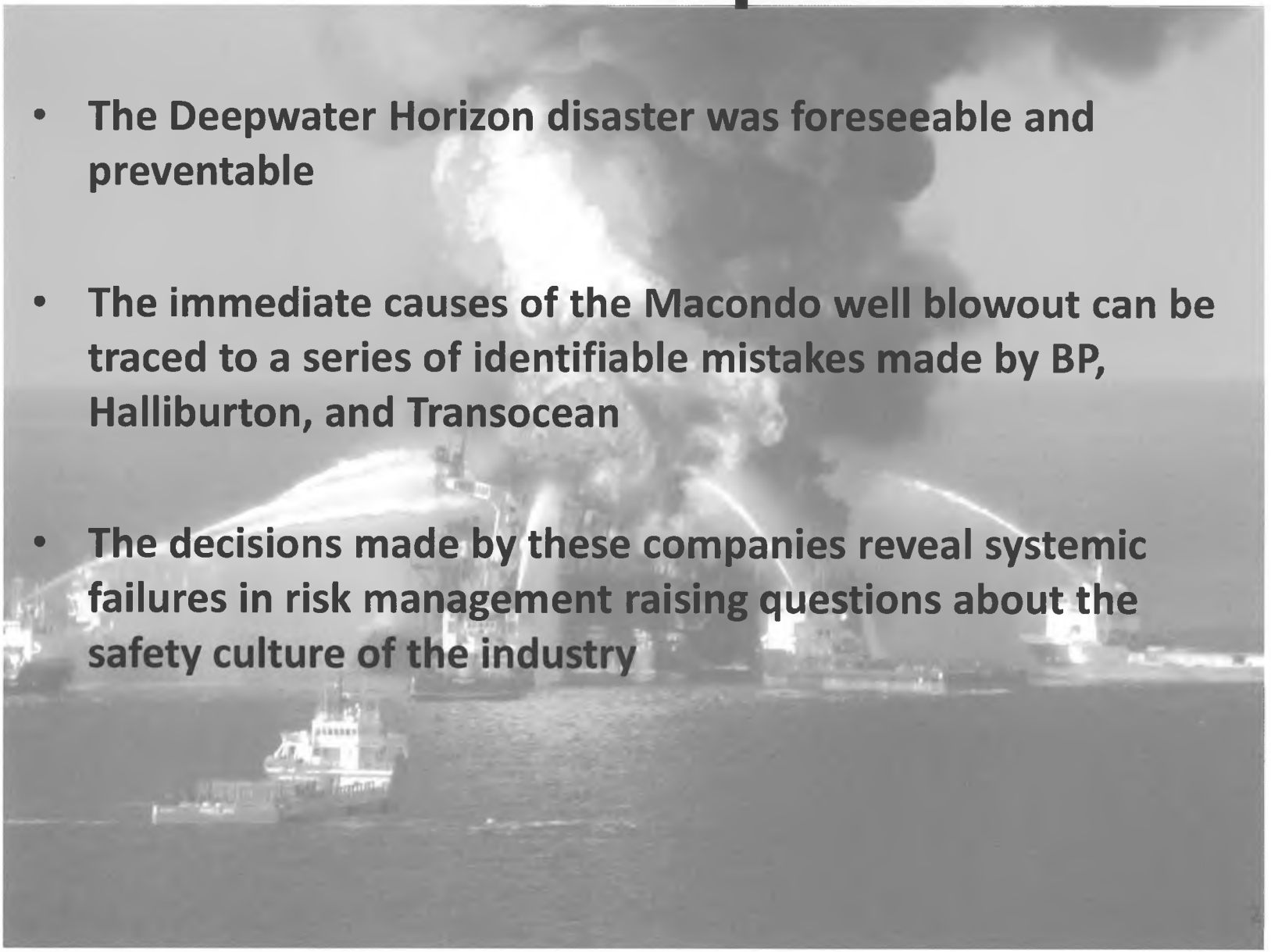
Report to the President

www.oilspillcommission.gov

National Commission on the
BP DEEPWATER HORIZON OIL SPILL
AND OFFSHORE DRILLING



Causes of Explosion



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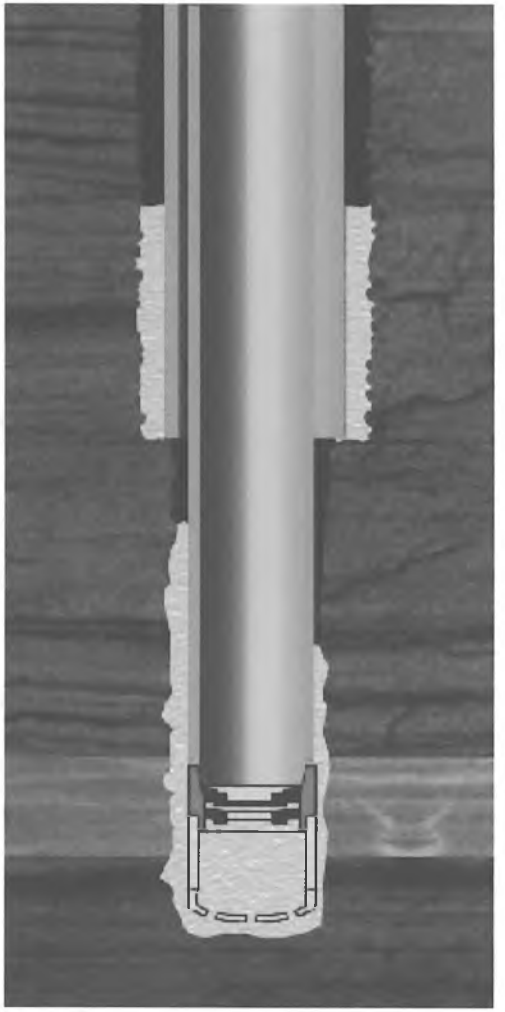
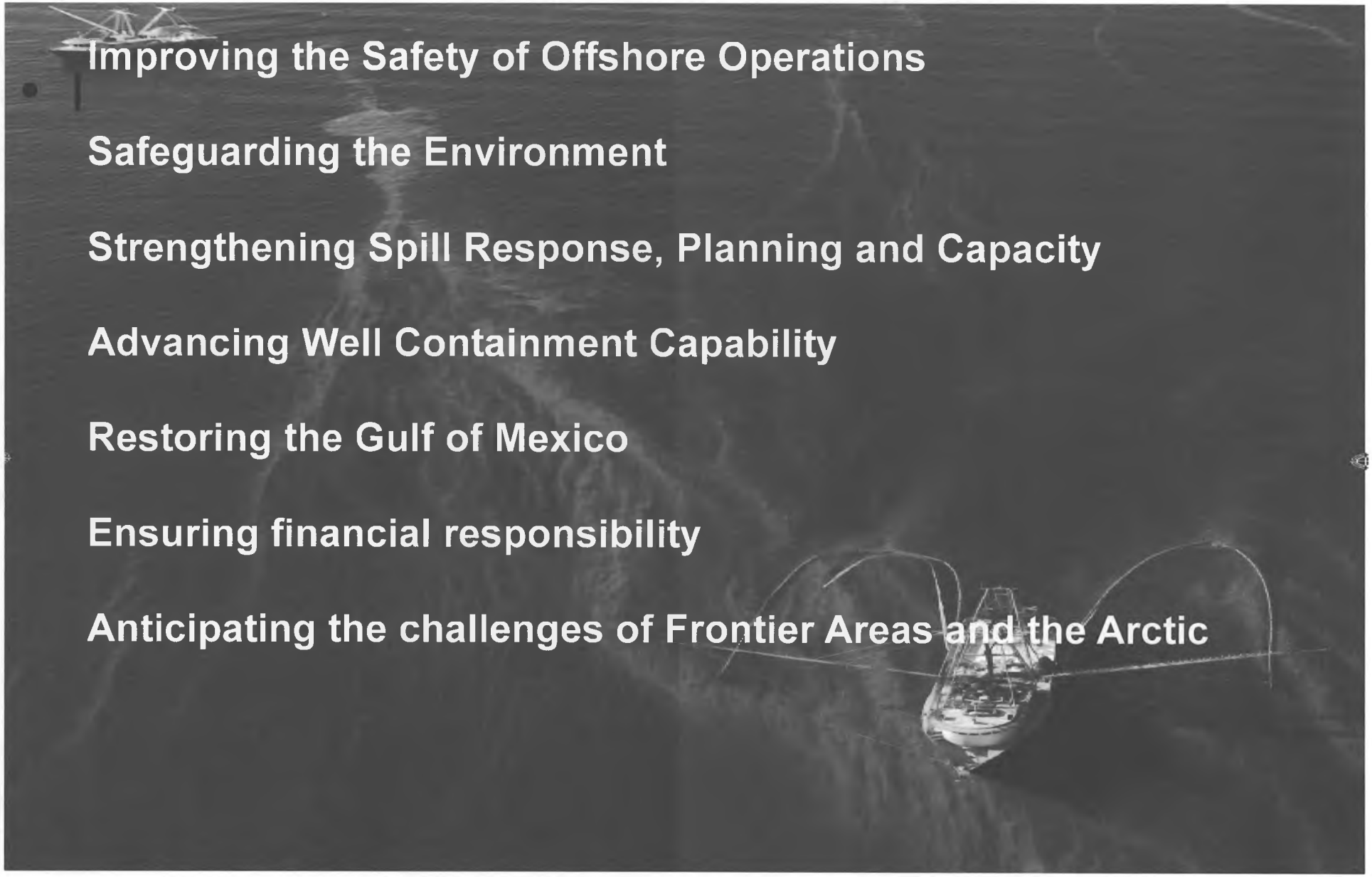


Government Also Failed

- Government regulations did not address several key causes of the blowout
- Regulators lacked the resources or technical expertise to address many issues
- The regulator, MMS, faced conflicts of interest in its diverse responsibilities:
  - Promote offshore leasing
  - Collect revenues from offshore leasing
  - Conduct environmental reviews
  - Review plans and issued permits
  - Conduct audits and inspections
  - Enforce safety and environmental regulations

Key Recommendations



Improving the Safety of Offshore Operations

Safeguarding the Environment

Strengthening Spill Response, Planning and Capacity

Advancing Well Containment Capability

Restoring the Gulf of Mexico

Ensuring financial responsibility

Anticipating the challenges of Frontier Areas and the Arctic

Recommendations for Federal Agencies

- Assign offshore energy management responsibilities to 3 entities
  - An independent safety authority
  - A Leasing and Environmental Science Office
  - An Office of Natural Resources Revenue
- Promulgate improved regulations and interagency coordination
- Develop management system incorporating "safety case" approach
- Promote adoption of consistent international best practice standards
- Improve NEPA environmental reviews
  - Stronger interagency consultation (particularly with NOAA)
  - Implemented by Office of Environmental Science

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  - A focused commitment to constant improvement and zero failure rate
  - Other high risk industries have agreed to hold themselves and peers accountable for safety
  - Set up mechanisms to make this real
- Should benchmark safety and environmental practice rules against recognized global best practices
- Should have containment technologies immediately available

Response and Containment Recommendations

- Improve oil spill response capabilities
  - Better planning: broader reviews, incorporate "worst-case" scenarios
  - Establish special processes for spills of national significance
  - Strengthen state and local involvement
  - Increased research and development
  - Improved regulations governing dispersants
  - More careful evaluation of extraordinary measures, e.g. sand berms
- Improve well containment capabilities
  - Government should acquire technical expertise
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  - Improve ability to estimate well flow rates accurately
  - Safer well design
  - Better and more sensors

Recommendations for the Arctic

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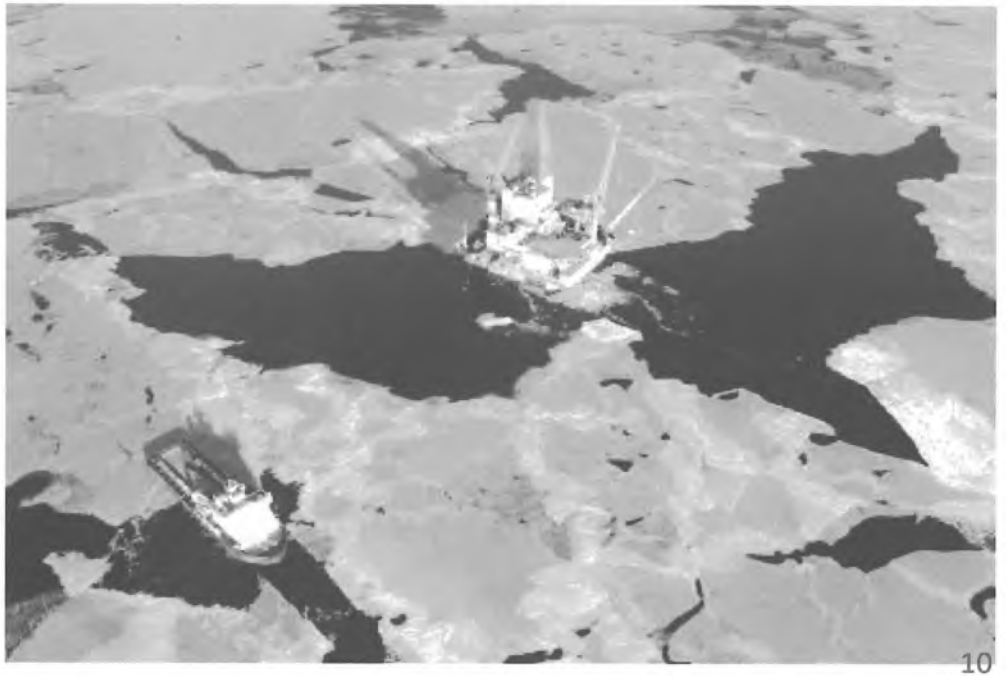
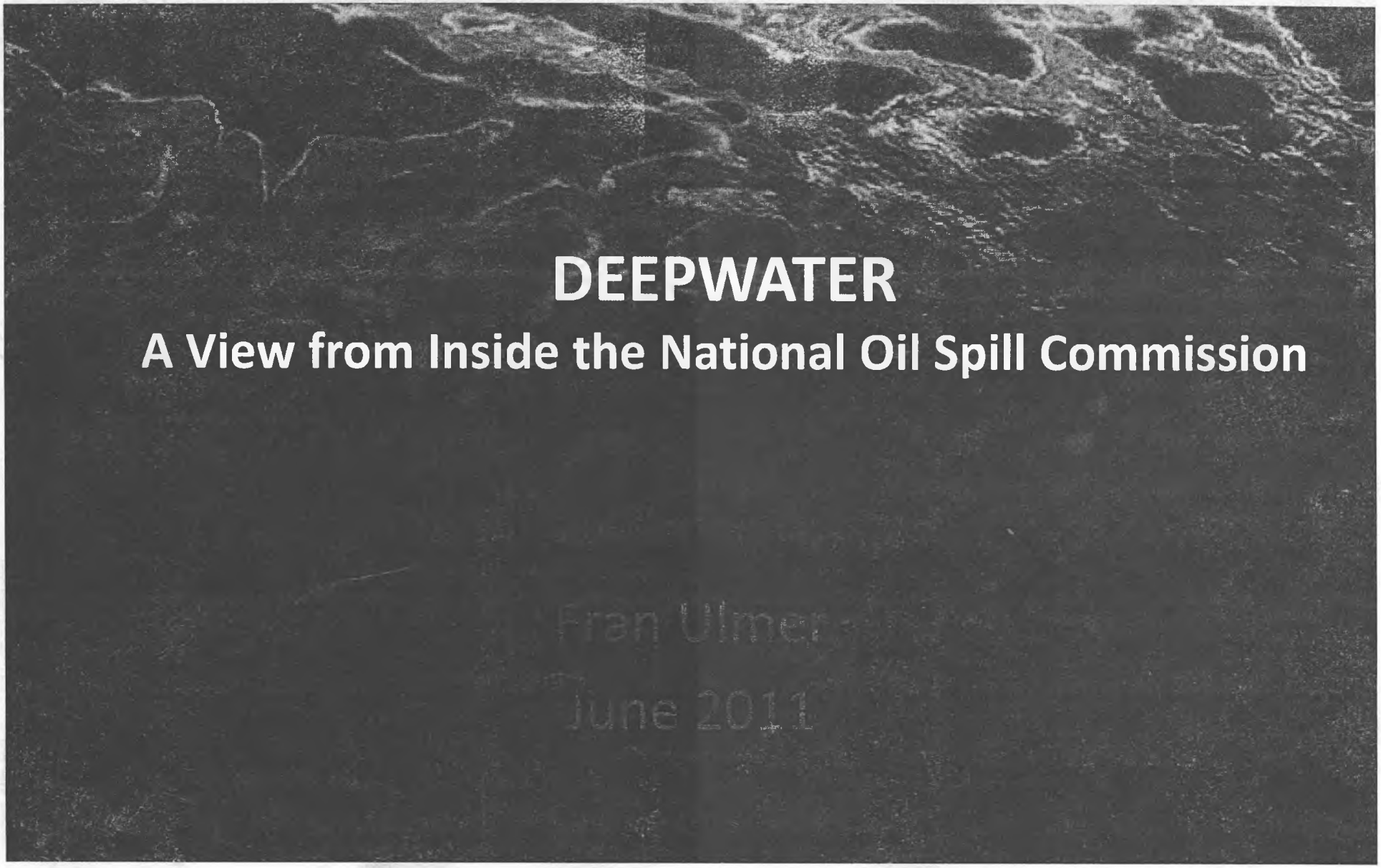
  - Containment
  - Search and rescue
- The U.S. should promote the development of international drilling standards for the Arctic





DEEPWATER

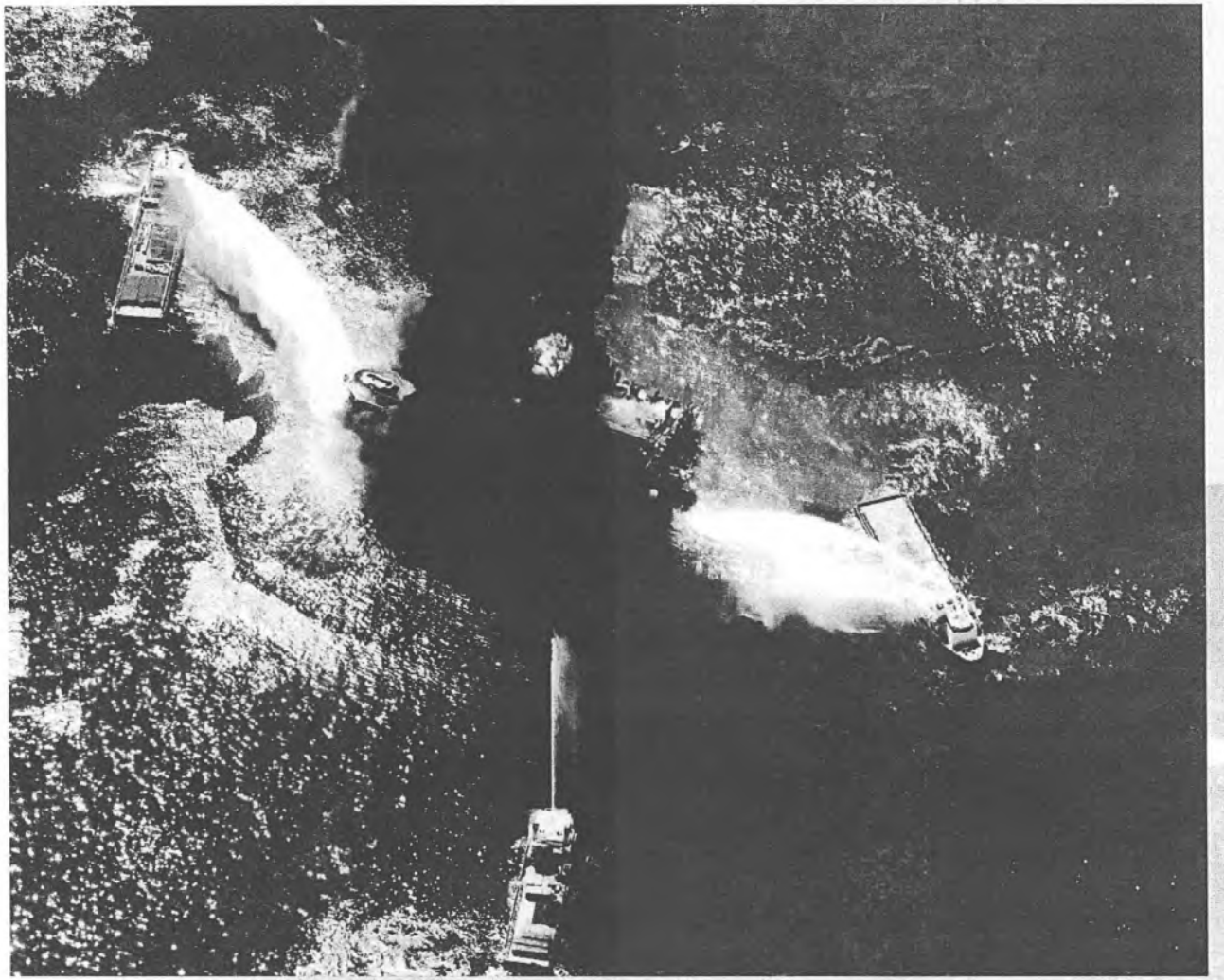
A View from Inside the National Oil Spill Commission

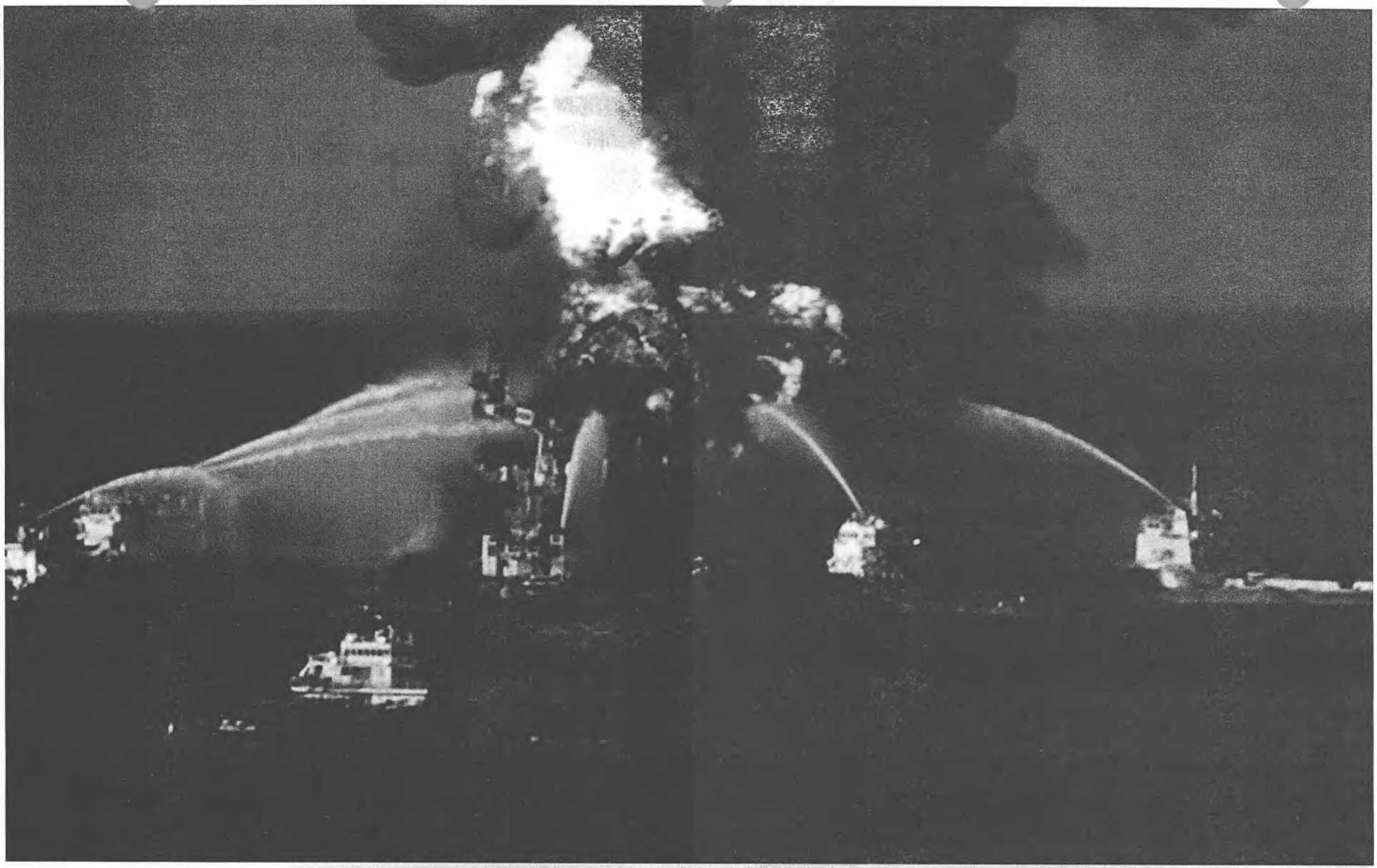
Fran Ulmer

June 2011

National Commission on the
BP DEEPWATER HORIZON OIL SPILL
AND OFFSHORE DRILLING

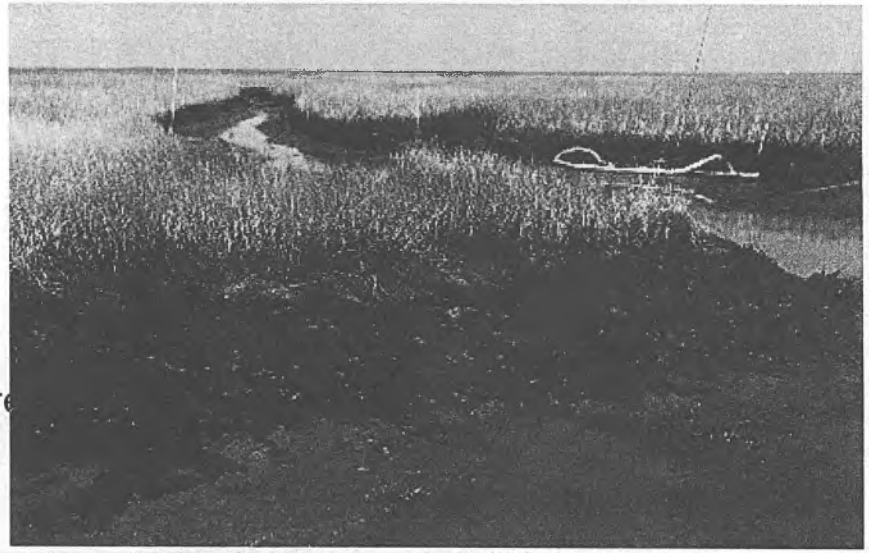
April 20, 2010

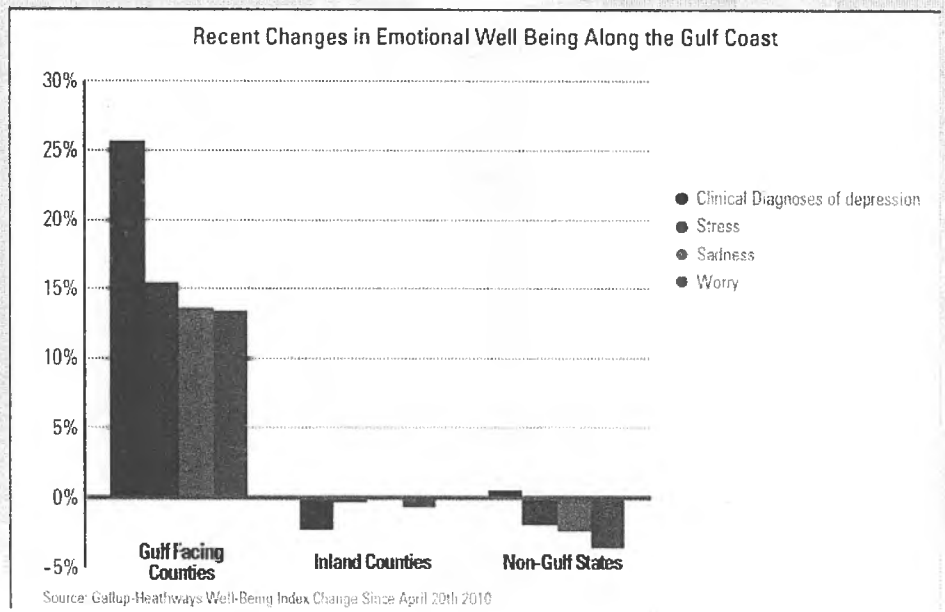




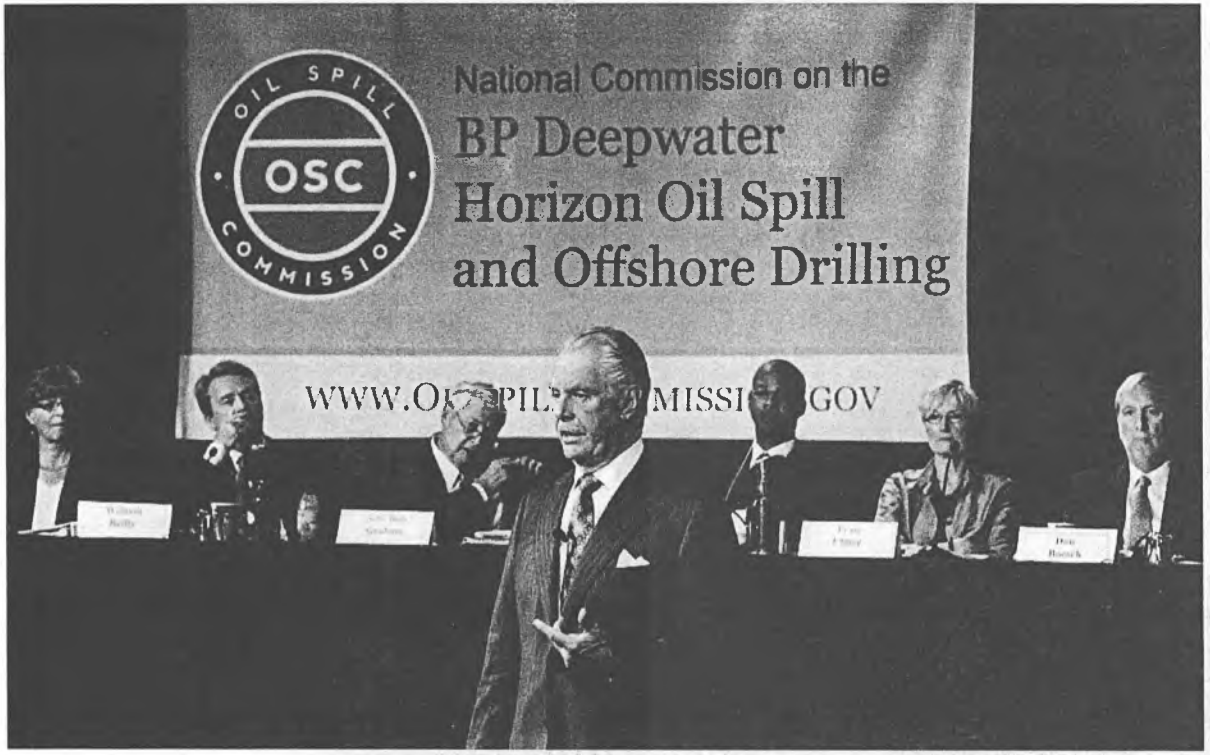
Costs of Blowout Significant

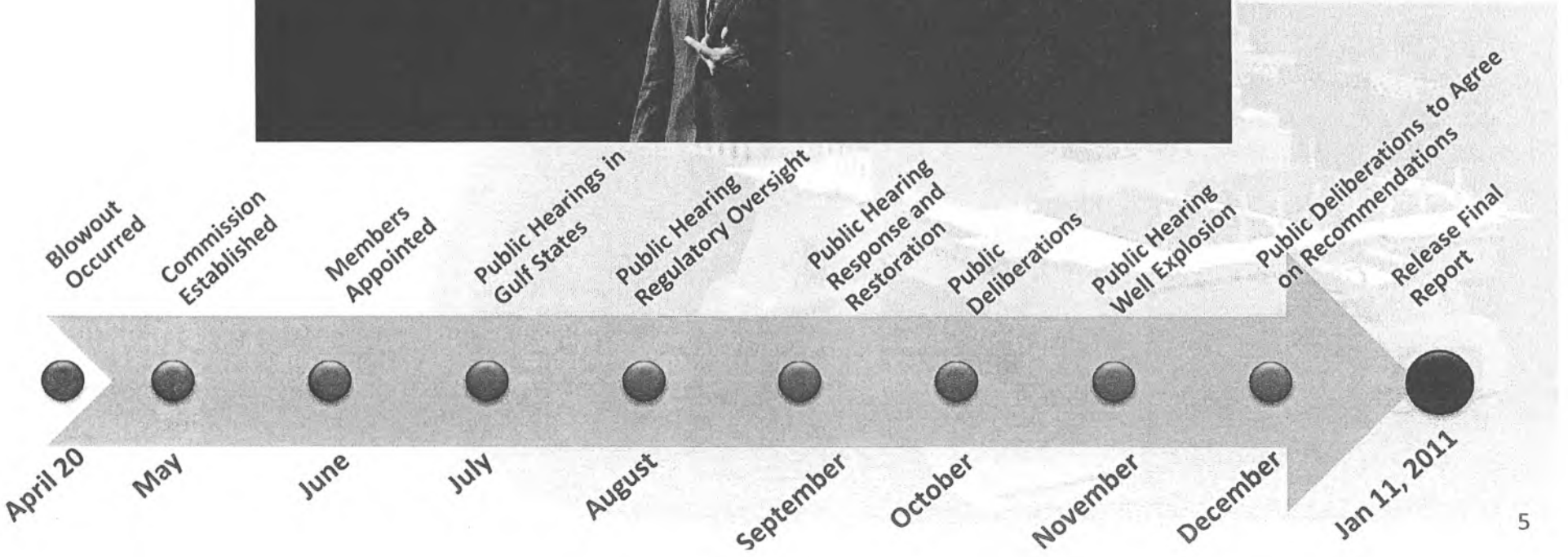
- Eleven men died, dozens injured
- Millions of gallons of oil released into Gulf
- Response Costs
- Environmental Damage
  - Marine and coastal ecosystems already severe stressed
  - Long-term impacts not yet known
- Economy
  - Seafood Industry
  - Tourism Industry
  - Oil and gas industry
- Residents of Gulf
  - Impacts on health
  - Increased depression





The Commission

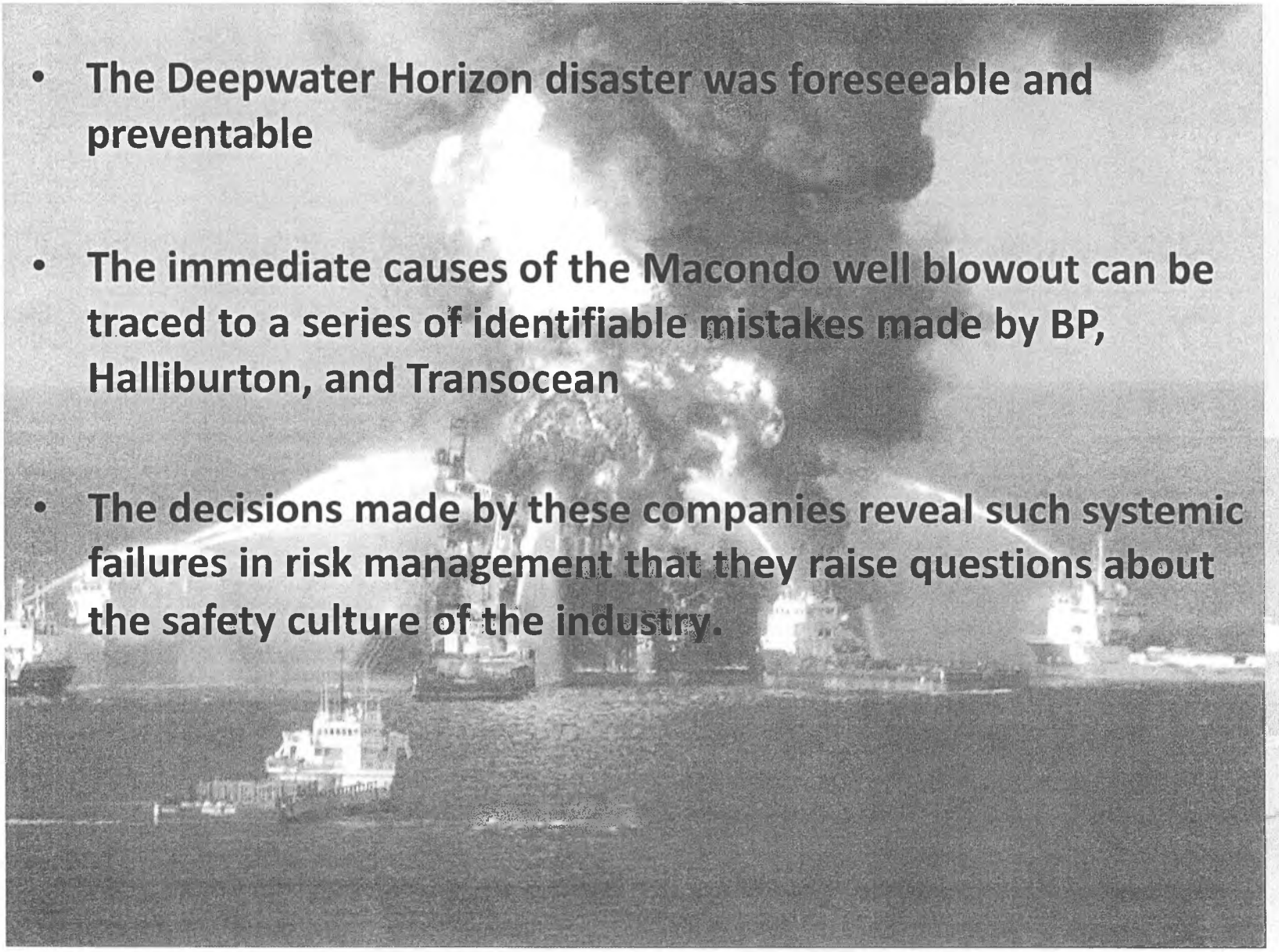




Our Mission

- **Created by Executive Order 13543, dated May 21, 2010**
- **The President asked the Commission to**
  - Examine the relevant facts and circumstances concerning the root causes of the Deepwater Horizon oil disaster;
  - Develop options for guarding against, and mitigating the impact of, oil spills associated with offshore drilling, taking into consideration the environmental, public health, and economic effects of such options
- **The Commission did not attempt to:**
  - Fix legal culpability
  - Reformulate US energy policy

Key Findings on Causes of Explosion



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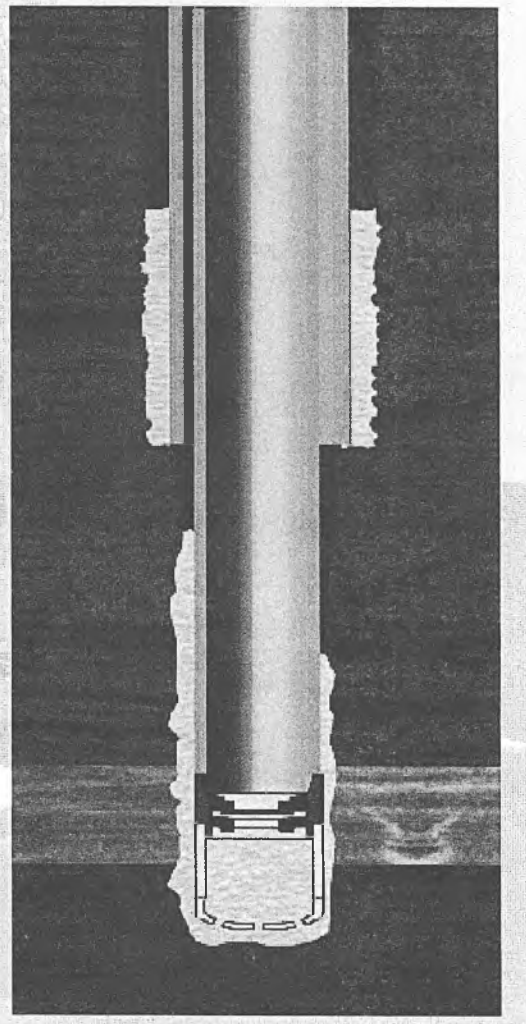

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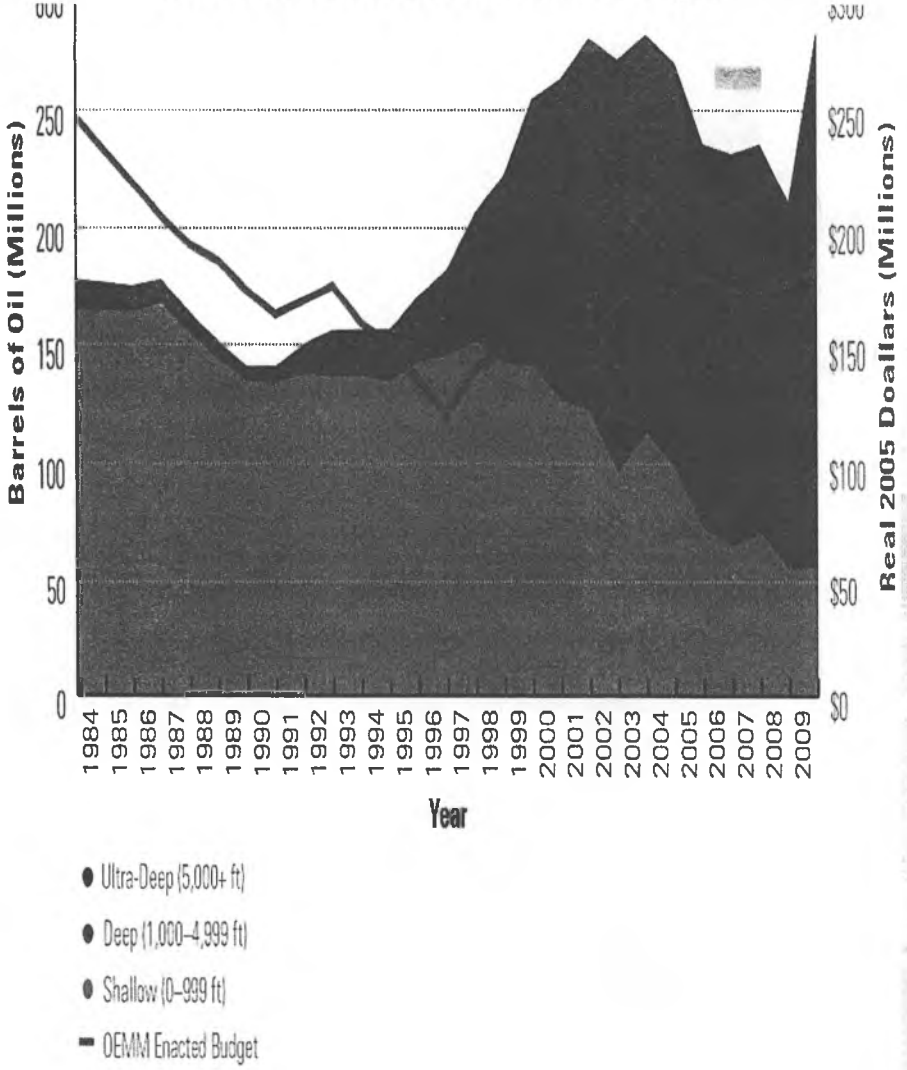
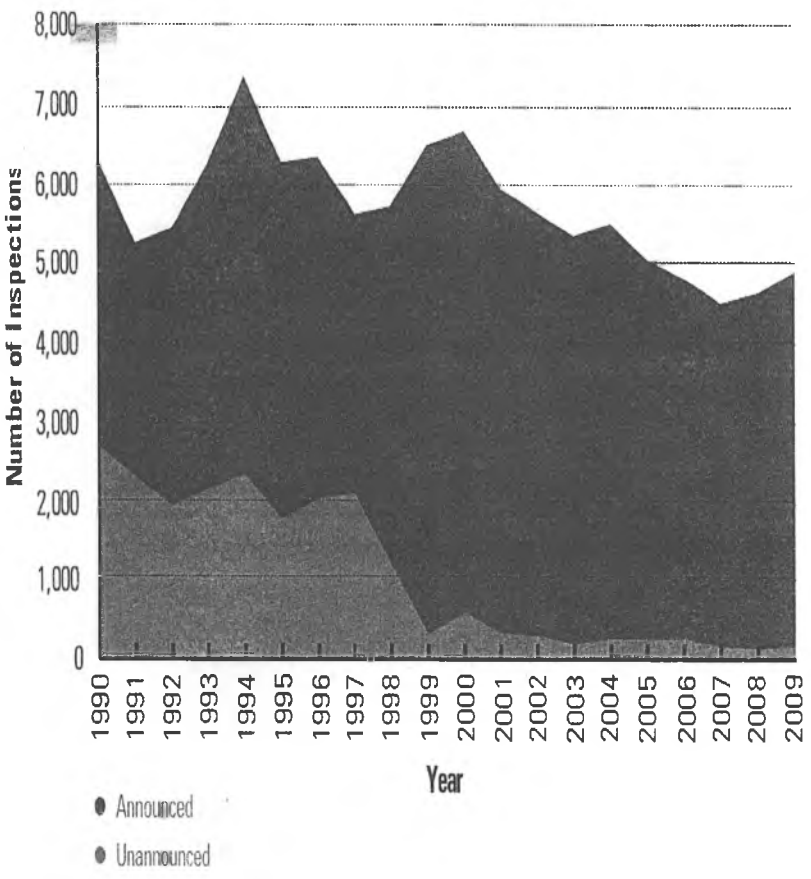
MMS Resource Constraints

OCS Oil Production and MMS Budget

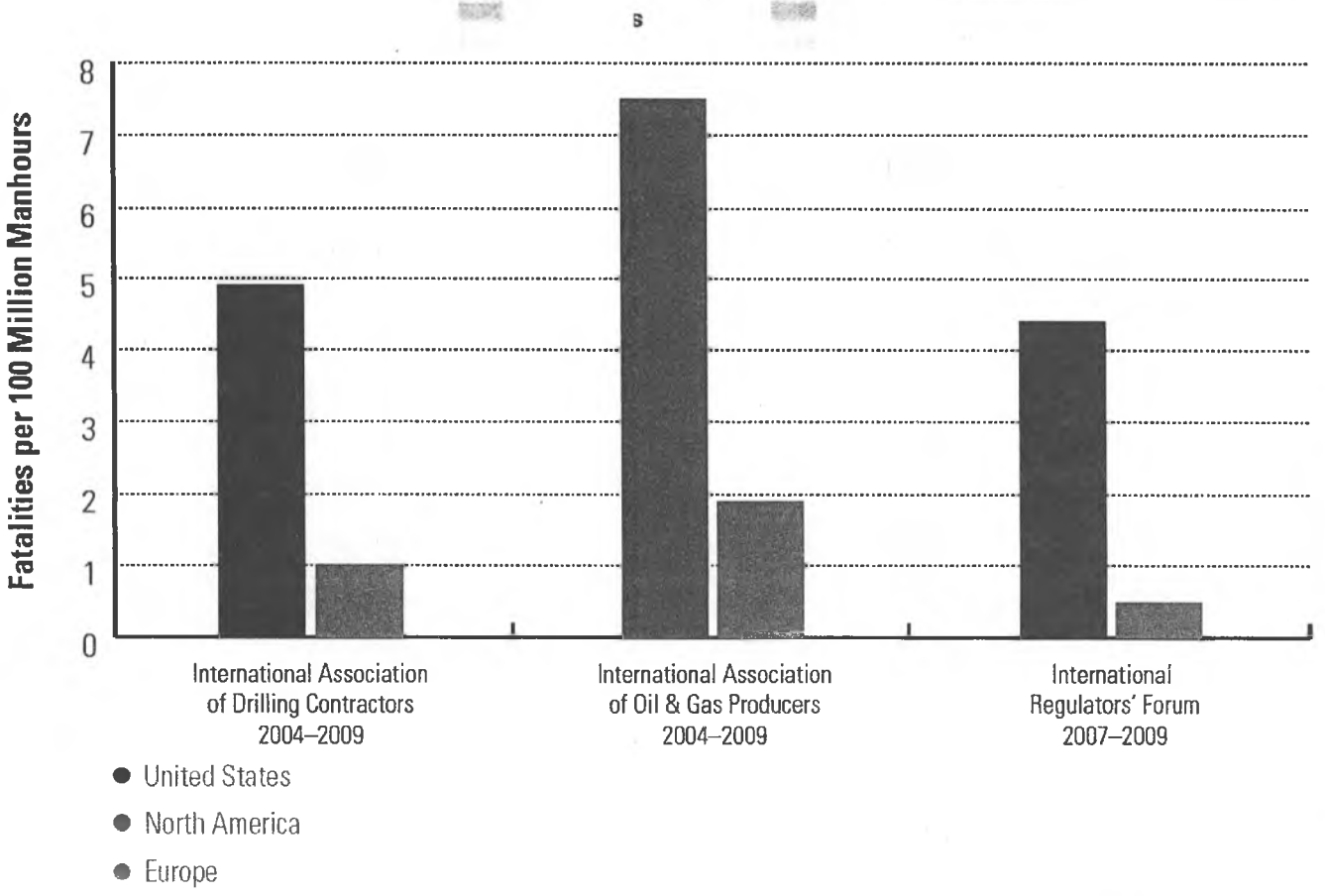


MMS Inspections



Lower Fatality Rate in European than US Operations

Fatalities from Offshore Oil and Gas Operations:
Europe and the United States



http://www.irfoffshoresafety.com/country/performance/.

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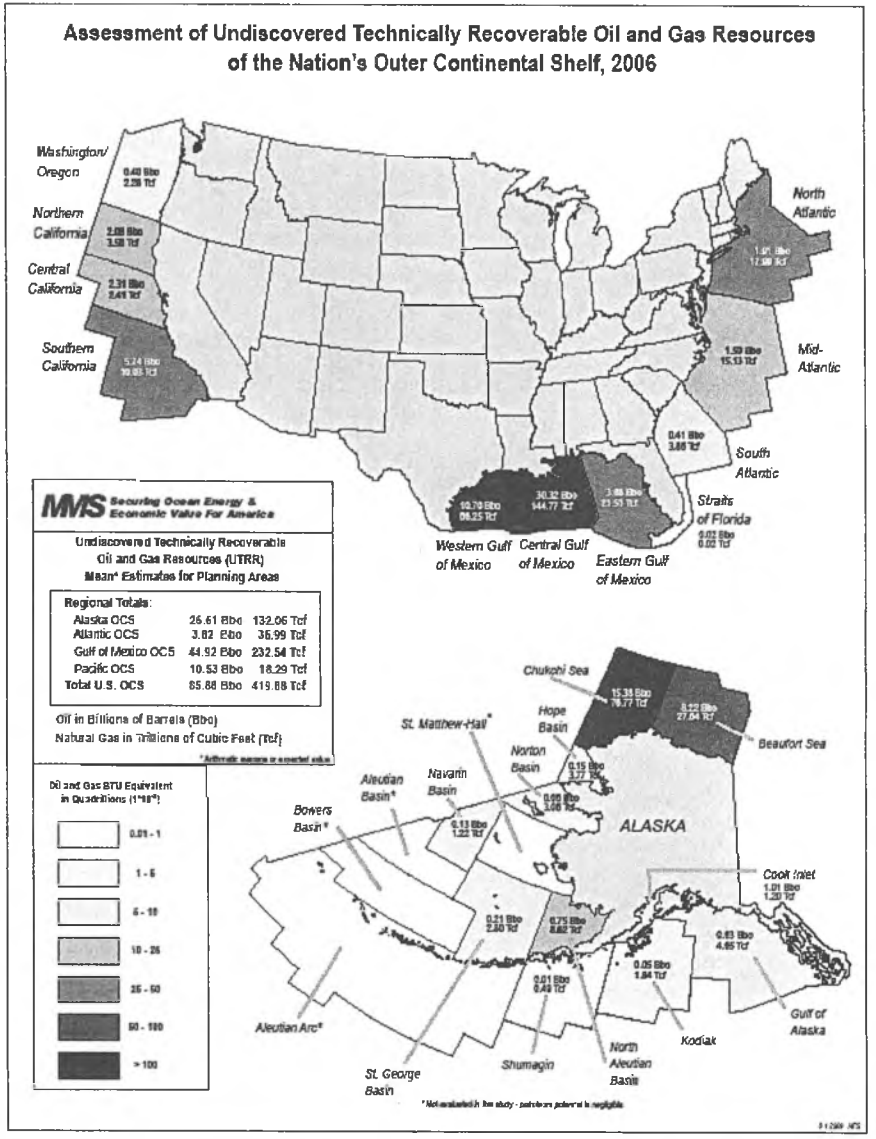
The Future

- Offshore drilling will become more complex and riskier
  - Deeper, higher pressure
  - New regions
  - More remote (Alaska)
- Offshore drilling in nations adjacent to the U.S. is likely to accelerate
  - Mexico and Cuba in the Gulf
  - Russia and Canada in Arctic
- Offshore deepwater drilling can be done safely



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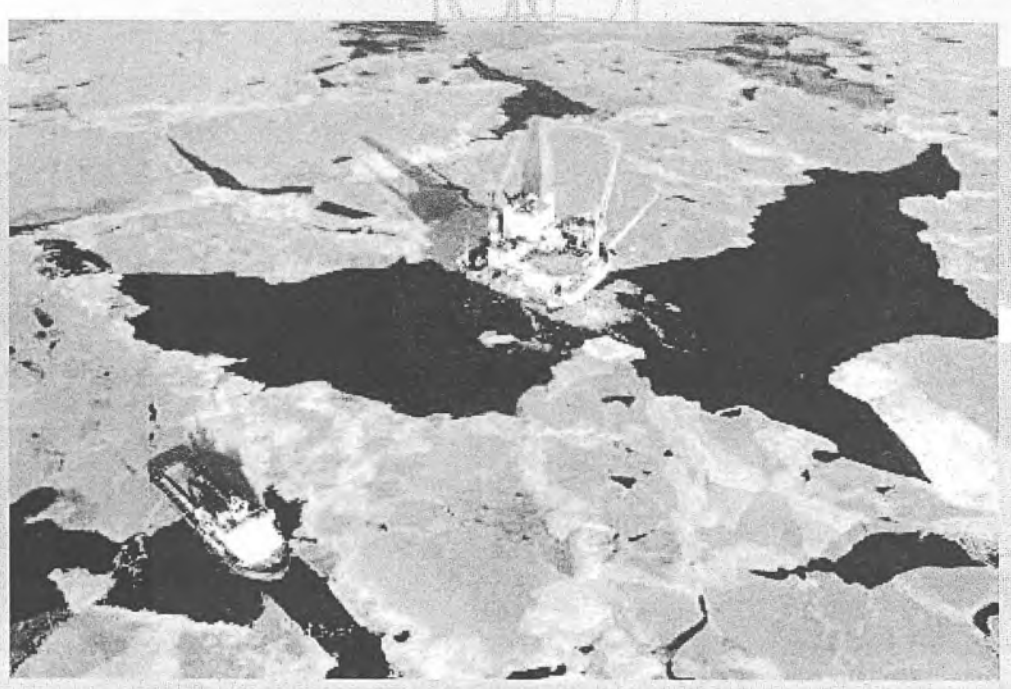
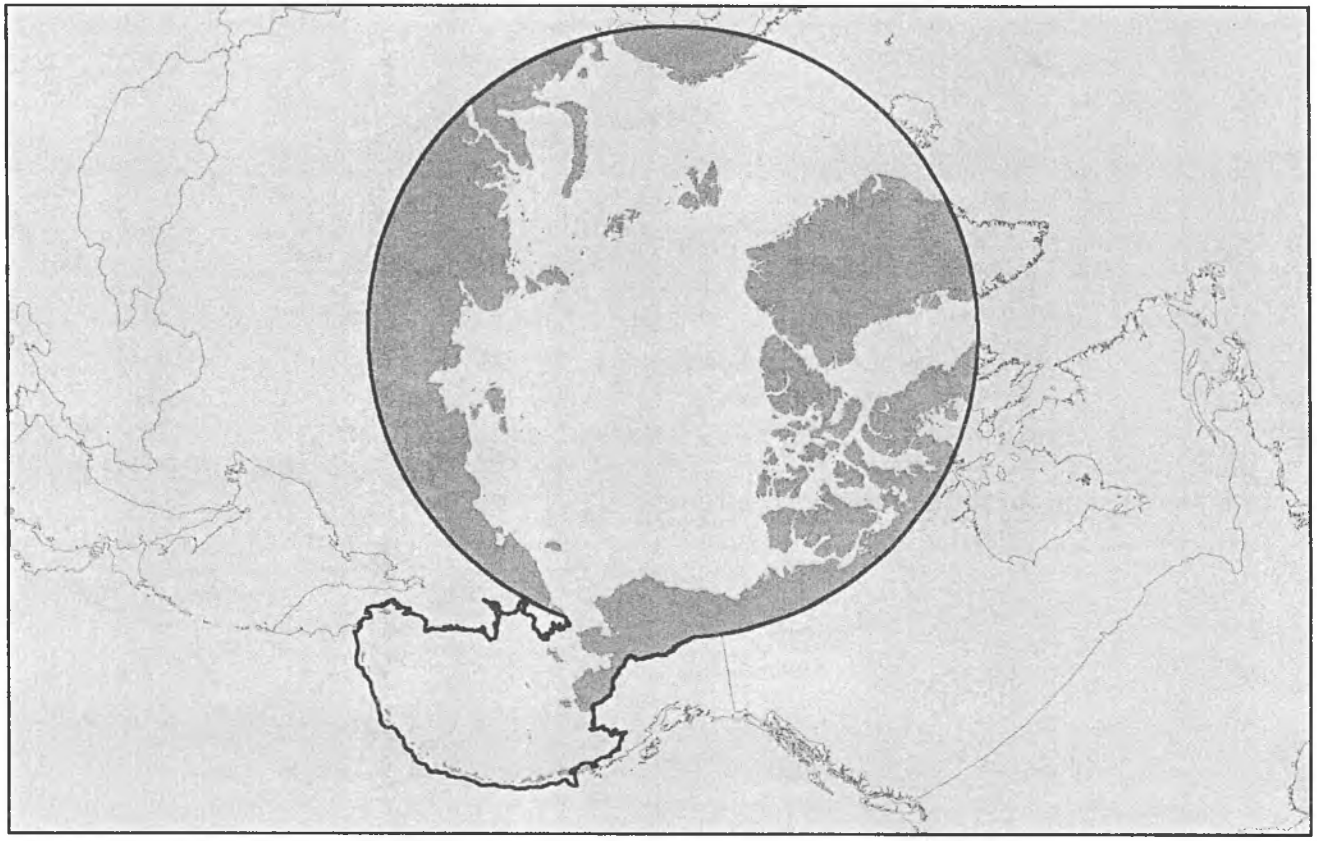


Arctic Boundary as defined by the Arctic Research and Policy Act (ARPA)

All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain.[1]

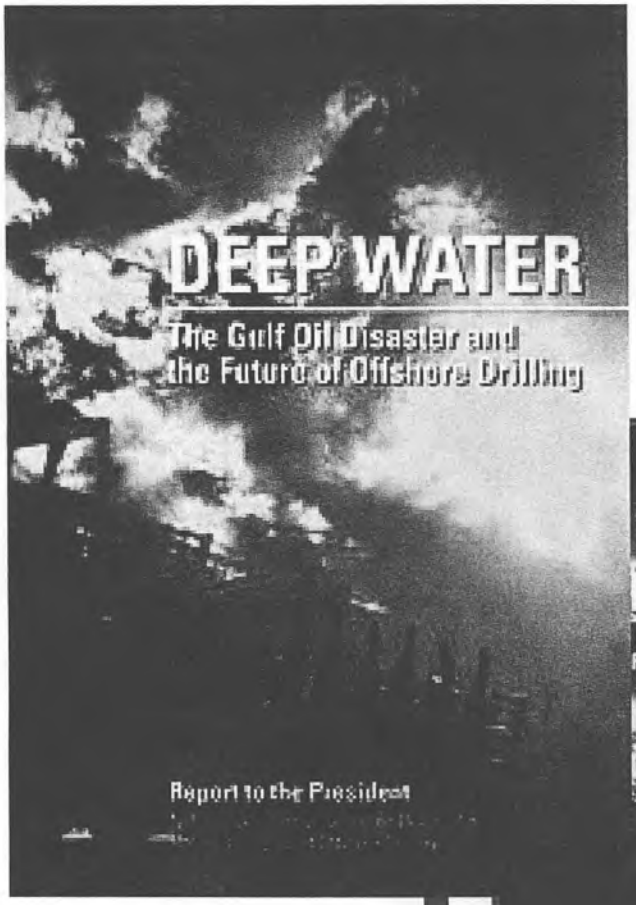


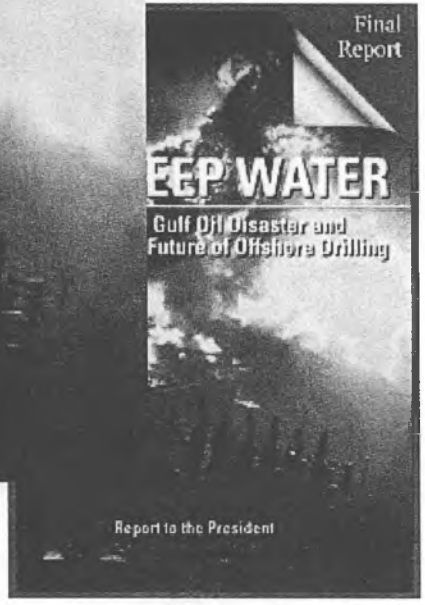
Acknowledgement: Funding for this map was provided by the National Science Foundation through the Arctic Research Mapping Application (armap.org) and Contract #0520837 to CH2M HILL for the Interagency Arctic Research Policy Committee (IARPC).

Map author: Allison Gaylord, Nuna Technologies. May 27, 2009.

1. The Aleutian chain boundary is demarcated by the 'Contiguous zone' limit of 24-nautical miles.

Reports and Website



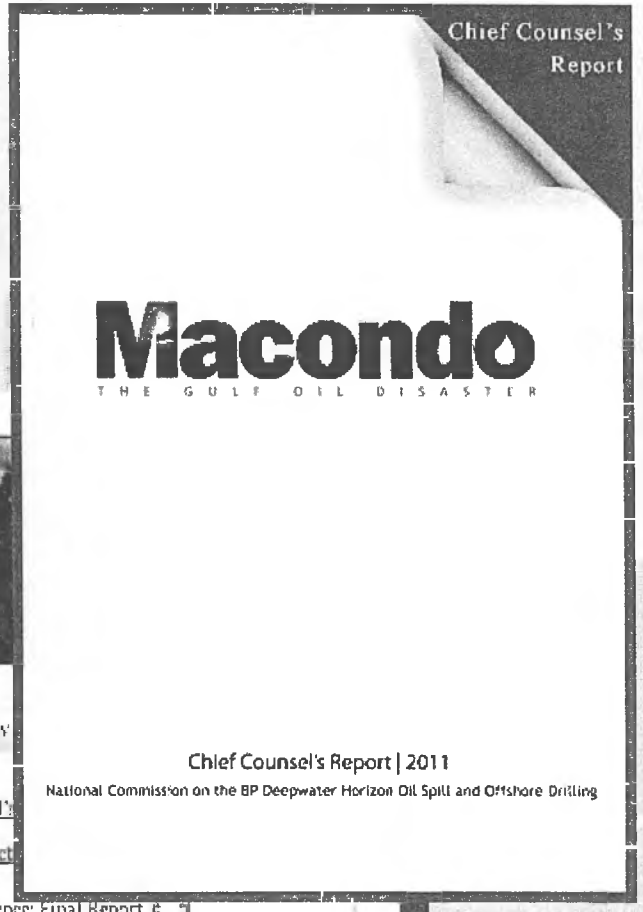


Printed copies of the report can be obtained from The Government Printing Office, and Amazon

What's New

New Content

- Chief Counsel's
- NEW! Interact
- Press Conference: Final Report
- Forum: Final Report



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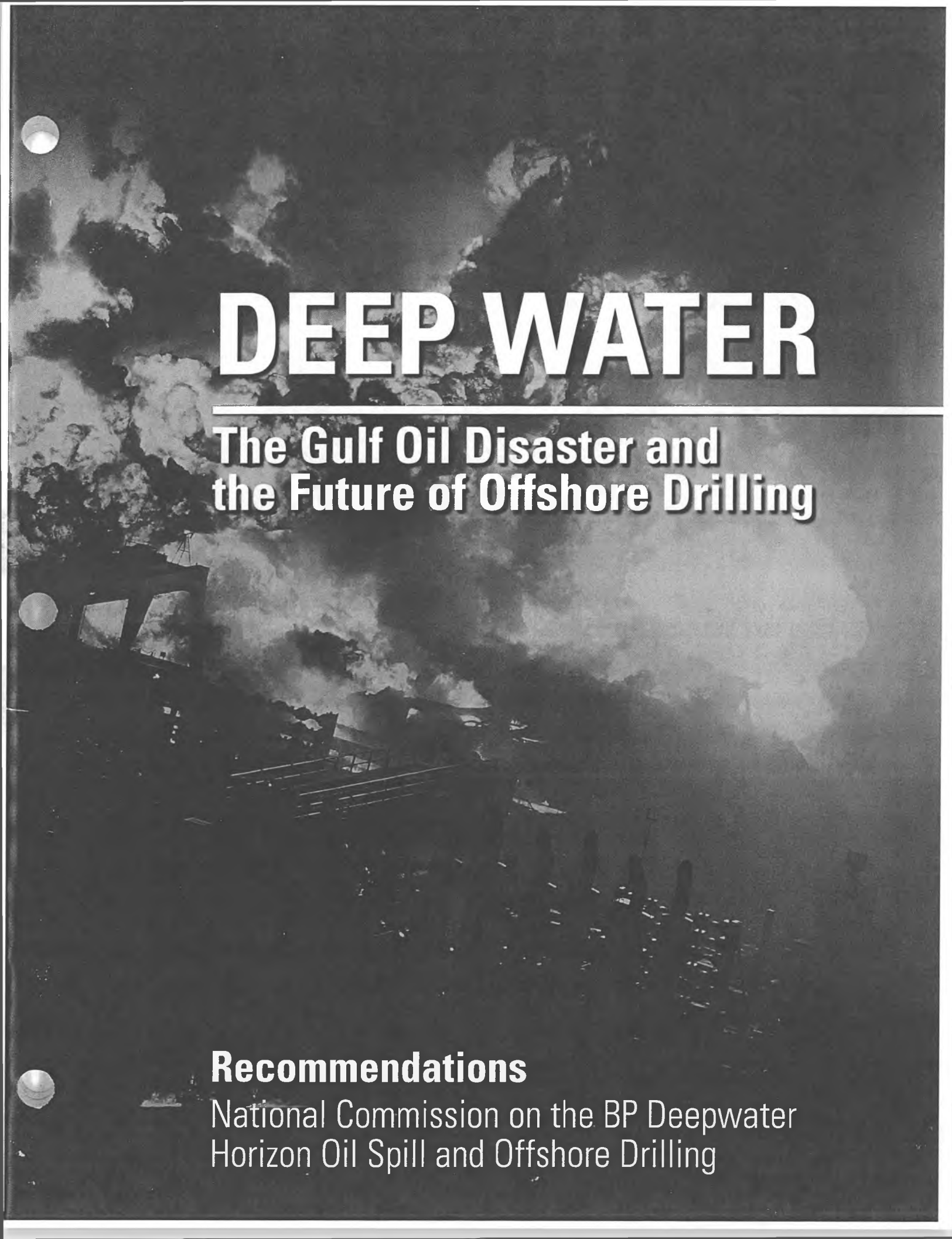
THE FOLLOWING 4 DOCUMENTS HAVE NOT BEEN FILMED BUT ARE AVAILABLE IN THE ORIGINAL FILE



DEEP WATER

The Gulf Oil Disaster and the Future of Offshore Drilling

Recommendations

National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling

#7

US ARCTIC RESEARCH COMMISSION

REPORT ON

GOALS AND OBJECTIVES FOR ARCTIC RESEARCH 2009–2010

FOR THE US ARCTIC RESEARCH PROGRAM PLAN

SCALING STUDIES IN ARCTIC SYSTEM SCIENCE AND POLICY SUPPORT

A CALL-TO-RESEARCH

A REPORT FROM THE
U.S. ARCTIC RESEARCH COMMISSION

SCICEX Phase II Science Plan

PART 1: TECHNICAL GUIDANCE FOR PLANNING SCIENCE ACCOMMODATION MISSIONS

10

Northern Waters Task Force Overview

NWTF Chair Rep. Joule

Northern Waters Task Force

An Introduction

NWTF: Introduction

The Northern Waters Task Force (NWTF) was created by HCR 22 during the 2010 legislative session.

NWTF: Membership

- The NWTF is comprised of legislators, leaders of Arctic communities, and members of key state and federal agencies.
- Membership includes:

Rep. Reggie Joule
Kotzebue, Chair

Sen. Bert Stedman
Sitka, Vice-Chair

Sen. Lyman Hoffman
Bethel

Rep. Bob Herron
Bethel

NWTF: Membership

DEC Commissioner
Larry Hartig

Mayor Edward Itta
North Slope Borough

Chris Hladick
Unalaska City Manager

Mayor Denise Michels
Nome

Chuck Greene
Vice-President, NANA Corp.

Dave Kubiak
Alaska Marine
Conservation Council

Alternates: Sen. Donald Olson; Rep. Bryce Edgmon; Richard Glenn, *Arctic Slope Regional Corp*oration; Commissioner Cora Campbell, *Alaska Dept. of Fish & Game; Rear Admiral Ostebo, Federal Liaison*

NWTF: Duties

- According to the resolution the task force will:
  - Create a state and federal commission responsible for overseeing development
  - Facilitate regional coordination, cooperation, and outreach in creating a commission to keep local stakeholders informed and able to engage
  - Identify and coordinate efforts of mutual concern for federal, state, local and international agencies
  - Conduct hearings in the northern region of the state to fulfill the above purposes

NWTF: Meetings

- Past Meetings
  - Anchorage- October 1st, 2010
    - *Introduction of issues and organizational meeting*
  - Barrow- December 2nd-3rd, 2010
    - *Local, regional and international perspective on the Arctic*
  - Juneau - March 14th, 2011
    - *Organizational meeting*

- Upcoming Meetings
  - Girdwood – June 19th-21st
    - *Arctic Imperative*
  - Kotzebue and Nome – July 5th-6th
  - Unalaska – August 24th-27th
  - Bethel – October

On the web at *www.housemajority.org/joule*

NWTF: Why monitor the Arctic?

- Loss of sea ice has led to increased human activity in the Arctic and has raised a variety of concerns about future development
- Forecasts predict the possibility of an ice-free Arctic within 20-30 years
- An ice-free Arctic would create new challenges and opportunities for
    - Arctic inhabitants
    - Communities
    - State of Alaska
    - United States
    - other countries

NWTF: Areas the task force is addressing

- Arctic Governance
- Oil, Gas and Mineral Development
- Arctic Fisheries
- Marine Transportation
- Arctic Research
- Arctic Infrastructure

NWTF: Arctic Governance

- The United States is an Arctic country by virtue of Alaska's geography
- Eight countries have territory north of the Arctic Circle
  - Finland
  - Sweden
  - Iceland
  - United States
  - Canada
  - Russia
  - Norway
  - Denmark (Greenland)
- The last five countries are on the Arctic coast

NWTF: Indigenous Engagement

- Seven of the eight countries in the Arctic are home to indigenous peoples.

- The indigenous populations have a unique and vast knowledge of the Arctic region and environments developed over a long period of time.

NWTF: Questions to Consider

- How does the US govern the Arctic internally while cooperating with the state and local Arctic communities and peoples?

- How do we govern the Arctic region cooperatively with other Arctic nations?

NWTF: Oil, Gas and Mineral Exploration

- A 2008 US geological survey estimates 13% of the earth's undiscovered oil reserves and 30% of the undiscovered gas reserves are in the Arctic.
- The majority of the oil is likely be offshore.
- <u>In perspective, this equates to:</u>
  - 90 billion barrels of oil
  - 1,700 trillion cubic feet of natural gas
  - 44 billion barrels of natural gas liquids

NWTF: Question to consider

- How do we develop our resources responsibly while maintaining sustainable environments and thriving Arctic communities?

- How do we develop Arctic resources cooperatively with other nations

  while maintaining sustainable environments and thriving Arctic communities?

NWTF: Arctic fisheries

- Alaska and the Arctic contain some of the worlds largest and most valuable fisheries.

- Scientists are discovering that a number of sub-arctic species, such as cod, herring and pollock,

  are expanding their habitation further north and creating commercial fishing opportunities.

- The North Pacific Fisheries Management Council currently bans commercial fishing in the Arctic.

NWTF: Question to consider

- Should commercial fishing be banned in the Arctic?
- Who will manage and monitor Arctic fisheries for sustainability?
- How would you manage an Arctic Ocean fisheries management area with other countries?

NWTF: Marine Transportation

- Diminished sea-ice has led to increases in commercial shipping on two trans-Arctic sea routes.
- An estimated 6,000 individual vessels operate in the Arctic (2009, AMSA).
- Tourism and passenger vessels visits are increasing.
- In 2007, an estimated 2.4 million cruise ship passengers traveled to Arctic destinations.

NWTF: Question to consider

- Who will govern shipping, security and safety in the Arctic Ocean?
- How do you govern shipping cooperatively with other nations?

NWTF: Infrastructure

Arctic Infrastructure Investment and Long-term Planning

The increase in human activity will require new infrastructure to support increased activities in

- fishing
- oil and gas development
- marine transportation

NWTF: Question to consider

- What infrastructure is needed to support increased activity in resource development, transportation, fisheries and national security?
- How can the infrastructure development be accomplished cooperatively with local communities to meet everyone's needs?
- Who is responsible for long-term planning and monitoring?

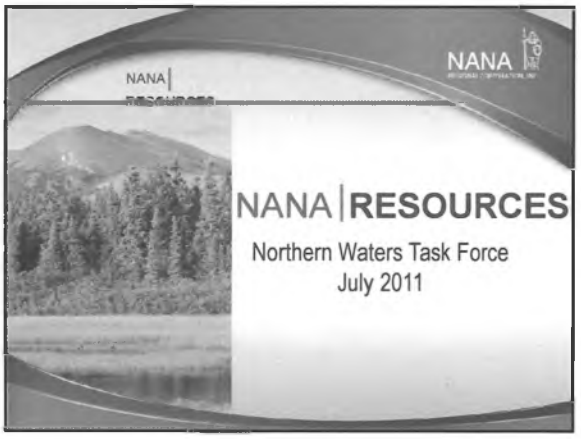
NWTF: Research

- What research needs to be done to ensure sustainable development while protecting the region?
- How do we work collaboratively with other Arctic countries on research to obtain the best available data?
- How do we decide what research is important?
- What research is still missing?

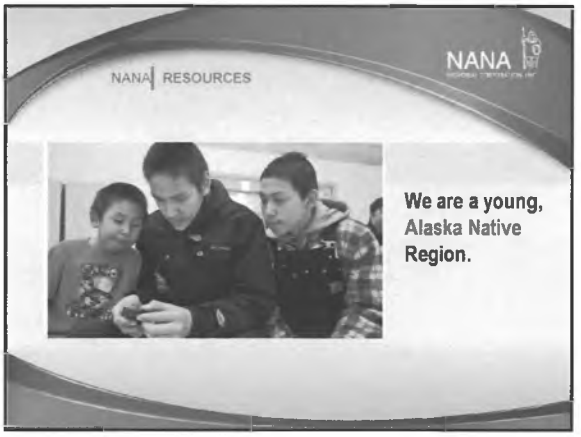
Northern Waters Task Force

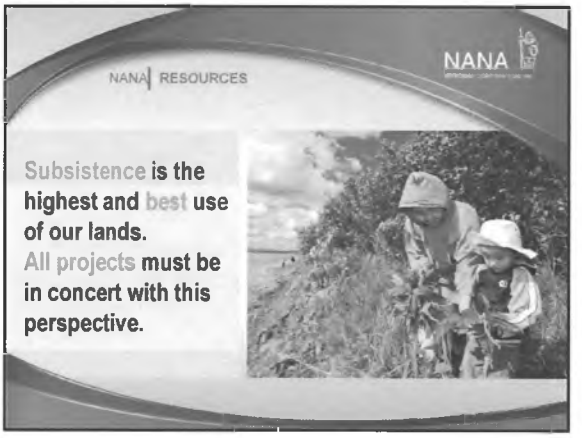
11

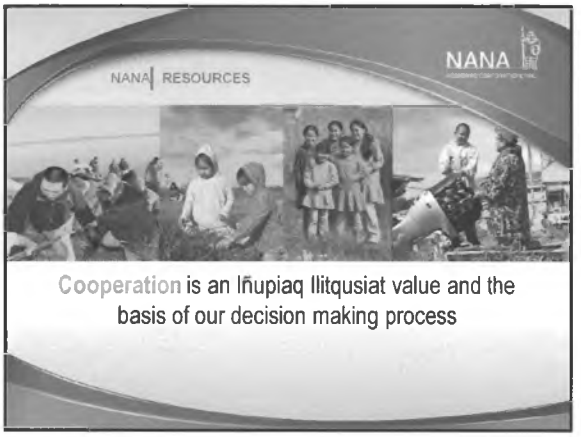
Nana Resources Testimony Presentation

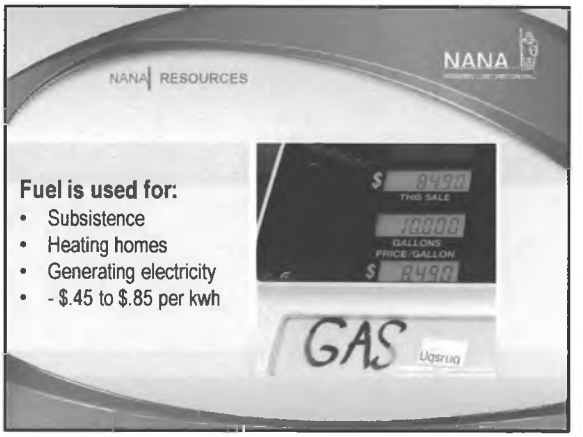

NANA
NANA RESOURCES
Northern Waters Task Force
July 2011

NANA
Red Dog Mine
Kivalina
Noatak
Kiana
Noorvik
Selawik
Amber
Kobuck
Shungnak
Buckland
NANA Region


NANA RESOURCES
NANA
We are a young, Alaska Native Region.


NANA RESOURCES
NANA
Subsistence is the highest and best use of our lands.
All projects must be in concert with this perspective.


NANA RESOURCES
NANA
Cooperation is an Iñupiaq Ilitqusiat value and the basis of our decision making process


NANA RESOURCES
NANA
Fuel is used for:
• Subsistence
• Heating homes
• Generating electricity
• - $.45 to $.85 per kwh
GAS

NANA GOVERNMENT RELATIONS

Current Community Conditions: Fuel Prices Across Alaska: January 2011 Update

Community	Heating Fuel #1 01/2011 Retail (selling price per gallon - $$)	% +/- Statewide Heating Fuel Average ($4.98)	%+/- 06/2010 Retail (selling price/gallon)	Gasoline #1 01/2011 Retail (selling price/gallon - $$)	% +/- Statewide Gasoline Average ($5.29)	% +/- 06/2010 Retail (selling price /gallon)
Deering	$5.20	4%	20%	$5.72	8%	22%
Kiana	$6.18	24%	3%	$6.70	27%	3%
Noorvik	$6.00	20%	18%	$6.45	22%	19%
Kotzebue	$5.13	3%	11%	$5.37	1%	10%
Northwest High	$8.06			$8.00		
Northwest Low	$4.03			$4.55		

Alaska Department of Commerce, Community, and Economic Development
Division of Community and Regional Affairs, Research and Analysis Section

The Red Dog Difference

- Roads between villages will only be viable with resource development projects.
- Energy infrastructure will be enhanced by resource development project funding.
- Money will be needed to protect access to subsistence and traditional activities.
- Access to gravel sources will save money for other village projects.

The Red Dog Difference

- Economic engine for Alaska and the region
- $1.5 billion in wages, royalties, taxes (1989 – 2010)
- $596 million in proceeds to NANA (1989 – 2010)
- $94 million in PILT to NAB (1989 – 2010)
- 58% shareholder hire (340 shareholder jobs)

Shareholder Benefits

- $20.5 million in dividends to 12,700 shareholders
- Additional $2,000 dividend to each NANA Elder
- $4 million to the Aqqaluk Trust
  - $803,920 in scholarships to 275 shareholders
- More than $200,000 in in-region sponsorships

Support for Future Development

Shareholder Survey

Support for Roads

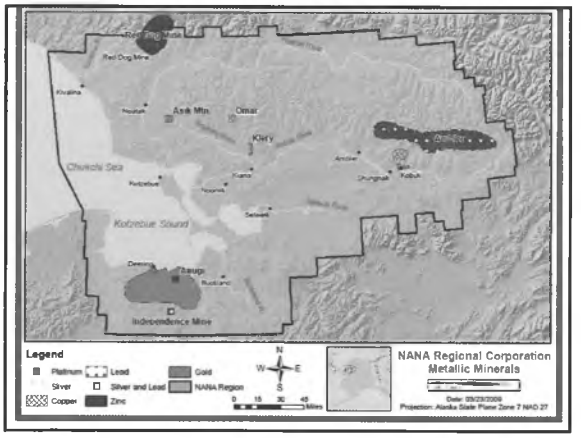
Shareholder Survey

NANA

Based upon NRC board and shareholder priorities the goal for the resource team is to develop new sources of jobs/revenues before Red Dog closes

- Shareholder priorities include lands/subsistence and mining development (jobs)
- Project development takes 15-20 years of active work
- Goal is to replace the jobs and revenue from Red Dog by 2031

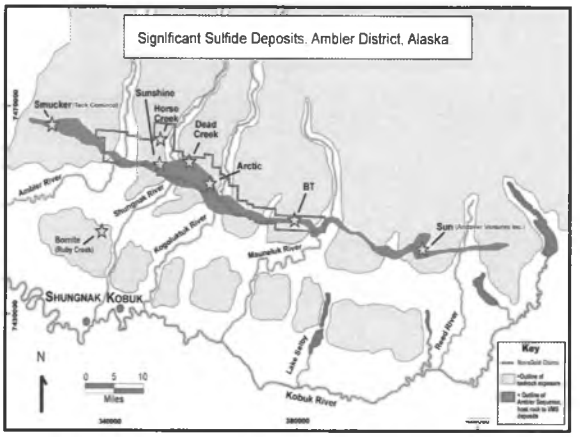
Overarching commitment is that subsistence is the primary and highest priority use of NANA's lands



NANA

Upper Kobuk Mineral Project

- Copper, Zinc, Lead and Silver
- Opportunity to expand reserve at the Arctic Deposit and Bornite
- 15 years of activity associated with trying to move project forward to this point in time
- NRC Board approved partnership with NovaGold for exploration
- Work in 2011



NANA

Oil and Gas projects

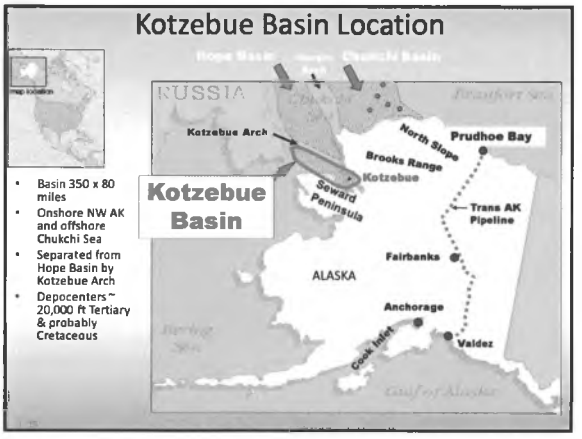
- No known resource; truly Wildcat exploration
- Good potential
- Partnered with Northwest Alaska, LLC
- 3 on-shore potential locations with 4 well sites
  - Kobuk Delta, Baldwin Peninsula and Cape Espenburg
- Working on funding – approximately $20-25M needed for 1-2 wells
- Approaching numerous companies

NANA

Key Points

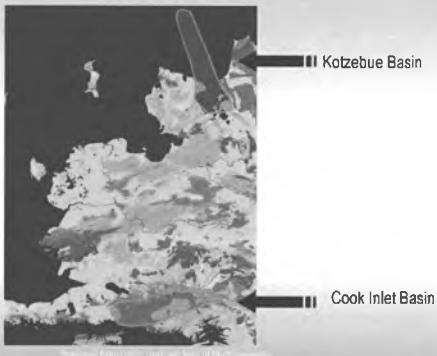
- Major unexplored deep (20,000') sedimentary basin
  - Similar in size to Cook Inlet & San Joaquin-Sacramento Basins
- Potential significant petroleum producing province
- Favorable hydrocarbon system
- Many large targets – structural and stratigraphic

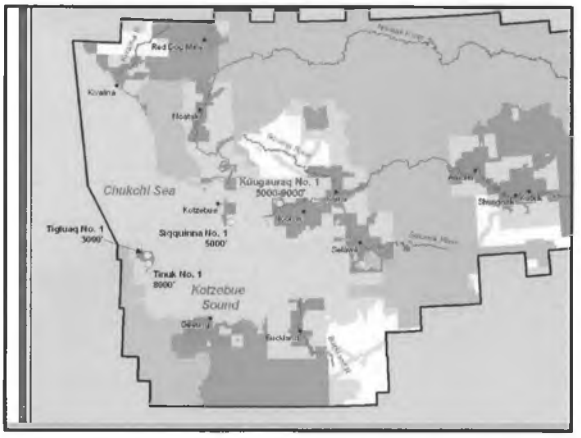
Kotzebue Basin Location



- Basin 350 x 80 miles
- Onshore NW AK and offshore Chukchi Sea
- Separated from Hope Basin by Kotzebue Arch
- Depocenters ~ 20,000 ft Tertiary & probably Cretaceous

Basin Comparison





Renewable Solutions

NANA

- Energy Efficiency & Conservation - Energy Wise
- Wind
- Hydro
- Biomass

Types of Mineral Resource Project Stages

	Exploration	Prefeasibility/ Scoping	Feasibility	Definitive (permitting?)	Construction
Resource	Inferred	Indicated	Measured	Measured	
Reserves	Assumed	Probable	Proven/Prob.	Proven	
Mine Plan	Sketch	Preliminary	Firm	Final	
Processing	Assumed	Options	Selected	Optimized	
Environment Impact	Concept	Approximate	Near Complete	Completed	
EIS	Conceptual	Scoped	Approved		
Closure Plan	Concept	Preliminary	Advanced	Final	
Permits	Assumed	Identified	Applied for	Granted	
Community	Fatal Flaws	Issues	Negotiations	Agreement	
Project Schedule	Assumed	Approximate	Firm	Final	
Cost Estimate	±30%	15-25%	±15%	±5	
Economics	Est. ±30%	Probable ±15%	Firm ±15%	Finalized	
Finance	Assumed	Options	Negotiations	In place	
Time	A few years	1-2 years	A few years	A few years	2-3 years
Cost of Stage	$10-30M	$10-30M	$20-80M	$5-10M	$100's M (>$500M)

Positive Order of Magnitude Study | Positive Prefeasibility Study | Positive Feasibility Study | Decision to Mine

Decision to Mine made once all permits and approvals received.

Building for the Future

NANA

- Funding
- Continue consultation
- Legislation
- Continue collaboration
- Secure a brighter tomorrow

NANA
Taikuu

Nome Meeting, July 8, 2011

<TARGET><BILL></BILL><SUBJECT>Nome Meeting, July 8, 2011</SUBJECT><COMM>ANW27</COMM></TARGET>

NWTF Meeting

Nome

July 8th, 2011

1	Agenda
2	Presenters
3	Nome Update – Impacts on Changes ***City of Nome – Mayor Denise Michels***
4	Alaska Deep Draft Arctic Ports Study ***AKDOT&PF – Michael Lukshin***
5	Alaska Regional Ports Study ***Army Corp Engineer - Stephen Boardman***
6	Bering Strait Port Access Route Study ***US Coast Guard – CPT Adam Shaw***
7	Arctic Pollution Response ***US Coast Guard – CPT Adam Shaw***
8	AK LCC Project ***AK Landscape Conser. Co-op – Polly Wheeler***
9	Why Track Vessels ***Marine Exchange of Alaska – Ed Page***
10	Arctic Search and Rescue ***US Coast Guard – CPT Adam Shaw***
11	NOAA's Arctic National & International Goals ***NOAA – Dr. Kathleen Crane***
12	INUIT Circumpolar Council Written Testimony ***ICC – Pres. Jimmy Stotts***
13	Northern Water Task Force Overview ***NWTF – Chair, Rep. Reggie Joule***
14	***Additional copies of handouts and materials***
15	Transportation in Nome A Historical Perspective

AVERY READY INDEX® 600087

1

Agenda

NOME:

<u>July 8th[th], Friday, Old St. Joes</u>

Presenters on the following Arctic infrastructure and research topics:

- **9 to 9:30 a.m. Nome update, impacts of recent changes on local community: Mayor Denise Michels**
- **9:30 to 10:30 a.m. Discussion of possible future deep water port sites in the Northern region, state and federal perspectives:**
    - **Department of Transportation, Michael Lukshin, Engineer**
    - **US Army Corps of Engineers, Stephen Boardman, District Chief, Civil Project Management Branch**

--15 min. break--

- **10:45 to 11:15 a.m. Bering Straits Port Access and Route Study presentation: Captain Adam Shaw, U.S. Coast Guard**
- **11:15 to 11:45 a.m. Land Conservation Cooperation Project: Polly Wheeler, Coordinator, Northwestern Interior Forest Landscape Conservation Cooperative, U.S. fish and Wildlife**

Lunch break from 11:45 to 1:00 p.m.

- **1 to 1:30 p.m. Discussion of vessel tracking in the Arctic: Marine Exchange of Alaska, Ed Page, U.S. Coast Guard (Ret), Executive Director, Marine Exchange of Alaska**
- **1:30 to 2 p.m. Navigational and search and rescue aides needed for the Arctic: U.S. Coast Guard, Captain Adam Shaw**
- **2. to 2:45 p.m. Arctic research presentation: Dr. Kathleen Crane, PhD, Arctic Research Program, NOAA Co Chair of the Arctic Council's Circumpolar Biodiversity Marine Monitoring Program, CAFF**
- **2:45 to 3:15 p.m. Inuit Circumpolar Council, Jimmy Stotts, President**

--15 min. break--

- **3:30-5:30 Presentation by Rep. Joule on Northern Waters Task Force followed by public Testimony on Northern Waters Issues**

2
Presenters

NORTHERN WATERS TASK FORCE
PRESENTERS JULY 8th, 2011
NOME, ALASKA

Nome Mayor, Denise Michels:

Mrs. Michels was elected to serve as Mayor of the City of Nome, pop. 3545, in the October 2003 municipal election. Born and raised in Nome, she is the first Alaskan Native to serve in this capacity, and the first woman elected to the post. As chief executive officer, she works closely with an appointed city manager, the Nome City Council and other elected and appointed boards and commissions. The Mayor is the chief spokesperson for the City, representing community legislative priorities to the Alaska Legislature and the U.S. Congressional delegation. She continues to focus on public safety, community, economic and infrastructure development, and promotes bringing diverse groups and residents together.

The position of the Nome Mayor can be characterized as a "full-time job with part-time pay". Mrs. Michels is employed as Director of Transportation by Kawerak, Inc., a Native not-for-profit service organization. In this position, she is responsible for overseeing the development and implementation of strategies for transportation and public infrastructure.

Stephen Boardman, District Chief, Civil Project Management Branch, U.S. Army Corps of Engineers:

Stephen C. Boardman serves as the District's Chief, Civil Project Management Branch since its inception in December 1990. His responsibilities include the planning, design, and construction of navigation improvement, flood control, and erosion control projects throughout the state. Mr. Boardman also serves as one of the District's Congressional Liaison Officers.

Earlier Alaska District assignments include Chief, Operations and Readiness Branch of the Construction-Operations Division (1982-1989); Chief, Project Operations Section of the Operations and Readiness Branch (1981-1982); and Chief, Compliance Section of the Regulatory Branch (1979-1981). Mr. Boardman worked in the Corps' Louisville District, Regulatory Branch, Operations Division from 1972-1979. Mr. Boardman received a B.S. degree in civil engineering from Rose-Hulman Institute of Technology, Terre Haute, Indiana, in 1972.

Captain Adam J. Shaw, United States Coast Guard:

Captain Shaw of San Jose, California, graduated from the United States Coast Guard Academy, earning a Bachelor's of Science degree in Management and Economics. He also earned a Master's of Public Administration degree from the University of Alaska. He holds a Merchant Mariner's License and is certified in the National Incident Management System. His Coast Guard career covers a broad range of assignments, including: coordinating Search and Rescue and Law Enforcement missions in the Gulf of Alaska; supervising a multi-million dollar acquisition project for the replacement of inland buoy tenders; managing inland waterways and aids to navigation for the entire California coast; and conducting International Port Security assessments in Africa, Europe and the Middle East. Captain Shaw also served on several Coast Guard Cutters (four as the Commanding Officer), conducting Law Enforcement, Oil Spill Response, Drug Interdiction, Search and Rescue, and Aids to Navigation missions. Captain Shaw is currently assigned to Juneau, Alaska where he is responsible for Maritime safety and security of Alaskan waters. Captain Shaw has three children with his wife, Christine Shaw from Fremont, California.

Polly Wheeler, Coordinator, Northwestern Interior Forest Landscape Conservation Cooperative

Polly Wheeler has lived in Alaska since 1983, 20 of those years in Fairbanks. She has worked throughout the state in various capacities dealing with natural and cultural resource management and policy. Polly earned her Master's degree in anthropology at the University of Alaska Fairbanks, and her Ph.D. in Anthropology from the University of Alberta. Prior to joining the U.S. Fish and Wildlife Service in 2002, Polly worked for private, tribal, and statewide organizations, and also owned her own contracting business. She came to the U.S. Fish and Wildlife Service from the Alaska Department of Fish and Game, where she headed up a subsistence research program for the northern parts of the state. Before joining the Northwestern Interior Forest LCC as Coordinator, Polly served as the Deputy Assistant Regional Director at the Office of Subsistence Management.

Captain Ed Page, Executive Director, Marine Exchange of Alaska:

Captain Page assumed the position as the first Executive Director of the non-profit Marine Exchange of Alaska in April 2001 after serving 29 years as a commissioned officer in the U.S. Coast Guard.

The Marine Exchange of Alaska is a maritime organization with the mission of providing information, communications and services to aid safe, secure, efficient and environmentally sound maritime operations. The Exchange has established an extensive satellite and AIS (Automatic Identification System) vessel tracking system to locate and monitor vessels in Alaska and North America. The system is presently used to track cargo ships, fishing vessels, tankers,

cruise ships, offshore supply vessels, ferries, tugs and barges, and Coast Guard vessels operating in Alaska and has aided responses to a variety of maritime emergencies including oil spills. The data from the system is presently being used to assess current and historical vessel traffic information in the Arctic for the conduct of risk assessment studies. Captain Page has led the Marine Exchange's development and operation of one of the largest and most comprehensive vessel tracking and maritime safety nets in the world with over 80 AIS stations extending from the Arctic west to Adak and south to Ketchikan earning the Coast Guard's Public Service Award.

Upon graduating from the Coast Guard Academy in 1972 Captain Page served as a deck officer on the Coast Guard cutter BOUTWELL, sailing out of Boston, and later Seattle conducting patrols of the Atlantic, Pacific and Alaska waters. He later served in marine safety, environmental protection and search and rescue assignments at Port Safety Station Concord, California, Loran Station Iwo Jima, Japan, Marine Safety Office San Francisco, Marine Safety Office Anchorage and Group Ketchikan. He also served as Chief of Environmental Protection for the 17th District in Juneau during which time he was involved in the response to the Exxon Valdez oil spill as well implementation of OPA-90.

Dr. Kathleen Crane, Program Manager, Arctic Research Program:

Dr. Crane is a Program Manager in the Arctic Research Program of the Climate Office of NOAA. She is currently the U.S. mission coordinator for the Russian American Long-term Census of the Arctic and the co-chair of the Arctic Council's Circumpolar Marine Biodiveristy Monitoring Program. She was formerly a Professor of Oceanography at Hunter College, the City University of New York and an Adjunct Senior Research Scientist at the Lamont-Doherty Earth Observatory of Columbia University. She received her PhD in 1977 at Scripps Institution of Oceanography, University of California, San Diego, and was a Post Doctoral Fellow at the Woods Hole Oceanographic Institution from 1977-1979. Dr. Crane has also been a visiting scientist at the University of California, Santa Barbara; the University of Hawaii; the University of Oslo, Norway; the University of Paris, France; the Environmental Defense Fund, where she developed the *Arctic At Risk* Program; and at the Naval Research Laboratory, where she managed the Arctic At Risk initiative. Dr. Crane has been the chief scientist of 20 multi-national expeditions including work with Russia, Japan, France, Italy, Norway, Sweden, Denmark, Germany, China and Canada. She has participated in 43 expeditions at sea, including many dives to the seafloor on the deep-diving submersibles Alvin and Mir.

James Stotts, President, Inuit Circumpolar Council-Alaska:

James Stotts (Jimmy) was born in 1947 at Barrow, Alaska and raised in Barrow and other communities throughout rural Alaska. Like many of his generation he attended Mt. Edgecumbe High School, a Bureau of Indian Affairs boarding school located in Sitka, Alaska. After high school he attended the University of Alaska Anchorage where he earned a degree in Business Management.

Jimmy has extensive managerial experience in the private sector. He worked for his village corporation (Ukpeagvik Inupiat Corporation) and regional corporation (Arctic Slope Regional Corporation). Over a thirty year career he worked in various executive capacities at both organizations and served on the Board of Directors of both organizations. Jimmy also had a brief career in local politics as an Assembly Member of the North Slope Borough from 1978 through 1983. He was elected President of the Assembly the last two years he served.

Jimmy has a long history of involvement with the Inuit Circumpolar Council (ICC). He represented Alaska on the first ICC Executive Council in 1980, eventually serving three consecutive terms from 1980 to 1989. In the early 1990s he worked for ICC Greenland as Environmental Projects Coordinator in Nuuk, Greenland. Since January 2008 he worked for ICC Alaska as Executive Director in Anchorage, Alaska. In June 2009 he was appointed by the ICC Executive Council to serve as ICC Acting Chair through June 2010. Jimmy currently serves as the President of ICC-Alaska.

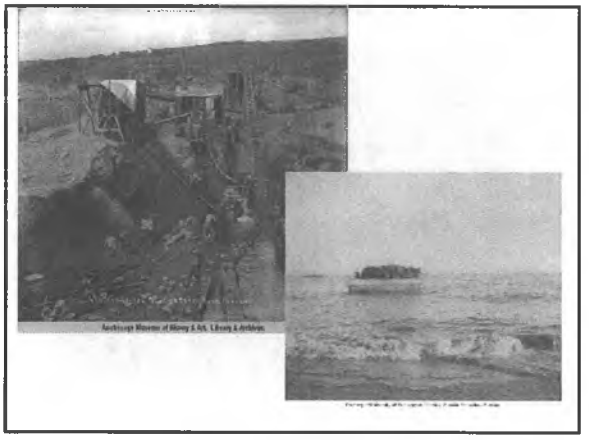
3

Nome Update Impacts on Changes

#9

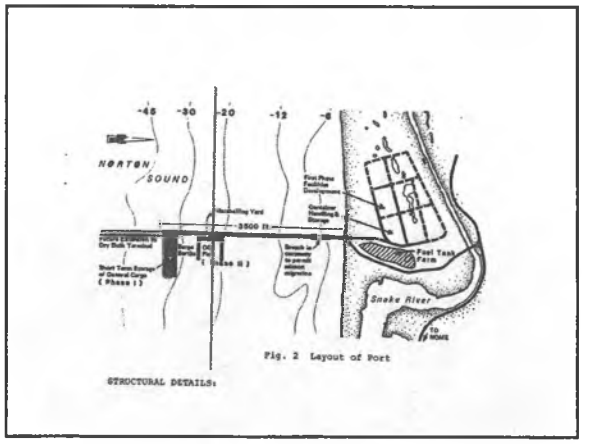
Northern Waters Task Force

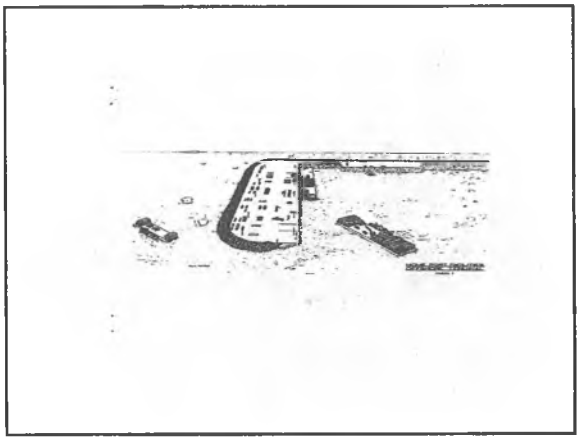
Bering Strait/Norton Sound
Regional Communities

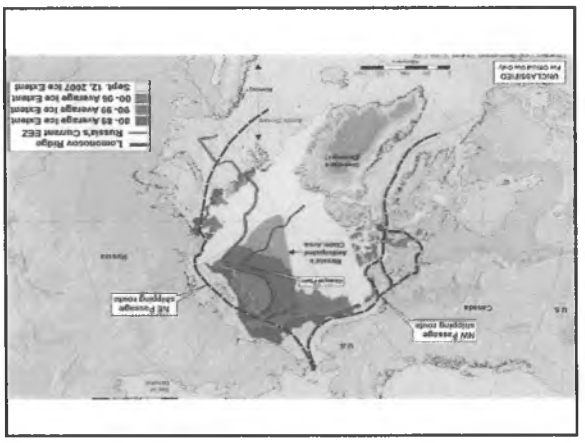


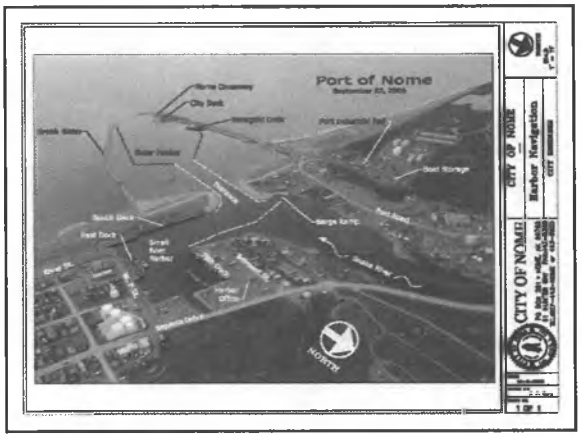
University of Alaska Anchorage, Archives & Manuscripts Dept.

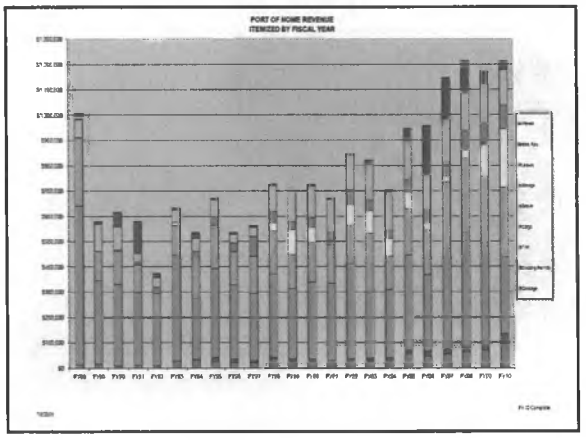
Dredging Nome Harbor Looking North - 1924
Property of Special Collections, University of Washington Libraries.

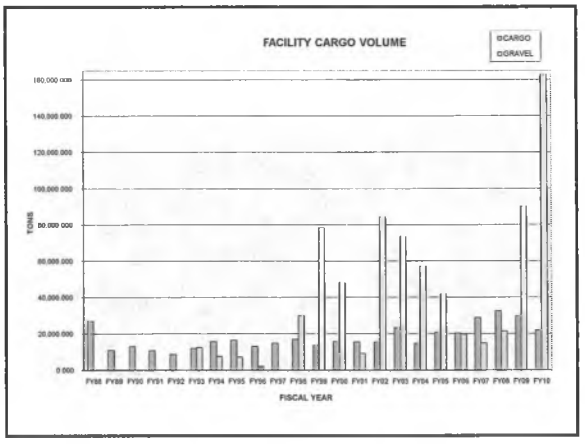

-45
-30
-20
-12
-8
NORTON SOUND
3500 ft
Fuel Tank Farm
Snake River
Fig. 2 Layout of Port
STRUCTURAL DETAILS:

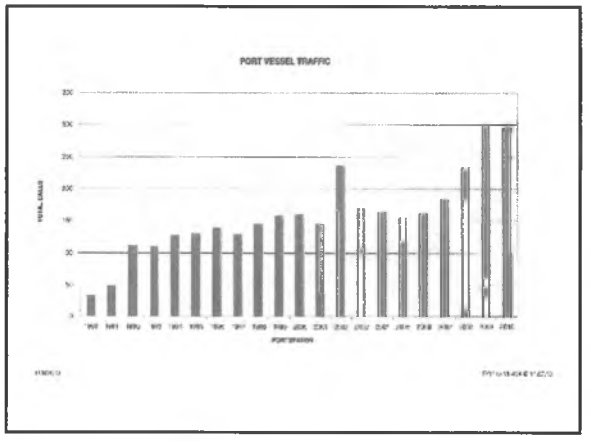





Port of Nome
CITY OF NOME
Harbor Navigation
NORTH


PORT OF NOME REVENUE
ITEMIZED BY FISCAL YEAR


FACILITY CARGO VOLUME
CARGO
GRAVEL
TONS
FISCAL YEAR


PORT VESSEL TRAFFIC

VEHICL
INSPECTI
POINT

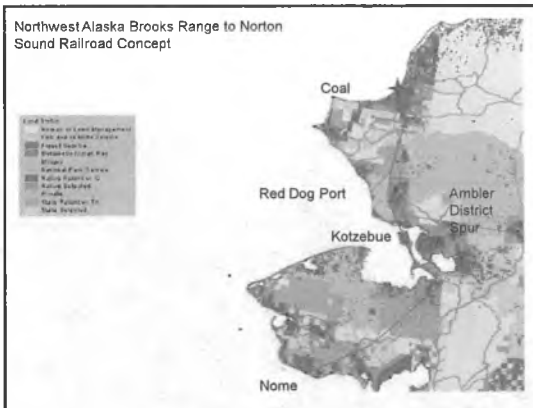
In November 2010 USCG Captain Raiha stopped in Nome. The ocean is ice free longer in the winter season.

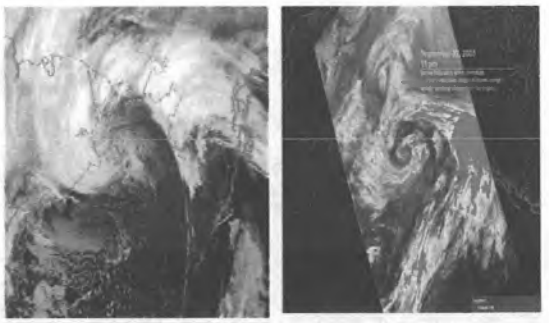
Diomede Islands

Potential choke point with ocean vessel traffic and the only way in and out of the Arctic Ocean on this side of the world. There are no established traffic plans. Marine mammals are important to our subsistence way of life.

Western Alaska Access Planning Study

Northwest Alaska Brooks Range to Norton Sound Railroad Concept





October 19, 2004 Bering Sea Storm

Central Pressure: 941 millibar

Thank you! Any questions contact Denise Michels, Mayor @ 443-6600 or email dmichels@nomealaska.org

From Mayor Michels
re: July meeting

Arctic Access Port-Nome – the northern most commercial port in the US
Presentation By Denise Michels, Mayor for the City of Nome 2011

Today I will provide an overview of our observations in regards to arctic marine shipping in Nome and activities in the region in general.

History: Nome we were "discovered" in 1899 during the gold rush and incorporated on April 9th, 1901. The City of Nome is located on the Seward Peninsula facing the Norton Sound. We are 539 air miles northwest of Anchorage and 520 air miles from Fairbanks. The Nome Census Area is commonly referred to as the Bering Strait region. Currently 17 communities occupy the Nome Census Area, of which Nome has the largest population at 3500 and is the regional hub for medical and transportation facilities including a port and harbor, and other essential services for the region. The Bering Strait region is about the size of West Virginia and a population of over 9000.

Unlike most areas in America, a road system does not exist throughout the Bering Strait Region. Air transportation is the most common and reliable mode of transportation throughout the year. During the summer months Nome is a hub for ocean shipping-- our port handles community re-supply and destinational traffic.

A 1900 DOI USGS Preliminary Report on the Cape Nome Gold Region identified a need for harbor facilities for ocean vessels. "Though it seems highly probable that with continued development of the Seward Peninsula regions these harbors will eventually have railroad connections with the Nome Region, nevertheless the lack of harbor facilities at present at Nome is embarrassing (Page 39). Improvements were suggested for necessary public improvements including constructing a deep water pier. It also recommended that a life saving station be established.

Hence today this is what we are talking about, over 100 years later--still the same issues. The USACE in 1919 started constructing the jetty to dredge the federal inner harbor for commerce activities.

In 1981 a Port Mast Plan was completed study identified a need to construct a 3,600 foot long causeway to support medium-draft ocean going vessels to -35 MML with dockside depth of 30 feet. For some reason or another they fell short and in 1985 they constructed the causeway to 2,712 feet with a -22 depth. (800 feet short)

In 1997 the City starting working with the USCOE along with other funding partners and in 2006 completed the Nome Harbor Improvements Project by adding an additional 3,025 foot breakwater east of the existing Causeway and a 270 foot spur at the end of the Causeway. These necessary improvements allow the Port of Nome to serve additional vessels in a more protected marine environment.

The Nome Small Boat Harbor offers protected mooring for recreational and fishing vessels up to a -10 foot draft (MLLW). We've also increased the floating dock space. Smaller cargo vessels and landing crafts load village freight and fuel at the east and south inner harbor sheet pile docks for delivery in the region. Another new addition to the Nome facility is a 60 foot wide concrete barge ramp located inside the inner harbor just west of the Snake River entrance providing the bulk cargo carriers with a suitable location closer to the Causeway to trans-load freight to landing crafts and roll equipment on and off their barges. These improvements have given benefited the private sector and increase their efficiencies in delivering services to Western Alaska.

There are plans for construction of two boat ramps to accommodate recreational water craft and suction dredges. With the high price of gold, suction dredges have increased in front of Nome in State waters. We do appreciate their business in Nome but we also need to solve user conflict and there is a need for enforcement.

As you can see in these slides tonnage and volume has increased since 1988 and continues to rise steadily. In the photo's you can see that we are at full capacity and we have vessels waiting to dock and utilize the cells. We need to extend the causeway add additional cells to meet the needs of the industry to allow aid in lowering their operational costs.

Arctic shipping has increased with more ocean vessel traffic in the Bering Sea and Norton Sound. Our data since 1990 for the Port of Nome vessel traffic was 34 dockings, we peaked in 2009 with 304 dockings and last year 295. This includes fuel, bulk cargo, gravel and equipment barges, cruise ships, government ships, research and exploration vessels. In 2008 we saw in increase due to the Chukchi lease sales. Miscellaneous pleasure craft vessels, including foreign registered vessels also stop in Nome. In 2008 three vessels completed the Northwest Passage; in 2009 four completed the trip and in 2010 three stopped in Nome.

Normally, four cruise ships use Nome as a port of call. The "World" stopped in Nome, this is a large class cruise ship.

The shipping seasons on the Bering Sea and Norton Sound waters are growing longer. For the last three years we have seen operations last until November. Captain Raiha brought in the USCG Alex Haley to Nome in November. 10 years ago this was almost unheard of.

Nome is in a strategic location for national defense, the Port of Nome is a logical location to serve the vast area from Unalaska to Barrow and beyond and can support the all ocean going vessels efforts to patrol and monitor the Bering and Chukchi Sea and Arctic Ocean. Nome is a prime location to be a FOL for quicker emergency responses and to monitor environmental concerns. The Port of Nome can presently serve as a port of refuge/place of refuge for medium size vessels.

In coinciding with this activity, the City of Nome is working with the US Corps of Engineers (USCOE) to expand the causeway to -35, this enhancement will allow the

Nome Port to accommodate vessels with drafts greater than 22 feet. The expansion is estimated at $1b to construct to meet the needs and demands of ocean vessel traffic. We will need investment partnerships from the State and Federal governments and the private sectors to help invest in this infrastructure.

This improvement will support and enable our country to protect our expanding economic fisheries interests. An immediate and important benefit of this investment in the City's infrastructure will be the increased efficiency in rural Western Alaska logistical support. With improvements of the port, resource development may become more economical and provide continued stimulus to the region and State economy. OCS vessels would save two days one way to the Chukchi leases and fuel can be brought in bigger barges which require less handling and safer for the environment. There are concerns by community member about vessels using Port Clarence, those residents heavily rely on marine mammals and fish for subsistence have concerns of continamines being released from vessels using it as a staging area.

The City is requesting Congressional support to provide additional resources to assist the USCG as they consider Nome as a Seasonal Forward Operating Location along with other Arctic locations. An increased port infrastructure would improve our capability to provide our Nation with critical nodes of Homeland Defense/Security presence in the Arctic and the need for environmental enforcement.

The City of Nome believes in responsible resource and economic development. As part of the planning process we must look at future economic opportunities in port development. There are two projects that we must consider and incorporate into our planning process.

Were working with DOTPF on the Nome Airport Master plan extending the runway safety area and recommend that they also incorporate needs of all intermodal making for a comprehensive system, air, water, rail/road. We are also supporting the Western Arctic Access Corridor to Nome. This would open up resource development and potentially increase shipping (barging ore out to markets, etc.,) So if you tie all these commerce activities together we trust all parties involved will recognize and concur with the needs the City has identified and advocate for improvements to our port and harbor and other intermodal infrastructure for national security and life safety along with economic development opportunities.

Within the Norton Sound and Bering Sea residents rely on marine mammals for subsistence. The choke point between Diomede and the Cape Prince of Wales has small ocean vessel traffic traveling between the two for hunting marine mammals. Residents use small skiffs to cross between the two because there is no public transportation. In the summer folks also cross to King Island. We have a healthy fishery in the waters with Norton Sound Economic Development Corporation the local CDQ, small vessels are fishing for herring, salmon, king crab and out at the St. Lawrence Island halibut. Traditional whaling activities also happen in the waters.

The reason why I bring this up is that user conflict will happen with large vessels and small skiffs using the same area. The Bering Sea is also known for its tremendously dangerous fall storms that create havoc and but life and property in danger. Response time from Kodiak to the Norton Sound is over 2 hours with a C130. The need for S&R near our fisherman, hunters and pleasure craft are essential. We rely on NOAA Weather information and support the need for more resources for reading equipment in gaps where there are no equipment. This gives us valuable time to protect our property and for vessels to find shelter during a storm.

Because of Alaska, the US is an Arctic Nation. Nome is the northern most Arctic Access port in the US. Any given time of the year we are working with multiple local, state, federal and international agencies, IMO's and businesses with climate change, resource development, logistics, etc. There is no stop shop within the State of Alaska and we have been participating in the State of Alaska's Northern Water's Task Force recommending that the State of Alaska create department to coordinate, communicate and consult with local communities.

The City of Nome supports the Arctic Marine Shipping Assessment's recommendations and encourages full public participation in the process. The City feels very strongly about Section II that we need to be at the table and consulted with at the local level regarding any proposed laws, regulations, and policies that the national and international bodies are considering because those decisions will affect us directly.

We support the Alaska Legislature's last two resolutions to Congress urging them to ratify UNCLOS. There are so many international vessels conducting studies beyond the EEZ based on information provided to us but because the US has not ratified UNCLOS we are "missing the boat". If ratified USA could start the process to claim that area.

We do appreciate the Institute of the North, Commonwealth of the North, the Aspen Institute and the Alaska Dispatch fostering discussion and we look forward to holding these policy discussions at the hub level in rural Alaska so that many of our residents who are sea faring folks to have the opportunity to participate. They have the local knowledge to aid in decision making.

Lastly we appreciate the efforts our congressional delegation has taken to bring Arctic issues to the forefront on national level. Based on this information, you can see that Arctic shipping has increased, **it is happening** and we need to be proactive to meet the needs of marine transportation instead of being reactive. Thank you for the invitation to speak to you today. I'm available if you have any questions.

4

Alaska Deep Draft Arctic Ports Study

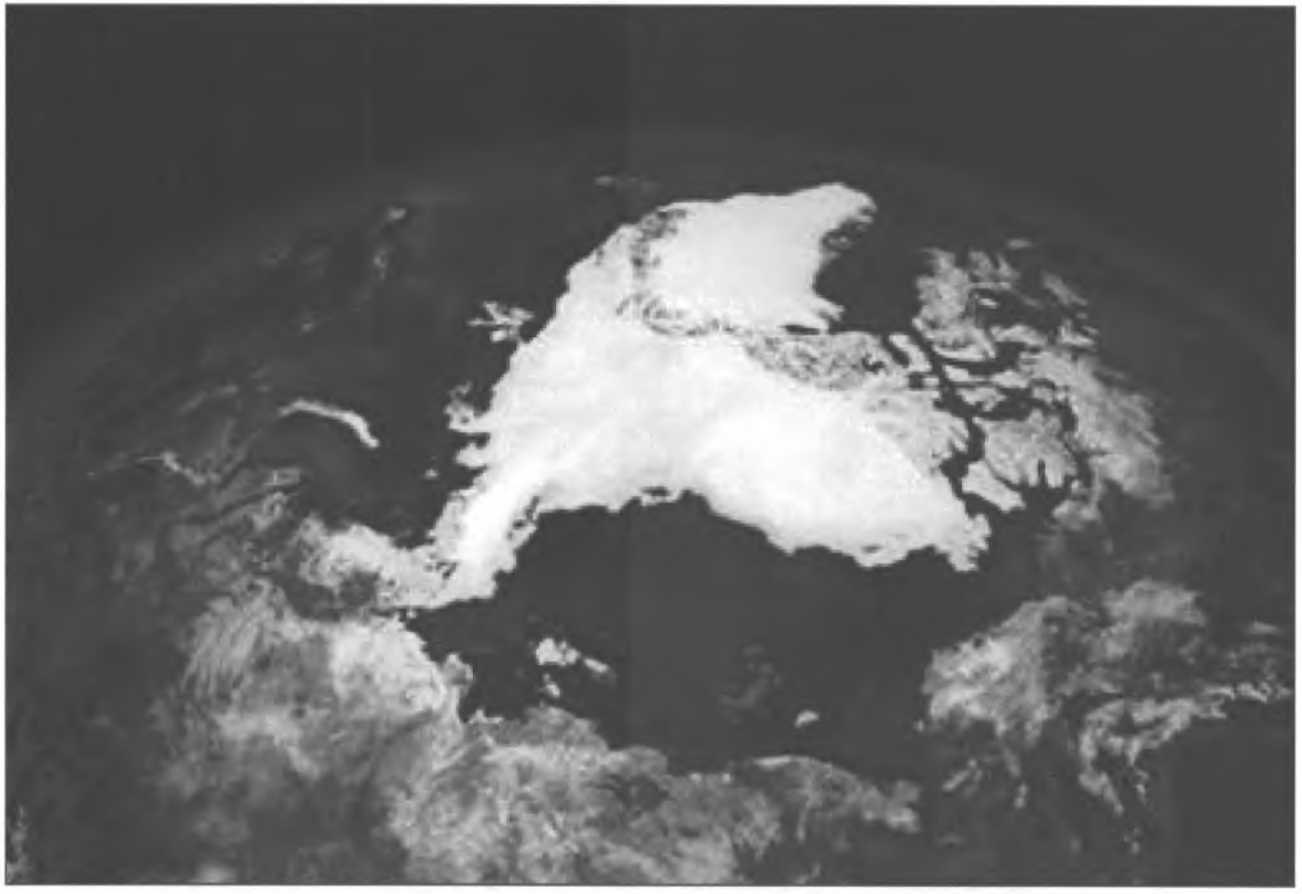
Alaska Department of Transportation & Public Facilities

Alaska Deep Draft Arctic Ports Study

Michael Lukshin, P.E.

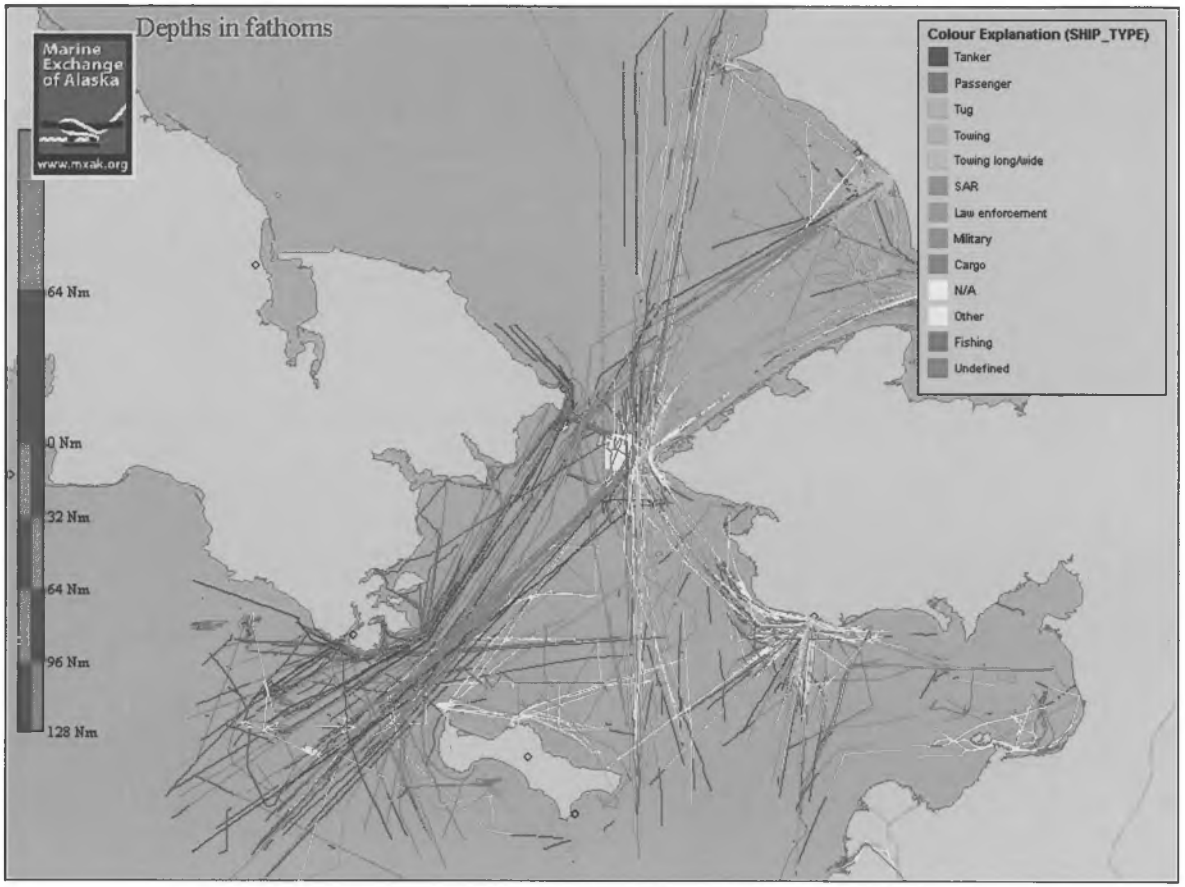
July 8, 2011

Sea ice is shrinking and thinning



Captain William Deal (Commanding Officer of Coast Guard station Kodiak) flying the HC-130 Hercules over the coast near Barrow on the last Arctic Domain Awareness flight of the year. Photo by Dennis Zaki

Arctic marine traffic is increasing



Why hold a planning charrette?

- Governor Parnell requested funding for an Arctic Ports Study to support economic development in Alaska.
- The state legislature appropriated funding for a 3-year study starting in FY2012.
- The Alaska Congressional delegation sponsored legislation highlighting the need for U.S. Arctic ports to support national sovereignty, environmental stewardship and life safety.

Panel #1 – Federal Interests

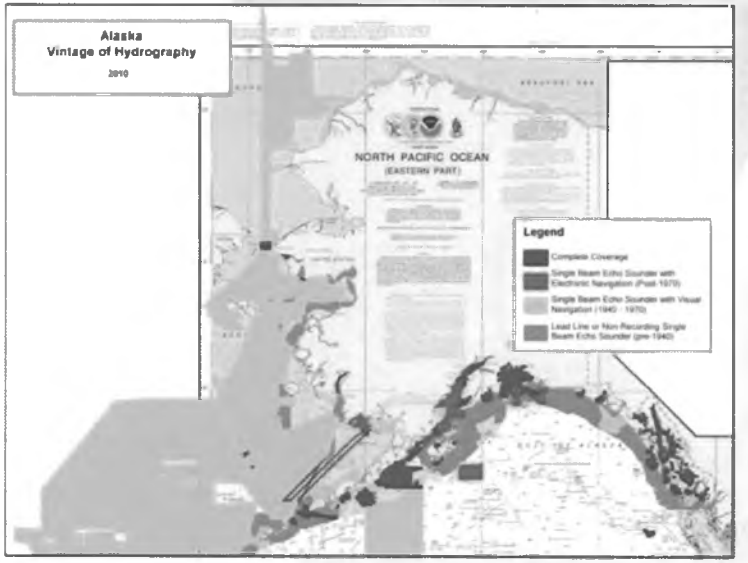
Long Distance Search And Rescue

Kodiak to Point Barrow is 940 miles across three mountain ranges

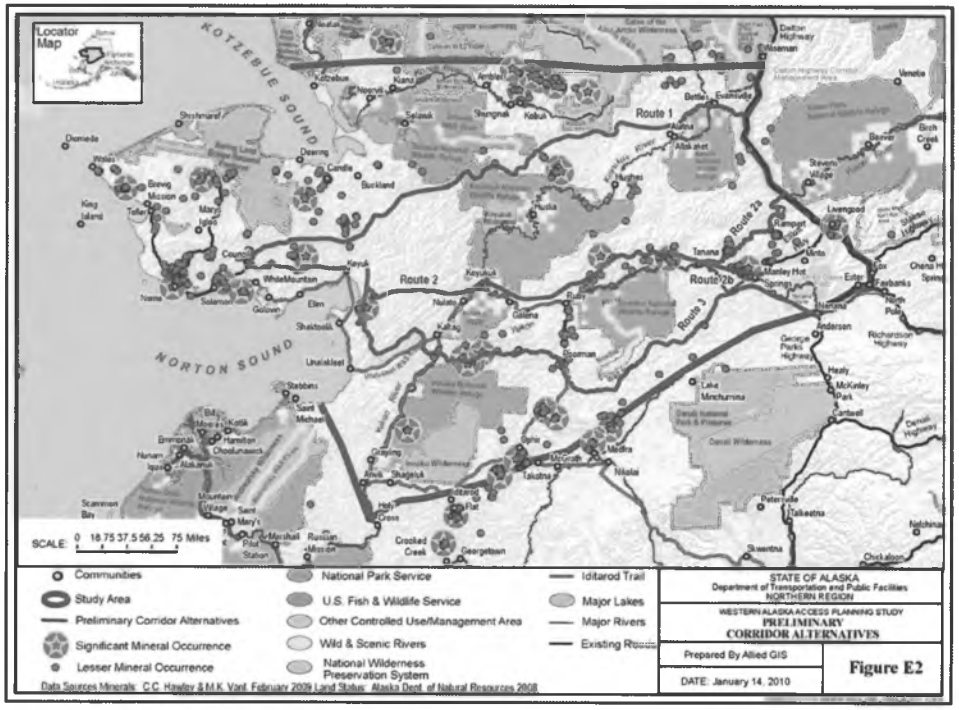
About the same distance as LA to Seattle!

26

Current State of Hydrography in Alaska



Panel #2 – State Interests

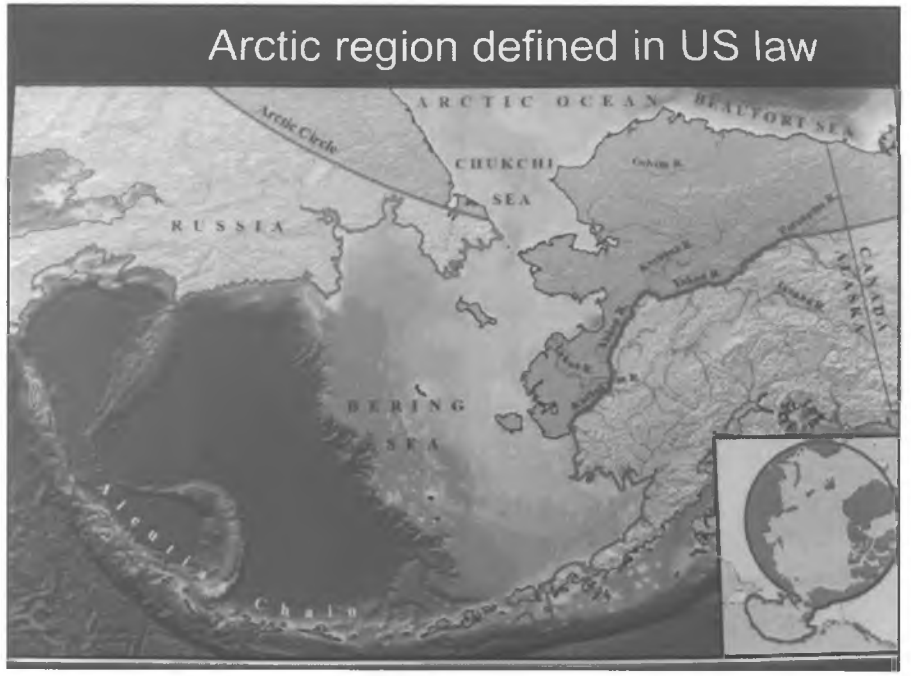


Panel #3 - Funding Options

Who Pays? / When?	Our Money	Other's Money
Now	Direct appropriation from GF (Example state or local capital budget)	Appropriation from Federal Government (Example: Federal Earmarks)
Future (Borrowing)	Our Child… (Example: G…	…r's Children …e: Stimulus)

P3's– Private capital funds; user's pay over time.

Breakout #1 - Define Arctic Geography

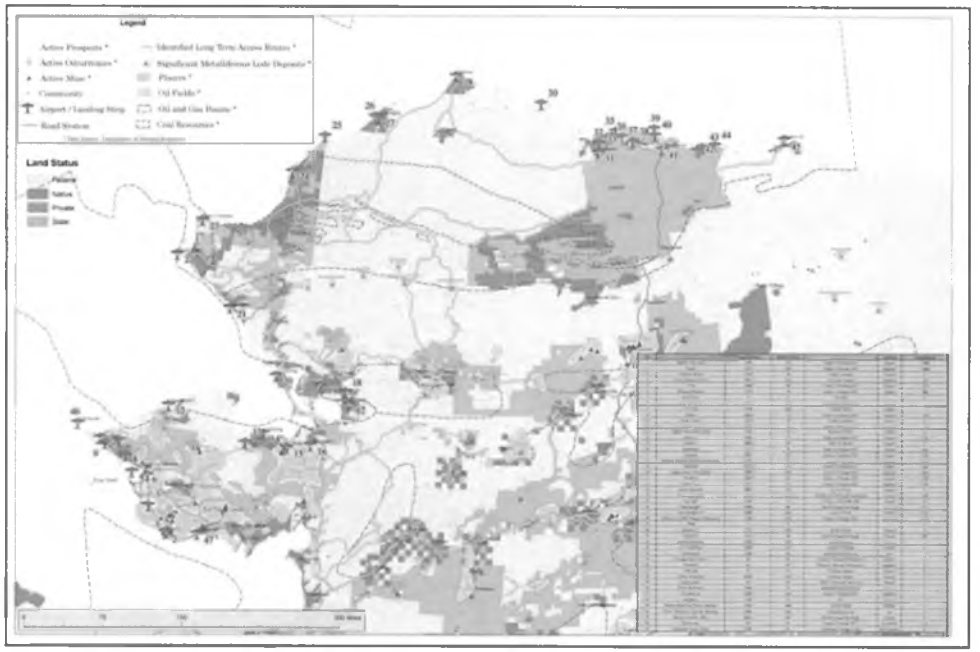


Breakout #2 - Define Vessel Parameters

- Diverse vessels types
- Desired depth 20-50’
- Need Tugs
- Increased traffic
  - SAR
  - Spill response
  - Life safety
- Port Infrastructure lacking

Breakout #3 - Port Siting

- No one port solution
- Need upland facilities
- Resource development and industry
- Partnerships necessary



Breakout #4 - Draft Study Outline

1. Executive Summary
2. Introduction
3. Driving Factors
4. Potential Port Sites
5. Land Access
6. Environmental Constraints
7. Vessel Parameters
8. Design Criteria
7. Port Site Evaluation
8. Port Structures
9. Port Layout Concepts
10. Shore-based Infrastructure Requirements
11. Cost Estimates
12. Schedule
13. Conclusion

What's Next?

- What's Clear?
- What's Unclear?
- Possible Interim Solutions
- Keys to a Successful Planning Study

Questions

For more information, contact:

Michael Lukshin, State Ports & Harbors Engineer, DOT&PF
michael.lukshin@alaska.gov

Eric Taylor, Transportation Planner, DOT&PF
eric.taylor@alaska.gov

Conference presentations, maps and summary are posted online at
http://www.poa.usace.army.mil/en/cw/AKPortsStudy.htm

5
Alaska Regional Ports Study

Northern Waters Task Force

Nome Meeting July 8, 2011

Alaska Regional Ports Study

Stephen Boardman, PE

Chief, Civil Project Management Branch

U.S. Corps of Engineers, Alaska District

Anchorage, Alaska

8 July 2011

Source: Adapted from FAA Chart: North Pacific Route Chart/Northeast Area.

US Army Corps of Engineers

BUILDING STRONG®

Agenda

- Navigational Improvements History
- Marine transportation successes
- Initiation of the Alaska Regional Ports Study
- Ongoing work
    - Economic evaluation of subsistence
    - Rock quarry findings
    - Climate change effects on transportation
    - Arctic Deep Draft Harbors Study
- The Path Forward

HISTORY

The Corps of Engineers has been developing and constructing navigational improvements in Alaska since 1912. The first project was improving the Apoon Mouth of the Yukon. The first permanent project was Nome Harbor which was started in 1916.

Since then the Corps has constructed 46 harbors and 15 channels. The Corps maintains the General Navigation Features (breakwaters, entrance channels, and maneuver channels) for each of the projects.

Two harbors are under construction while we are improving another.

Marine transportation successes

- Constructed Harbor Projects or Phases

	Project Cost ($000)	Basin Size (acres)	Approx # of Vessels Accommodated
Unalaska Hbr – Phase 1	8,900	16.8	75
Douglas Hbr – Phase 1	4,300	5.5	72
False Pass Harbor	23,000	5.2	88
Saint Paul Harbor	21,000	3.3	60

Unalaska Harbor

Douglas Harbor

False Pass Harbor

Marine transportation successes (Cont.)

- Constructed Harbor Projects or Phases

	Project Cost ($000)	Basin Size (acres)	Approx # of Vessels Accommodated
Chignik Harbor	8,800	4.8	70
Seward Breakwater Extension	4,164	11.7	346

Seward Breakwater Extension

Marine transportation Success Stories

- Ongoing Construction Projects

	Project Cost ($000)	Basin Size (acres)	Approx # of Vessels Accommodated
Akutan Harbor	31,897	14.9	58
Douglas Floating Breakwater – Phase 2	1,770	See Previous Slide	
Unalaska Floating Breakwater – Phase 2	12,526	See Previous Slide	

Akutan Harbor Site

Future Navigational Improvements

- Projects in Design
  - Haines Harbor Expansion
  - Valdez Harbor
  - Port Lions (on hold pending funding)

Future Navigational Improvements

- Ongoing Harbor Studies

	Reconnaissance	Feasibility
Craig	X	
Kasaan	X	
Sitka	X	
AK Regional Ports		X
Elim		X
Homer (on hold)		X
Little Diomede		X
Savoonga		X
Whittier		X
Anchorage Harbor Deepening		X
X – Denotes limited funding		

Marine transportation success stories

- Data Collection and Analyses
  - Western Alaska Hindcast Study
  - Western Alaska Storm-Induced Water Level Prediction
- Alaska Ocean Observing System (AOOS)
  - Multi-agency Initiative: DEC, F&G, DNR, Universities, USGS, USCG, Corps, USFWS, USFS, BOEMRE, and others
  - Building network of observation platforms and forecast models
- Coordinating planning and engineering efforts
  - State coastal engineers, University of Alaska, U.S. Navy

Transition From Individual to Systems Based Planning

- For years, every project had to be justified on its own merits. Neighbors often competed against each other to justify any improvements.
- Desire by many was to have a harbor at each community. Insufficient benefits to support adjacent harbors.
- Initial funding provided in FFY 2003 to begin a Reconnaissance level study to determine if there was a Federal interest in participating in cost shared feasibility studies addressing regional ports and harbors throughout the State of Alaska.
- However, we realized that harbors were a system, not individual community needs, and as such they need to be analyzed and justified as a system.

Transition From Individual to Systems Based Planning

- The focus of the study was to be a systematic analysis of existing and future needs for harbors and navigational systems.
- Coastal Alaska was divided into five regions: Southeast, Southcentral, Yukon-Kuskokwim, and Northwestern Regions.
- Early on it was determined that the State of Alaska would be a major stakeholder, if not the most logical cost sharing partner, for such an analysis.
- In order to gain knowledge prior to the conclusion of the Reconnaissance (905(b)) Report, the State of Alaska and the Corps of Engineers hosted the first Alaska Regional Ports Conference in January 2008. Over 125 attendees.
    - Overwhelming Mandate – The need for ongoing collaboration, comprehensive planning and leadership.
    - Develop a comprehensive ports and harbor plan for Alaska.

Transition From Individual to Systems Based Planning

- Corps published the 905(b) Report in May 2008.
- State of Alaska and Corps of Engineers entered into a cost shared Feasibility Study to establish baseline information needed for a statewide plan. The following items were commissioned:
    - Strategic Trends Analysis
    - Hub Analysis
    - Projects Needs List
    - Policy Recommendations
    - Identify locations of potential construction materials (ex., rock)
- Second Statewide Alaska Regional Ports and Harbors Conference conducted November 2010. 150+ attendees.
    - Reviewed the projects lists by region, identified selection criteria for investment, and ranked projects by priority.

Initiated a Subset Study to the Alaska Regional Ports Study – Arctic Deep Draft Harbors Study

- Interest by Congressional Delegation and Governor.
- Goal – Identify and locate potential sites for an arctic deep water (draft) port(s).
- To do that, we needed to identify criteria for an arctic deep draft harbor :
    - What is required? - Depth, moorage capacity, upland infrastructure, intermodal transportation requirements, etc.
    - Who are the potential users?
    - Where is the arctic?
- Conducted a "Planning Charrette" in May 2011.
- Next step – Extend the request for information to the public.

Next Steps

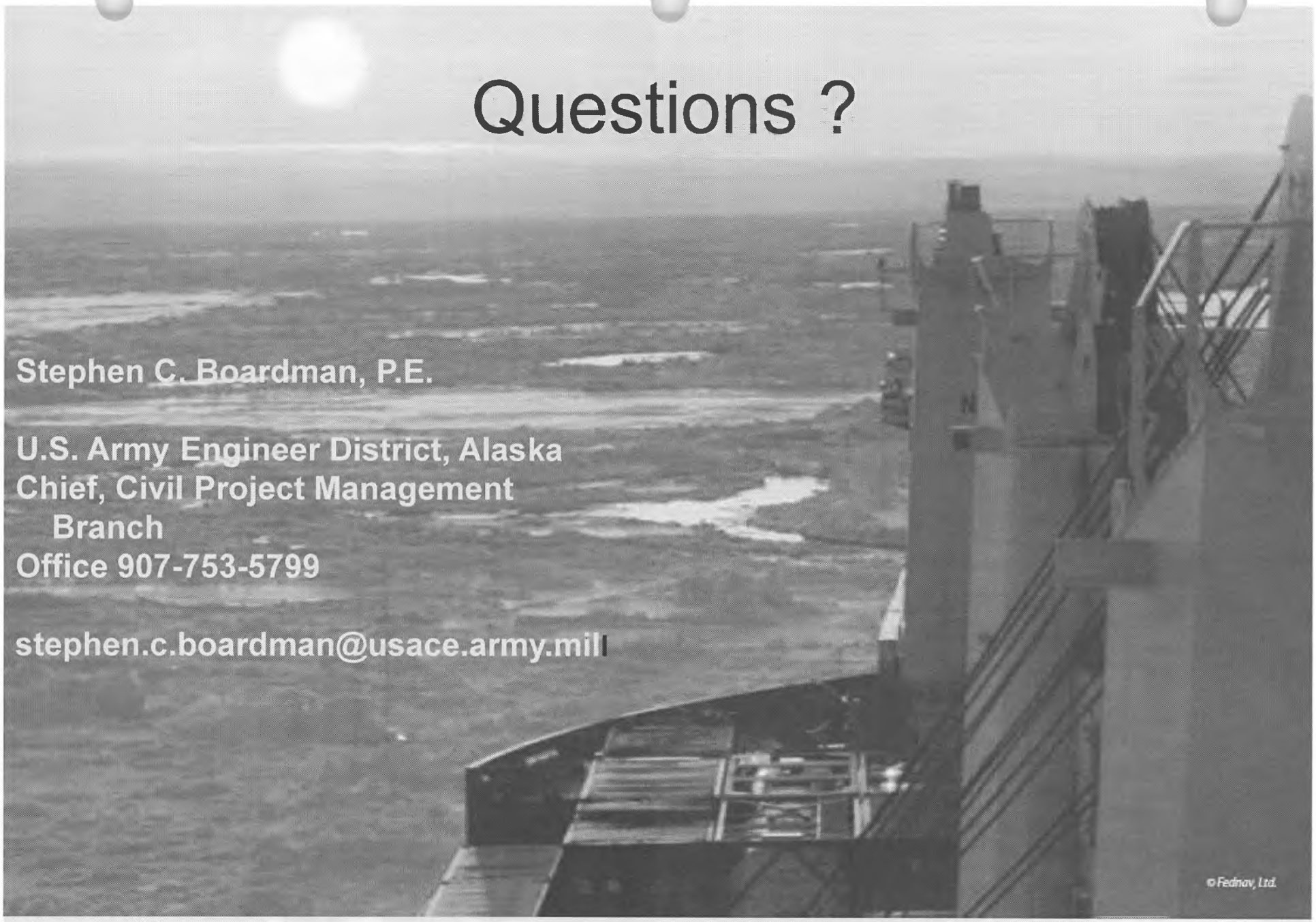
- Funding constraints:
  - Federal funding is limited. Not included in PRESBUD for FFY11 or FFY12. Reprogramming funds from other existing projects.
  - State funding is limited. SFY12 appropriation.

Where One Can Find Information on the Alaska Regional Ports Study

1. 2008 Statewide Conference
2. 2010 Statewide Conference
3. 2011 Arctic Deep Draft Study Charrette

http://www.usace.army.mil/en/cw/AKPortsStudy.htm

Questions ?



Stephen C. Boardman, P.E.

U.S. Army Engineer District, Alaska
Chief, Civil Project Management Branch
Office 907-753-5799

stephen.c.boardman@usace.army.mil

Employ an Integrated, Comprehensive Systems-Based Approach

Lessons Learned From Hurricane Katrina

- Tyranny of Decisions (50 Year Chronology)
- Recommendations:
  - "Actions for Change"
    1. Comprehensive systems approach
    2. Risk-informed decision making
    3. Communication of risk to the public
    4. Professional and technical expertise

Capitalizing on Federal Policy Interpretations

- Subsistence Benefit Evaluation
  - Historically undervalued economic benefit
  - Partnered with Kawerak to study quantifiable value of subsistence activities
  - Will culminate in economic model which captures nuances of subsistence
- Watershed/Systems Approach
  - Harbors function as a system
- Streamline Planning Process

Employ an Integrated, Comprehensive Systems-Based Approach

Why?

- *Focus on balancing multiple objectives with a view towards future needs*
- *Develop partnerships through strategic alliances*
- *Develop system wide opportunities*
- Consider future comprehensive needs by developing a long term framework for decision making

Employ an Integrated, Comprehensive Systems-Based Approach How Do We Get There?

- ✓ Different Levels of Government and Community Coming Together
- ✓ New Partnerships and Collaboration
- ✓ Expanded Sponsor involvement
- ✓ Identify solutions to local and regional problems with broader ramifications

Improve Project Development Process

- Rock Quarry Investigation
  - Partnered with State explore new quarry development
  - Joint quarry development
  - Evaluate improvements to Corps permitting process
- Contracting Options
  - Notice to Proceed – specify multi-year time frame
  - Separable construction components (contracts)
- Shared Projects
  - Local, State, USCG, Corps, Navy, etc
  - Shared use and costs

Corps Marine Development Authorities

- General Investigations
  - Specifically Authorized
- Continuing Authorities Program
  - Section 107 for small navigation projects (ON HOLD)
- Planning Assistance to States
- Tribal Partnership
- Interagency and International Support

Committee for Marine Transportation Systems

- Develop and implement national MTS policies
- Interagency partnership of four lead MTS agencies
  - US Army Corps of Engineers (MG William Grisoli, Chair)
  - National Oceanic and Atmospheric Administration
  - Maritime Administration
  - U.S. Coast Guard
  - Over twenty agencies or departments represented
- 2010 Work Plan Tasks – Integrated Action Teams (IATs)
  - MTS National Strategy
  - Assessment of the MTS
  - Maritime Data Coordination and Information Management
  - Navigation Technology Integration & Coordination

6
Bering Strait Port Access Route Study

Bering Strait
Port Access Route Study

Captain Adam Shaw
17th Coast Guard District

Ports and Waterways Safety Act (PWSA)
P.L. 95-474; 33 U.S.C. 1223

Coast Guard is responsible for:

Designation of fairways and traffic separation schemes to provide safe access routes for vessels proceeding to and from ports

International Strait = International Rules

International Maritime Organization study requires evaluation of:

- Navigational Hazards
- Traffic Patterns
- Environmental Concerns
- Aids to Navigation
- Hydrographic Surveys

PARS Process

Federal Register Notice
Public Comment (ends May 9th)

Port Access Route Study
Vessel Traffic, Marine Environmental, Mandatory or Voluntary, AtoN Considerations

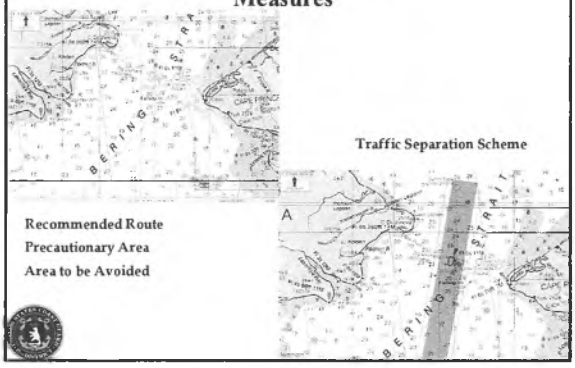
Federal Register Notice
Public Comment (on PARS recommendations)

US Interagency Group
Departments of State, Defense, and Commerce

Joint US-Russia Proposal Negotiations

International Maritime Organization

Potential Ship Routing Measures



Ship Reporting Systems

- Simple Call In Reporting
- Vessel Traffic Services

We are specifically looking for answers to the following questions:

1. What navigational hazards do vessels operating in the study area face?
2. Are there strains on safe navigation in the Bering Strait, such as increasing traffic density?
3. What are the benefits and drawbacks to establishing new routing measures?
4. What impacts, both positive and negative, would new routing measures have on the study area?
5. What costs and benefits are associated with the potential study recommendations listed above? What measures do you think are most cost effective?

Questions?

Captain Adam Shaw
(907) 463-2803
Adam.J.Shaw@uscg.mil

Send Comments to:
http://www.regulations.gov
Document type: "Notices"
Keyword: "USCG-2010-0833"

7
Arctic Search and Rescue

ARCTIC SEARCH AND RESCUE
NWTF - 08 July 2011

Captain Adam Shaw
Chief of Prevention
CCGD17

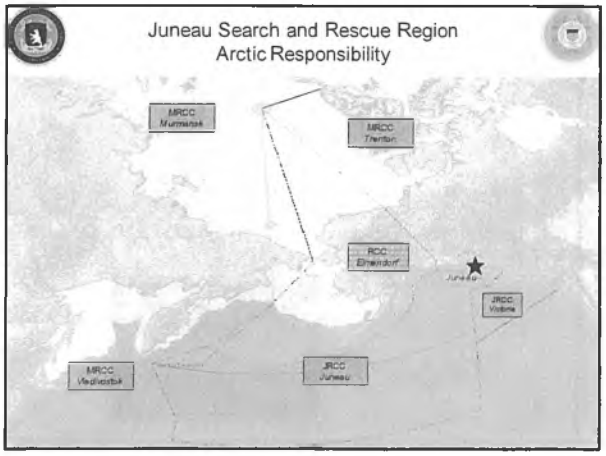
U.S. Coast Guard – Seventeenth Coast Guard District
Juneau Search and Rescue Region

U.S. Coast Guard – Seventeenth Coast Guard District
Juneau Search and Rescue Region

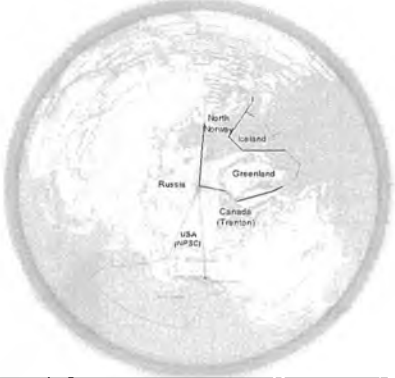
U.S. Coast Guard – Seventeenth Coast Guard District
Juneau Search and Rescue Region

Location	Distance	To Base FW	To Base (RW)
North Pole	1925NM	9 Hours	-
Pt Barrow	757NM	3 Hours	9-14 Hours
Prudhoe Bay	820NM	3 Hours	8.5 Hours
Nome	541NM	2 Hours	5-8 Hours
St. Paul	580NM	2 Hours	7 Hours
Cold Bay	375NM	1.5 Hours	3.5 Hours
Dutch Harbor	530NM	2 Hours	8 Hours
Adak	910NM	3.25 Hours	10 Hours
Attu	1025NM	4.25 Hours	13.5 Hours

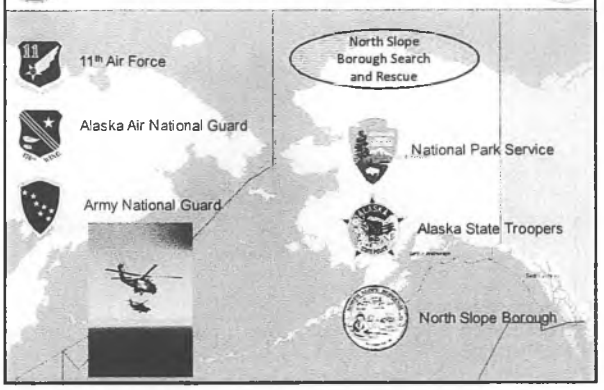
Juneau Search and Rescue Region
Arctic Responsibility



Search and Rescue in the Arctic
Arctic SAR Regions

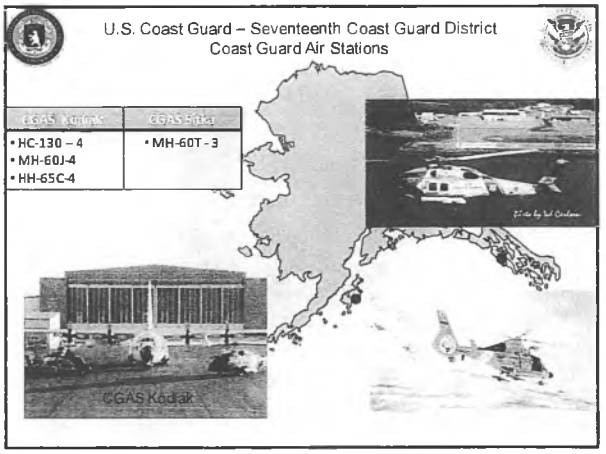


Alaska Search and Rescue
Federal and State and Local Partners



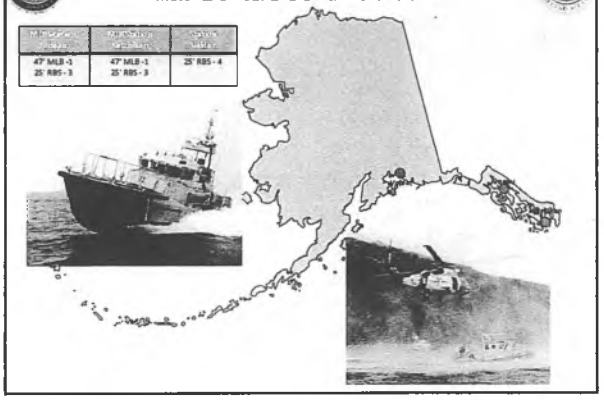
U.S. Coast Guard – Seventeenth Coast Guard District
Coast Guard Air Stations

CGAS Kodiak	CGAS Sitka
• HC-130 – 4 • MH-60J-4 • HH-65C-4	• MH-60T - 3

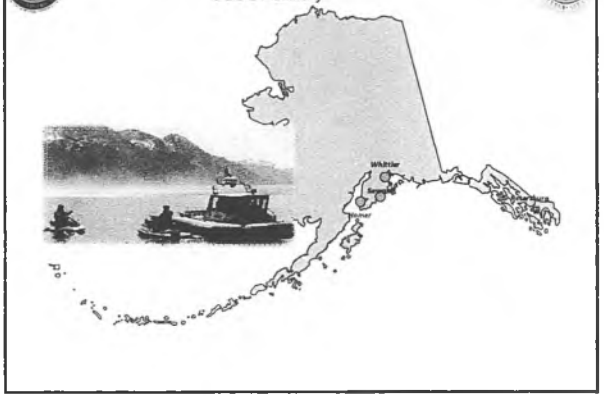


U.S. Coast Guard – Seventeenth Coast Guard District
Motor Life Boat and Small Boat Stations

47' MLB -1 25' RBS - 3	47' MLB -1 25' RBS - 3	25' RBS - 4

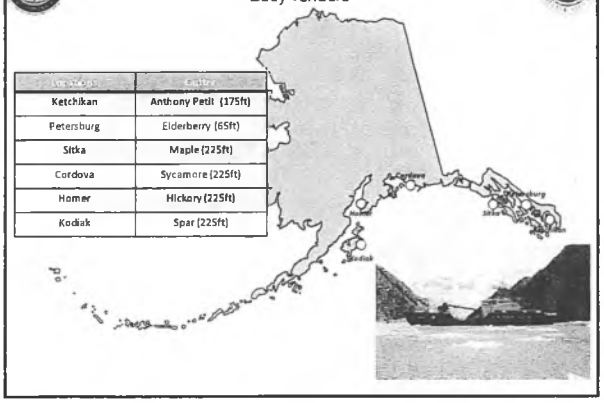


U.S. Coast Guard – Seventeenth Coast Guard District
USCG Auxiliary Stations



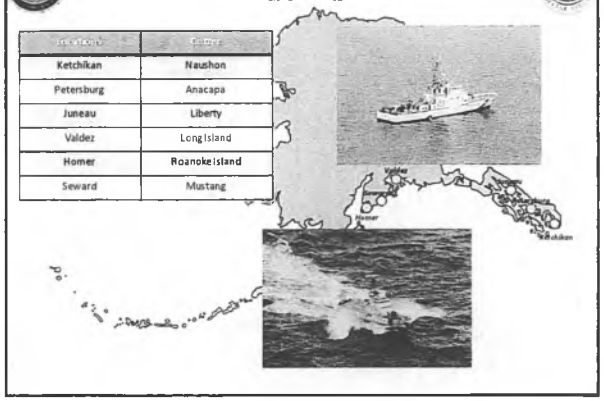
U.S. Coast Guard – Seventeenth Coast Guard District
Buoy Tenders

Location	Cutter
Ketchikan	Anthony Petit (175ft)
Petersburg	Elderberry (65ft)
Sitka	Maple (225ft)
Cordova	Sycamore (225ft)
Homer	Hickory (225ft)
Kodiak	Spar (225ft)



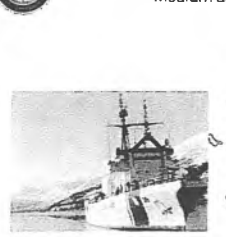
U.S. Coast Guard – Seventeenth Coast Guard District
Patrol Boats

Location	Cutter
Ketchikan	Naushon
Petersburg	Anacapa
Juneau	Liberty
Valdez	Long Island
Homer	Roanoke Island
Seward	Mustang



U.S. Coast Guard – Seventeenth Coast Guard District
Medium and High Endurance Cutters

Location	Cutter
Kodiak	MUNRO
Kodiak	Alex Haley



U.S. Coast Guard – Seventeenth Coast Guard District
Ice Breakers

U.S. Coast Guard – Seventeenth Coast Guard District
Forward Operating Locations

U.S. Coast Guard – Seventeenth Coast Guard District
SAR Partners

11th Air Force – 176 Air Wing
Joint Base Elmendorf-Ft Richardson

Unit	Location	Assets
RCC Elmendorf	Anchorage	SAR Controllers
176th Air Wing	Anchorage	Rescue Squadrons
210th Rescue Squad	Anchorage	Pavehawk
211th Rescue Squad	Anchorage	HC-130 Tankers
212th Rescue Squad	Anchorage	Pararescuemen

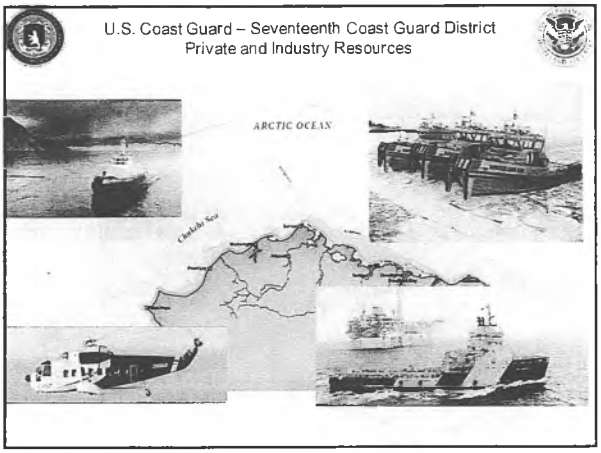
U.S. Coast Guard – Seventeenth Coast Guard District
Local Arctic SAR Partners

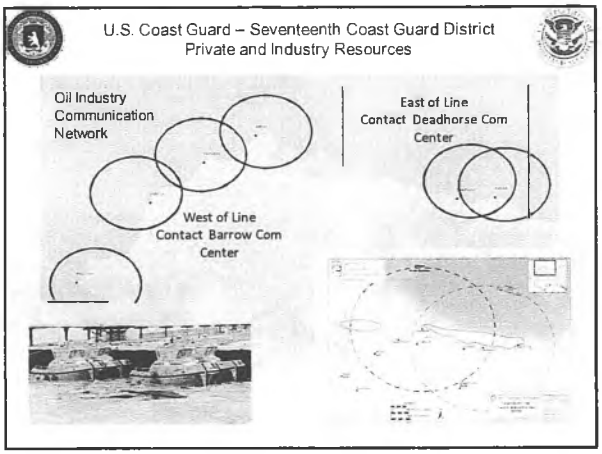
Alaska State Troopers

State Responsibility
• Coordination of volunteer groups
• IC of SAR for the State of Alaska
• Maintains aircraft, land and water craft for SAR and law enforcement
• Located in remote regions of the state

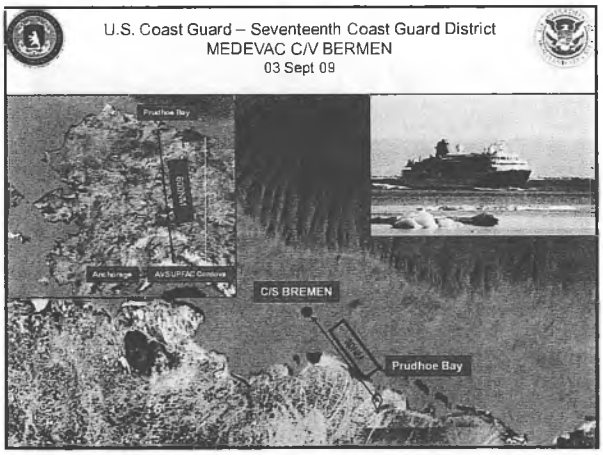
U.S. Coast Guard – Seventeenth Coast Guard District
Local Arctic SAR Partners

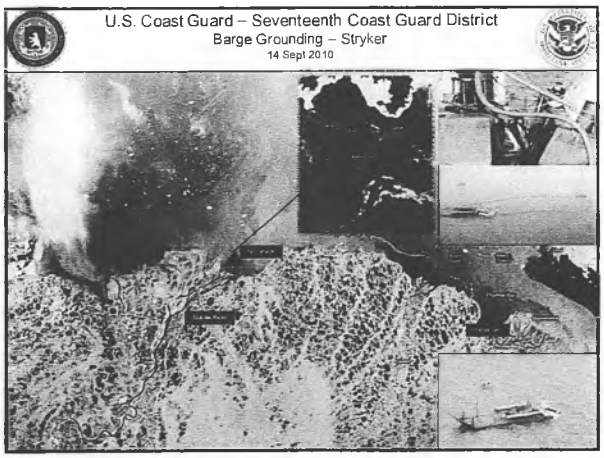
North Slope Borough SAR - Local Assets	
Lear 31A	King Air B200
Bell 412SP(2) no hoist capability	PLB Loner Program
Snow Machines	Paid and Volunteer Staff


U.S. Coast Guard – Seventeenth Coast Guard District
Private and Industry Resources
ARCTIC OCEAN


U.S. Coast Guard – Seventeenth Coast Guard District
Private and Industry Resources
Oil Industry
Communication
Network
East of Line
Contact Deadhorse Com
Center
West of Line
Contact Barrow Com
Center

U.S. Coast Guard – Seventeenth Coast Guard District
Domestic Outreach
ARCTIC CROSSROADS


U.S. Coast Guard – Seventeenth Coast Guard District
MEDEVAC C/V BERMEN
03 Sept 09
C/S BREMEN
Prudhoe Bay


U.S. Coast Guard – Seventeenth Coast Guard District
Barge Grounding – Stryker
14 Sept 2010

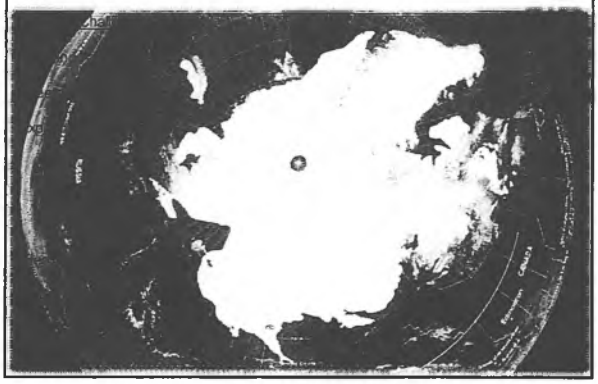
Russian Arctic Research Camp NP-37
21 May 2010
1200 NM
600 NM

Arctic/Antarctic Mass Rescue

2007 M/V EXPLORER with 154 passengers & crew struck an ice berg and sank off Antarctica. Next cruise was to be in the Arctic.

2010 M/V Clipper Adventurer runs aground in the Canadian Arctic with 197 passengers and crew aboard.

U.S. Coast Guard – Seventeenth Coast Guard District Challenges and Goals



Captain Adam Shaw
(907) 463-2803
Adam.J.Shaw@USCG.Mil

8

Alaska Landscape Conservation Project

Alaska's Landscape Conservation Cooperatives

Climate Impacts

Wetlands and estuaries critical to shorebirds, waterfowl, and salmon may be affected by sea-level rise and coastal erosion.

The reduction in sea-ice is bringing new opportunities for shipping routes that would cross through the Alaska LCCs, but also threatens many ice-dependent species.

Changing ocean temperatures, circulation patterns and acidity may alter the entire marine ecosystem, affecting, among other things, the availability of prey for seabirds, marine mammals, and important commercial and subsistence fisheries.

Coastal erosion, accelerated by increased storm activity, is already forcing some villages in Alaska to relocate.

Warming and melting permafrost will change the landscape, altering the distribution and abundance of wetlands and some vegetation communities. The stability of village infrastructure and services such as water treatment facilities and roads are uncertain.

Increased wildfire, with potential increases in pests and diseases, are expected throughout the boreal regions of the state.

USFWS

Landscape Conservation Cooperatives in Alaska:
Alaska overlaps five LCCs: Aleutians and Bering Sea Islands, Arctic, North Pacific, Northwest Interior Forest, and Western Alaska. Each LCC is in a different stage of development. The Arctic LCC was the first LCC to be established in Alaska. In 2010, steps were taken to pilot both Western Alaska and North Pacific. Both the Aleutians and Bering Sea Islands and Northwestern Interior Forest are still in the early stages of initiation.

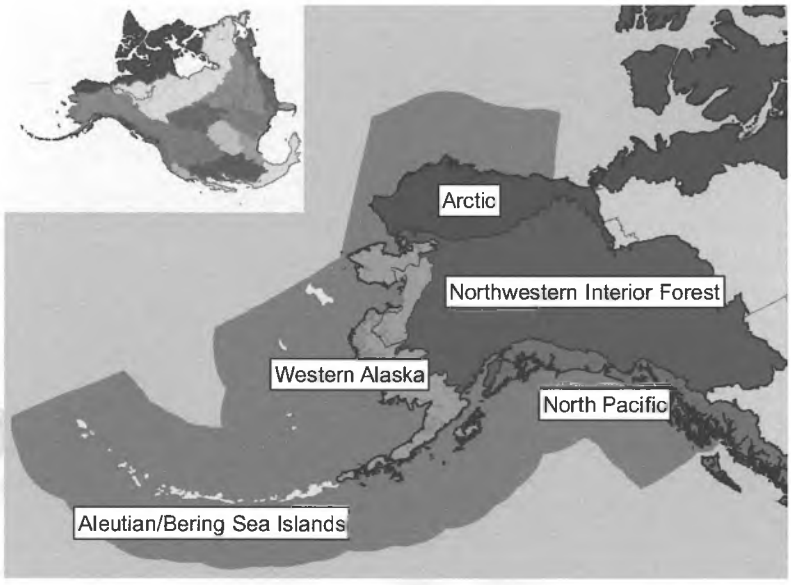
The Conservation Challenge

Climate change is one of the greatest environmental and conservation challenges of the 21st century. The impacts of climate change are already being felt in Alaska. Coastal erosion is accelerating, threatening homes and infrastructure, and as a result, entire communities may need to be relocated. Changing migration patterns of waterfowl, terrestrial and marine mammals, and fluctuations in the movement of fish stocks have influenced subsistence harvest. Warm, dry summers are producing drought conditions over much of the state, altering the landscape by drying wetlands, slowing the growth of trees, and producing more frequent wildland fires.

Understanding and responding to the many facets of environmental change will require unprecedented collaboration and communication among researchers, public agencies, and private organizations.

Landscape Conservation Cooperatives

Landscape Conservation Cooperatives (LCCs) are self-directed partnerships that link science with conservation actions to address climate change and other stressors within and across landscapes. They compliment and build upon existing science and conservation efforts – such as fish habitat partnerships and migratory bird joint ventures – as well as water resources, land, and cultural partnerships. While LCCs will not assume other partner responsibilities or supersede agency decision-making, they will provide the scientific information needed to help inform the development of strategic conservation actions.



Terrestrial boundaries of the five LCCs within Alaska; marine boundary of Alaska LCCs shown in teal blue. Inset shows distribution of LCCs across the North American continent.

USFWS

Susanne Miller/USFWS

Arctic LCC

Contact:
Greg Balogh
Arctic LCC Coordinator
greg_balogh@fws.gov
(907) 786-3605

The geographic scope of the Arctic LCC spans the northern portion of Alaska and Canada. Within Alaska, the landscape is characterized by rugged mountains, large expanses of tundra, and abundant wetlands and ponds. Arctic Alaska provides breeding grounds for millions of birds from more than 100 species, including species that breed nowhere else in the U.S. The area also provides habitat for threatened Steller's eiders, spectacled eiders, and polar bear as well as other species of conservation concern, including yellow-billed loon, Kittlitz's murrelet, Pacific black brant, and Pacific walrus.

The cultural identity of Alaska Natives and arctic rural residents is closely tied to their environment, and subsistence harvest continues to provide a large portion of the food consumed in arctic communities. Important subsistence resources include marine mammals, caribou, fish, and waterfowl. Climate change is already affecting access to some of these species.

The Arctic LCC was established in 2009. The Arctic Steering Committee has developed a charter and identified a set of common conservation goals. Projects funded in 2010, focus on modeling ecosystem transitions, understanding the arctic hydrologic systems, and improving access to geospatial data. The geographic scope of this LCC creates additional collaboration opportunities with Canada and potentially other arctic nations.

Bill Hinkey/USFWS

Western Alaska LCC

Contact:
Karen A. Murphy
Western Alaska LCC Coordinator
karen_a_murphy@fws.gov
(907) 786-3501

The Western Alaska LCC covers a wide diversity of ecological conditions including permafrost dominated landscapes, complex river deltas, abundant volcanoes, and forests. Western Alaska streams are home to the world's largest natural runs of Pacific salmon and the adjacent marine waters support the largest commercial fisheries in the U.S. They support local communities both as a source of income and as a key component of a subsistence lifestyle.

The Western Alaska LCC is home to Pacific walrus, threatened sea otters, and spectacled and Steller's eiders. Steller sea lions, short-tailed albatrosses, and eight species of whales in this region are endangered. Millions of seabirds breeding along the shore form a strong link between land and sea. Astounding numbers of waterfowl and shorebirds use these areas for breeding, migration, and wintering habitat. Caribou roam the land, as do populations of moose, bears and wolves.

In 2010, the first steps were taken to pilot the Western Alaska LCC. Representatives from State and Federal agencies have recently begun discussing how to convene the partnerships. We are meeting throughout the region to speak with potential partners from the local borough governments, Alaska Native organizations and tribes, other government and nongovernment organizations and academia. A climate change state-of-the-science workshop to help this new LCC identify initial science needs and collaboration opportunities is being scheduled for 2011.

Steve Hillebrand/USFWS

Steve Hillebrand/USFWS

North Pacific LCC

Contact:
Mary Mahaffy
Interim NPLCC Coordinator
mary_mahaffy@fws.gov
(360) 753-7763

Art Souls/USFWS

U.S. Forest Service

The North Pacific LCC stretches from the eastern half of the Kenai Peninsula south to northern California. The marine, estuarine, freshwater, and terrestrial habitats of this LCC support a rich diversity of species. They have cultural significance to Native Americans throughout the region. Marine and coastal island habitats are essential to sea birds, shorebirds and other Pacific Flyway migratory species. Highly productive nearshore marine ecosystems are key to sustaining healthy populations of marine mammals, Pacific salmon, forage fish, and shellfish. Forested habitats in the Pacific Coast mountain ranges support many resident and migratory birds including species of conservation concern such as marbled murrelets, and Queen Charlotte goshawks. Prairie habitats in the southern regions of this LCC are host to numerous species of imperiled plants, birds, mammals, and butterflies.

In 2010, the first steps were taken to pilot the North Pacific LCC. This LCC area already has a number of partnerships focused on large-scale biological planning and conservation design. We will work closely with these existing partnerships and provide a forum that encourages continuous exchange of information and feedback and enhances understanding among resource managers, scientists, and stakeholders. The geographic scope of this LCC creates additional collaboration opportunities with Canada and the other states within the LCC.

Aleutian/Bering Sea Islands LCC

Contact:
Steve Delehanty
steve_delehanty@fws.gov
(907) 235-6546

USFWS

The Aleutians and Bering Sea Islands area supports an extraordinarily productive marine ecosystem. Pollock, cod, flatfish, halibut, crab, and salmon are abundant, and these fisheries provide more than half of the seafood consumed in the U.S. In addition to providing jobs and income through the commercial fishing industry, the region supports the subsistence lifestyle of many communities within the LCC. About 100 million seabirds from more than 30 different species breed and summer here. Nearly half of Alaska's seabirds breed in 10 large colonies in the Bering Sea. Tens of thousands of marine mammals including Steller sea lions, sea otters, seals, Pacific walrus, and whales depend on this important region.

There are already a number of strong conservation and management partnerships operating within the boundary of the Aleutian/Bering Islands LCC. The challenge will be to bring these existing partnerships together to identify shared goals and consider how climate change may add new dimensions to existing resource challenges and to seek ways to appropriately integrate this science with on-going marine partnerships.

In 2010, the Aleutian/Bering Islands LCC established an initial partnership of interested agencies and organizations.

Steve Hillebrand/USFWS

Northwestern Interior Forest LCC

Contact:
Mike Spindler
(907) 456-0331
mike_spindler@fws.gov

The geographic scope of the Northwestern Interior Forest LCC includes south central and interior Alaska, most of the Yukon Territory, and the northern portion of British Columbia. The LCC is dominated by a patchwork of spruce and hardwood forests, regions of extensive wetlands and numerous lakes, and rugged alpine tundra. In more mountainous areas, ice fields and glaciers are interspersed among the tundra and forested lowlands. Frequent wildland fires continually reshape the mosaic of vegetation communities.

The boundary of the LCC encompasses large portions of the Yukon, Kuskokwim, Susitna, and Copper River watersheds. The landscape remains largely undeveloped and supports health populations of large and small mammals, resident fish, Pacific salmon, and upland birds. During summer, the region provides valuable breeding habitat for millions of migratory waterfowl. All of these resources are critical to the cultural heritage of Alaska Natives and support a subsistence lifestyle.

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USFWS

In 2011, early initiation steps for the Northwestern Interior Forest LCC will begin and a partnership of interested agencies and organizations will be established. There are already a number of conservation and management partnerships operating in the area and the Northwestern Interior Forest LCC will identify ways to contribute to those efforts by addressing their science needs. By virtue of its geographic scope, this LCC creates additional opportunities for collaboration with Canada.

Facilitating Collaborative Action on Climate Change within Alaska

The Alaska Climate Change Executive Roundtable (ACCER), established in 2007, is comprised of both federal and non-federal senior level agency executives from throughout Alaska. The ACCER will provide the oversight necessary to ensure coordination and integration of activities within the five Alaska LCCs, as well as coordination among the LCCs, the USGS Climate Science Center, and NOAA's Climate Service for Alaska.

LCC Contributions to Conservation

- Articulate priority science needs of the partnerships and find ways to address those needs.
- Help partners design and implement science-based monitoring programs.
- Work with partners to improve access to natural resources spatial data.
- Form a link between research communities and resource managers.

Alaska Region LCC Contact

Cynthia Jacobson, Ph.D.
Assistant Regional Director, Science Applications

U.S. Fish and Wildlife Service
1011 E. Tudor Road, MS-281
Anchorage, AK 99503

907-786-3508
cynthia_jacobson@fws.gov

October 2010.

9

Inuit Circumpolar Council Written Testimony

INUIT

Northern Waters Task Force (July 2011)
By Jim Stotts, ICC Alaska President

I'm Jim Stotts, President of the Alaska branch of the Inuit Circumpolar Council (ICC). Our membership includes Inupiat, St. Lawrence Island Yupik and Central Yupik from the Bering Straits, North Slope, Northwest and Southwest delta regions. Internationally ICC represents approximately 160,000 Inuit from Alaska, Canada, Greenland, and Chukotka.

Thank you for this opportunity to address the task force. It's fitting that the task force is meeting here in Nome since there are northern waters issues facing the Bering Straits region and communities. We hope concerns raised at this meeting will lead to State policy that will help the region and improve community life.

I testified at the second task force meeting last December in Barrow. I'm providing copies of my earlier testimony to illustrate what's been going on during the past seven months. These two testimonies when viewed together will show some trends and serves as a sort of report card on progress from the ICC perspective.

We're glad to see the task force discussions now have a somewhat broader and more balanced focus. This is evident from the task force agenda for the recent meeting in Kotzebue and this meeting here in Nome.

In addition to marine shipping, oil and gas, mining, ports and infrastructure; there is discussion on oil spill prevention and response, environmental concerns, biodiversity, and Inuit concerns and perspectives. We applaud the task force for recognizing the need to look at development more holistically. Cultural, social and environmental issues must be considered at the same time as economic and resource development issues.

At the Barrow meeting: we mentioned ICC had arranged for an invitation to the Commissioner of Health and Social Services to an Arctic nations health ministers meeting in Nuuk, Greenland; and ICC invited the Commissioner of Natural Resources to an Inuit Leaders Summit on resource development in Ottawa, Canada. Both of these meetings occurred last February.

Unfortunately the State declined to attend either meeting. These meetings would have provided an excellent opportunity for the State to network and expand its horizons. We're providing copies of *"A Circumpolar Inuit Declaration on Resource Development Principles in Inuit Nunaat"* for your review and information. This declaration was formulated at the Inuit Leaders Summit in Ottawa.

On a positive note, Lieutenant Governor Mead Treadwell attended the Arctic Council Ministers meeting last May in Nuuk, Greenland as part of the U.S. delegation. We can't think of anyone better suited to represent the State at these forums than Mead Treadwell. Hopefully this outreach will continue. Make no mistake about it; this is where much of the action is. This is where Arctic policy is being made. The recent *"Arctic Imperatives Summit"* held in Girdwood clearly emphasized this fact.

At the Barrow meeting, we presented eight specific recommendations to the task force. I want to focus now on our fourth recommendation which simply states that: science and traditional knowledge should form the basis for decisions.

The current prevailing opinion is: not enough is known about the Arctic Ocean to start the development being contemplated. In other words: more science is necessary to better understand the ecosystem and the consequences of our actions. This has been stated many times by Inuit, local authorities, the scientific community, the Arctic Council, and our own federal government.

Despite this strong prevailing opinion, the State continues to take the position that enough scientific research has been conducted and let's start development, right now. This is political decision making, and has nothing to do with using science and traditional knowledge to make decisions. We believe this is the wrong approach. The risk is too high for Arctic peoples and the Arctic Ocean environment. So, our advice is simple: let's quit dragging our feet and start conducting the scientific research that's needed. The State of Alaska needs to step up and be part of the solution.

What about traditional knowledge? How will traditional knowledge be captured? How will local input be obtained? We don't mean to rub salt on old wounds, but what happened regarding Alaska's Coastal Zone Management Program recently was a big step backwards in our opinion. This was a huge lost opportunity for cooperation between the State and local authorities. This was a huge lost opportunity to incorporate traditional knowledge into the planning process. What does aggregate evidence mean, exactly? At the Barrow meeting, our second recommendation was: put strong local influence back into Coastal Zone Management.

I'd like to switch topics now and talk about another issue that ICC believes is important to bring before the task force.

The number one priority of ICC Alaska is food security. Food security is a global concern and a critical issue for Inuit as well. We are concerned about the fish, birds and animals that we depend on for nutritional and cultural survival. We are concerned about the need for a clean and safe habitat for those food resources. For ICC Alaska this is job #1.

This leads me to an issue that hasn't been discussed by the task force, but needs to be mentioned since it involves northern water resources. That issue is commercial fishing and its effects on Inuit food security. I realize that commercial fishing is outside the mandate of the task force, but commercial fishing is impacting Inuit food security and some of our people have trouble putting food on the table because of restrictions on subsistence fishing. It's not an exaggeration to say we are getting starved out.

Last month, the North Pacific Fishery Management Council met here in Nome to discuss, among other issues, salmon by-catch problems in the pollock fishery. ICC Alaska provided testimony at that meeting. Much of the testimony given at this meeting mentioned salmon by-catch problems under State managed fisheries as a major culprit when it comes to getting salmon up the rivers to spawn.

Despite the best efforts of the State to manage salmon, our people find themselves losing access to this important food resource. It's high time to find a solution to this problem. It's time to address the Bristol Bay and Area M fisheries. Not enough salmon are making their way back up the rivers of western Alaska. This is another strong message that needs to find its way back to Juneau.

We traveled to Juneau last March and met with a number of Commissioners about the possibility of the State becoming involved in the Arctic Council and other international forums where Arctic policy is being created. We suggested the State create a small group to work with ICC cooperatively on issues concerning us all. We still wait.

We're sorry if we're coming on a little strong; but it's becoming increasingly clear to us that the current State administration has little, if any, interest in cooperating with Inuit. When it comes to development our positions are miles apart and we can't seem to sit down together and talk about it. So, we will continue talking with our federal government and others that will listen. We will contribute our views and traditional knowledge and are confident we will be listened to. We're sorry to say the current State administration has left us with no other option.

We know many of you with the task force believe much as we do. We thank those of you that fought the good fight trying to keep the Coastal Zone Management Program alive. We know you did the best you could. Unfortunately, our best just wasn't good enough at the end of the day. It's not the end of the world. The discussion on the future of the Arctic is just getting started and we will continue.

So, this is our evaluation on progress made over the past seven months; we think the trend is negative; and the report card had a poor grade. As before, we wish the task force good luck, and we still are willing to help if we can. Thank you and I'll be happy to answer any questions you may have.

Northern Waters Task Force (December 2010)
By Jim Stotts, ICC Alaska President

Thank you for this opportunity to address the Northern Waters Task Force (NWTF). Thank you for making the effort to visit Barrow which is on the front line for resource development in the US portion of the Arctic Ocean.

My name is Jim Stotts and I'm President of the Alaska chapter of the Inuit Circumpolar Council (ICC). Our membership includes Inuit from the North Slope, Northwest, Bering Straits and Southwest Delta regions of the state. Internationally, the ICC represents 160,000 Inuit from the United States, Canada, Greenland and Russia.

As a recognized non-governmental organization with consultative status to the United Nations, and a permanent participant to the Arctic Council, ICC is very much aware of activities going on in the Arctic at both the national and international level.

ICC's purpose is: to strengthen unity among Inuit of the Arctic; to promote Inuit rights and interests at the international level; to develop and encourage long term policies that protect the Arctic environment; and seek full and active partnership in the political, economic, and social development of the Arctic.

In other words, ICC pushes for Inuit influence over all activities affecting them and their homeland, on land, air and sea. This has been ICC's mission for 30 years. It's fitting to note that the ICC started right here in Barrow, through the vision of Eben Hopson Sr, the first Mayor of the North Slope Borough.

The NWTF is just starting its work and this is only its second hearing. So, timing is perfect to get things started out right, to ensure that the task force develops a balanced perspective moving forward. In ICC's opinion, the State of Alaska needs a more balanced perspective when it comes to development in northern waters and the Arctic Ocean.

We believe the State's approach is too favorable on the side of development. In other words, resource development trumps all other considerations, including cultural, social and environmental considerations. We hope the task force will be able to get beyond this lop-sided approach and come up with some ideas that the Inupiat can get behind. Without a balanced focus this could end up being a wasted effort.

Sadly there is no representation from tribal organizations on the task force. The task force would benefit greatly from a tribal presence. The Arctic Council, the inter-governmental organization of the eight Arctic nations, charged with developing Arctic policy, has indigenous people's organizations as permanent participants. The newly formed US National Ocean Council also calls for a tribal presence. The State of Alaska should consider doing the same. This would give the State greater credibility and acceptance with the Inupiat which is sorely needed at this time.

In HCR-22 which establishes the NWTF, the duties of the task force are spelled out as: 1) assess and facilitate the creation of a joint state and federal commission to oversee development of state and federal northern ocean waters; 2) facilitate regional coordination, cooperation, and outreach regarding creation of the commission to keep local stakeholders informed and incorporate their input into the process; 3) identify and coordinate mutual concerns of federal, state, and local agencies, and international interests in the creation of the commission. These are the three duties of the task force.

The task force shall carry out these duties by holding hearings in the northern region of the State, providing recommendations regarding the creation of the joint commission, and delivering reports to the legislature with legislative proposals for consideration in January 2012. In a nutshell this is the mandate of the NWTF.

I would be remiss if I didn't mention the fact that the State of Alaska missed an excellent opportunity to address one of the most important concerns raised by local authorities when the State failed to act, last legislative session, to strengthen Coastal Zone Management. Local influence was, in effect, rubbed out. In our opinion, the State decided to follow industry's lead and made the wrong decision, again.

From ICCs perspective it appears the State doesn't trust local people and has decided that it will make the decisions that affect them on their behalf. It's no wonder the Inupiat are losing trust in the State to help them with their problems and concerns. This task force will have to wrestle with this local perception as it moves ahead trying to develop recommendations that Inupiat can support. Again, a balanced approach is necessary.

Cultural, social and environmental issues must be considered at the same time as economic and resource development issues.

A few words about the Arctic Council, the Council has been and continues to be involved in developing Arctic policy in many areas, including areas that directly impact Arctic indigenous peoples. For example, on February 16th, there will be a meeting of the Health Ministers from the eight Arctic nations in Nuuk, Greenland. The Alaska State Commissioner of Health and Social Services will be invited to this meeting based on ICC Alaska's recommendation that he be invited. ICC Alaska knows the State will accept the invitation in the spirit in which it's made. We hope this will lead to mutual cooperation on the many health issues facing the Arctic. At least, it's a chance.

I mention this is to illustrate that Inupiat are and have been involved for many years in the process of helping create Arctic policy at the national and international level. Policies that protect the environment while allowing for sustainable development. Our understanding of sustainability includes the notion of cultural sustainability. We are fighting to keep our culture alive in this modern world. We will not back down. Some of you realize this already.

The United States and its Arctic Council partners are addressing important matters facing the Arctic. Offshore oil and gas and other Arctic Ocean developments, such as Arctic marine shipping, are just two of the topics being discussed. Other matters such as environmental protection, biological diversity, and climate change are also on the front burner.

The Arctic Council discusses many other topics that ICC chooses to call the "Human Dimension". The human dimension includes topics of great concern to the Arctic's indigenous peoples and residents at the community level, including: education, health, language and culture, community energy and infrastructure needs, pollution and toxic contamination, scientific research and traditional knowledge, just to name some of the issues being discussed.

I suggest the NWTF needs to be informed on the workings of the Arctic Council, including the perspectives of its permanent participants. The Council has already done much great work on the issues before this task force. It appears development of the Arctic Ocean will take a cooperative international approach rather than each Arctic nation going its own way. This means the State of Alaska will have to cooperate within this larger framework or get left behind or left out of the discussion. Please don't take this as a threat, it's simply my observation. This process is pretty far down the track already.

Early indications are that the US National Oceans Council will take a similar holistic approach to development as well. The task force probably should keep this in mind and keep itself informed on what's going on at the National Oceans Council. Again, we think this is good advice.

Okay, now for some specific recommendations:

1) **Include a tribal presence on the task force**
2) **Put strong local influence back into Coastal Zone Management**
3) **Realize Arctic offshore development is international in nature**
4) **Science and traditional knowledge should form the basis for decisions**
5) **Focus on offshore development must be holistic, not lopsided**
6) **Inupiat must benefit from development, beyond jobs**
7) **Seriously consider the NSB's offshore oil and gas policy (eight points)**
8) **Expand the task force mandate to review the environmental side of Arctic Ocean resource development**

In closing, I want to mention that the ICC is facilitating and hosting an Inuit Leader's Summit on Resource Development February 23-24 in Ottawa, Canada. The three topics of discussion are: offshore oil and gas development, uranium mining, and the social and environmental impact assessment process.

This Summit will bring together Inuit leaders from our four countries to discuss these important topics. The State of Alaska Commissioner of the Department of Natural Resources will be invited to the Summit to listen to what Inuit are thinking. This will be a great opportunity for networking. We hope the State will be able to attend.

Thank you for your time and good luck as you move forward. If ICC can be of help in the future please just let us know. I will be forwarding a copy of the Inuit Arctic Policy to Representative Joule for the task force's consideration. We call it the bible. If you have any questions, I'll be happy to try to answer them at this time.

INUIT

A Circumpolar Inuit Declaration on Resource Development Principles in Inuit Nunaat

Preamble

Recognizing the Arctic's great resource wealth, the increasing global demand for the Arctic's minerals and hydrocarbons, the scope and depth of climate change and other environmental pressures and challenges facing the Arctic;

Mindful of the core rights of Inuit as recognized in the *United Nations Declaration on the Rights of Indigenous Peoples*, as provided for in a variety of other legal and political instruments and mechanisms, including land rights settlement legislation, land claims agreements (treaties), and self-government, intergovernmental and constitutional arrangements, and as asserted in *A Circumpolar Inuit Declaration on Sovereignty in the Arctic*; and

Respectful of the ingenuity, resilience and wisdom of previous generations of Inuit, confident of the ability of every generation of Inuit to adapt to change, and determined to provide for the material and cultural well-being of Inuit into the future;

We, the Inuit of *Inuit Nunaat*, declare:

- Healthy communities and households require both a healthy environment and a healthy economy.
- Economic development and social and cultural development must go hand in hand.
- Greater Inuit economic, social and cultural self-sufficiency is an essential part of greater Inuit political self-determination.
- Renewable resources have sustained Inuit from the time preceding recorded history to the present. Future generations of Inuit will continue to rely on Arctic foods for nutritional, social, cultural and economic purposes.
- Responsible non-renewable resource development can also make an important and durable contribution to the well-being of current and future generations of Inuit. Managed under *Inuit Nunaat* governance structures, non-renewable resource development can contribute to Inuit economic and social development through both private sector channels (employment, incomes, businesses) and public sector channels (revenues from publicly owned lands, tax revenues, infrastructure).
- The pace of resource development has profound implications for Inuit. A proper balance must be struck. Inuit desire resource development at a rate sufficient to provide durable and diversified economic growth, but constrained enough to forestall environmental degradation and an overwhelming influx of outside labour.
- Resource development results in environmental and social impacts as well as opportunities for economic benefits. In the weighing of impacts and benefits, those who face the greatest and longest-lasting impacts must have the greatest opportunities, and a primary place in the decision-making. This principle applies between *Inuit Nunaat* and the rest of the world, and within *Inuit Nunaat*.
- All resource development must contribute actively and significantly to improving Inuit living standards and social conditions, and non-renewable resource development, in particular, must promote economic diversification through contributions to education and other forms of social development, physical infrastructure, and non-extractive industries.
- Inuit welcome the opportunity to work in full partnership with resource developers, governments and local communities in the sustainable development of resources of *Inuit Nunaat*, including related policy-making, to the long-lasting benefit of Inuit and with respect for baseline environmental and social responsibilities.

In further detail, we declare:

1. Candour, Clarity and Transparency

1.1 The world's peoples and their social, cultural and economic systems are becoming more interconnected, the pace of change is accelerating, the challenges faced by the world are escalating in complexity, and the risks associated with human activities are of increasing significance.

1.2 To prosper under these circumstances, the peoples and states of the world must conduct their relations cooperatively with candour, clarity and transparency – an approach in keeping with Inuit culture and custom.

1.3 It is our desire to declare our key understandings, positions and intentions in relation to resource development, recognizing that doing so will benefit Inuit and the global community.

1.4 While the focus of this Declaration is on the development of non-renewable resources, it must be understood that (a) issues surrounding the appropriate use of non-renewable and renewable resources are inextricably linked, and (b) the principles set out in this Declaration are, in many ways, applicable to the use of renewable resources.

2. United Nations Declaration on the Rights of Indigenous Peoples

2.1 Resource development in *Inuit Nunaat* must be grounded in the *United Nations Declaration on the Rights of Indigenous Peoples.*

2.2 The *UN Declaration* recognizes the right of indigenous peoples to self-determination. Under that right, Inuit have the right to freely determine collectively our political, social, economic, and cultural development. Resource development in *Inuit Nunaat* directly engages our right to self-determination, and many other provisions of the *UN Declaration.*

2.3 Our rights as an indigenous people, including our right to self-determination, may be exercised in a practical way through governance structures that combine both Inuit and non-Inuit constituents. No matter what level or form of self-determination the Inuit of any particular region have achieved, resource development in *Inuit Nunaat* must proceed only with the free, prior, and informed consent of the Inuit of that region.

2.4 Private sector resource developers, and governments and public bodies charged with the public management of resource development, must all conduct themselves in concert with the *UN Declaration.* Respect for the *UN Declaration* should be open and transparent, and be subject to independent and impartial review.

3. A Circumpolar Inuit Declaration on Sovereignty in the Arctic

3.1 Resource development in *Inuit Nunaat* must be grounded in *A Circumpolar Inuit Declaration on Sovereignty in the Arctic*, adopted by the Inuit Circumpolar Council in April 2009.

3.2 *A Circumpolar Inuit Declaration on Sovereignty in the Arctic* identified many principles that are relevant to the governance and carrying out of resource development in *Inuit Nunaat*, including the importance of the rule of law and recognition of the rights of Inuit as an Arctic indigenous people under both international and domestic law.

4. Inuit as Partners in Policy Making and Decision Making

4.1 Central to *A Circumpolar Inuit Declaration on Sovereignty in the Arctic* is the requirement that Inuit must be active and equal partners in policy-making and decision-making affecting *Inuit Nunaat.*

4.2 Partnerships with Inuit in relation to resource development will have different characteristics depending on the circumstances, but the spirit and substance of partnership must extend to both public sector governance and private sector enterprise.

4.3 Partnerships must include the meaningful engagement and active participation of Inuit in local communities who are most directly affected by resource development in *Inuit Nunaat.*

4.4 Partnerships must draw upon the growing capacity and aspirations of Inuit businesses and enterprises through use of vehicles such as joint ventures, commercial mechanisms for facilitating equity participation, and the issuance of land and resource rights through licences, leases and similar instruments.

4.5 Inuit recognize the need within *Inuit Nunaat* to create and implement inter-Inuit consultation mechanisms to ensure that approval of major resource development projects in one Inuit region, with major environmental and other implications for one or more adjacent Inuit regions, is accompanied by sufficient opportunity for an

informed exchange of information and opinion between or among the Inuit regions.

5. Global Environmental Security

5.1 Inuit and others – through their institutions and international instruments – have a shared responsibility to evaluate the risks and benefits of their actions through the prism of global environmental security.

5.2 Resource development in *Inuit Nunaat* must contribute to, and not detract from, global, national and regional efforts to curb greenhouse emissions and should always be seen through the reality of climate change.

5.3 In their implementation of mechanisms for adaptation to climate change, states and the international community as a whole must commit to paying the cost of climate change adaptation measures and the upgrading of fuel-related infrastructure in *Inuit Nunaat* regions and communities.

5.4 Resource development projects must not exacerbate the climate change-related stresses on the survival of Arctic wildlife.

5.5 To minimize risk to global environmental security, the pace of resource development in the Arctic must be carefully considered.

6. Healthy Communities in a Healthy Environment

6.1 The physical and mental health of human communities and individuals cannot be separated from the health of the natural environment.

6.2 Resource development proposals for *Inuit Nunaat* must be assessed holistically, placing human needs at the centre.

6.3 Resource development in *Inuit Nunaat* must promote the physical and mental health of communities and individuals within *Inuit Nunaat.*

6.4 Resource development must enhance, not detract from, Inuit food security.

6.5 In a contemporary context, healthy communities in the Arctic require the establishment, maintenance and improvement of core infrastructure needs, including housing, education, health care and social service delivery infrastructure, and core transportation and communications networks that facilitate both public sector activities and private sector entrepreneurship.

7. Economic Self-Sufficiency and the Sustainable Development of Resources in *Inuit Nunaat*

7.1 Inuit seek to make use of the economic opportunities available through long-term development of the resources of *Inuit Nunaat.*

7.2 Resource development in *Inuit Nunaat* must be sustainable. It must serve the needs of Inuit today without compromising the ability of Inuit meet their needs of tomorrow.

7.3 The proponent of a resource development project bears the burden of demonstrating that the proposed development is sustainable.

7.4 In determining the sustainability of a resource development initiative, the best available scientific and Inuit knowledge and standards must be determined and employed.

7.5 International standard-setting bodies must seek and secure direct and meaningful input from Inuit. National, regional and local bodies, such as offshore and land management regimes, must be designed and operated to be effective, transparent and accountable, thereby gaining and sustaining the confidence of the Inuit public at all times.

7.6 Sustainability standards must emphasize the need for the demonstrated support of those communities directly affected by a resource development proposal.

8. Impact Assessment, Prevention and Mitigation

8.1 Notwithstanding property rights or government rights-granting regimes, there is no free-standing or unqualified "right" to proceed with non-renewable resource development in *Inuit Nunaat.* Projects must be scrutinized by Inuit and proved to be in the best interests of Inuit and the wider public.

8.2 Land and offshore management regimes must include (a) long-term land use plans that set out ground rules for development applicable to specific projects, and (b) robust impact assessment processes to gauge the likely impacts of specific projects.

8.3 Management, land use planning and impact assessment regimes must address the cumulative impacts of existing and potential projects and, where prudent, limit the number and scope of projects permitted.

8.4 Impact assessments covering broad geographic areas are important and necessary management tools, and their completion in advance of specific project proposals should be encouraged.

8.5 Impact assessments should examine all potential environmental, socio-economic and cultural impacts anticipated both during the project and after the project is completed or abandoned.

8.6 In accordance with relevant provisions of the *Rio Declaration on Environment and Development*, the precautionary principle and the polluter pays principle must be applied in all stages of project planning, assessment, implementation and reclamation.

8.7 Reclamation and recovery of habitat and affected lands and waters must be thoroughly planned and fully funded in advance of and throughout project implementation.

8.8 All development in *Inuit Nunaat* must adhere to the most developed and demanding environmental standards taking Arctic conditions fully into account. (For example, mining operations and offshore hydro-carbon development should entail zero-volume discharge onto land and into Arctic waters.)

8.9 Preventing spills offshore and eliminating release of toxic substances to land and waters are paramount. Prevention efforts should be viewed as investments that pay dividends in cost avoidance.

8.10 Response to spills, contamination of lands or waters, and mining emergencies must meet the highest technological standards and be anchored in proven cleanup technologies with full Inuit participation.

8.11 Proposals for spill response in Arctic waters must include a proven demonstration of the industry's ability to retrieve spilled oil in frozen, broken and refreezing ice conditions. Allowing resource development without such a demonstration would be fundamentally irresponsible.

8.12 Effective oil spill prevention and response in Arctic waters requires active monitoring of vessel traffic and swift and effective emergency response in the event of mishap. Public authorities and developers with relevant responsibilities must commit to increased investment in navigation aids, vessel traffic management, ship compliance inspections, security considerations, emergency response capability, and overall port and harbour infrastructure.

8.13 Standards and requirements for Arctic marine pilots must be carefully conceived and strictly applied.

8.14 An international liability and compensation regime for contamination of lands, waters and marine areas resulting from offshore oil exploration and exploitation must be established.

8.15 Respecting the Arctic Council's "Arctic Offshore Oil and Gas Guidelines" as minimum standa

9. Improving Inuit Living Standards and Expanding Inuit Governance

9.1 Inuit expect that new resource development projects will contribute to an improvement in our material well-being. This expectation is well-rooted in the fundamental features of relevant international indigenous and human rights laws and standards, in the underlying constitutional constructs and political values of the four Arctic States in which Inuit live, and in the application of fairness and reason.

9.2 Through a variety of mechanisms – land rights settlement legislation, land claims agreements (treaties), self-government arrangements, and intergovernmental and Constitutional provisions – Inuit have acquired critical means and levels of control over the governance of *Inuit Nunaat.* Many of these mechanisms provide for direct Inuit participation in specialized resource management bodies, including planning, project review, and regulatory bodies.

9.3 While this trend is primarily a result of Inuit effort and determination, it has often been assisted and welcomed as healthy and normative by and within the four Arctic States.

9.4 Accordingly, resource development projects must take into account the trend toward greater Inuit self-governance and, to the extent possible, advance it.

9.5 Public sector revenues derived from all phases of resource development should be distributed in a fair and visible way according to the following hierarchy of priorities: (1) providing security against unplanned or unintended environmental consequences, (2) compensating for negative community and regional impacts, (3) contributing to the improvement of community and regional living standards and overall well-being, and (4) contributing to the fiscal health and stability of institutions and mechanisms of Inuit governan Only after the legitimate needs of the Inuit of *Inuit Nunaat* are met, should public sector revenues contribute to the coffers of central State treasuries.

9.6 Inuit employment at all levels must be maximized in

resource development activities in *Inuit Nunaat.*

9.7 Independent of the rate of resource development, Inuit must derive direct and substantial employment income benefit from resource development projects. Accordingly, an Inuit education fund should be established in each of Canada, Greenland, Russia and the U.S.A. with public sector investments.

10. Promoting and Accommodating a Dynamic Inuit Culture

10.1 Many international law principles and standards in relation to indigenous peoples are rooted in the strong conviction that the development and preservation of human cultural diversity is both a responsibility and a benefit for all humanity. The *UN Declaration on the Rights of Indigenous Peoples* acknowledges that indigenous peoples have the right to maintain, control, protect and develop their language, traditional knowledge and cultural heritage and expressions.

10.2 Inuit culture is both well-rooted and dynamic. Inuit are committed to ensuring that resource development projects must be planned and implemented in such a way as to support and enhance Inuit culture, rather than subvert or overwhelm it.

10.3 Inuit are committed to safe-guarding Inuit culture against excess adverse pressures and impacts that could be brought on by an overly ambitious, ill timed, or poorly planned and implemented staging of major resource development projects, particularly insofar as such a scenario precipitated a major influx of non-Inuit while failing to impart the technologies, skills and training, and business opportunities needed by Inuit.

10.4 Governments, public bodies and private sector actors in *Inuit Nunaat* must share in these commitments.

We, the *Inuit* of *Inuit Nunaat*, are committed to the principles on resource development in *Inuit Nunaat* set out in this Declaration. Inuit invite – and are entitled to expect – all those who have or seek a role in the governance, management, development, or use of the resources of *Inuit Nunaat* to conduct themselves within the letter and spirit of this Declaration.

Aqqaluk Lynge
Chair
Inuit Circumpolar Council

Jim Stotts
Vice Chair
Alaska

Duane Smith
Vice Chair
Canada

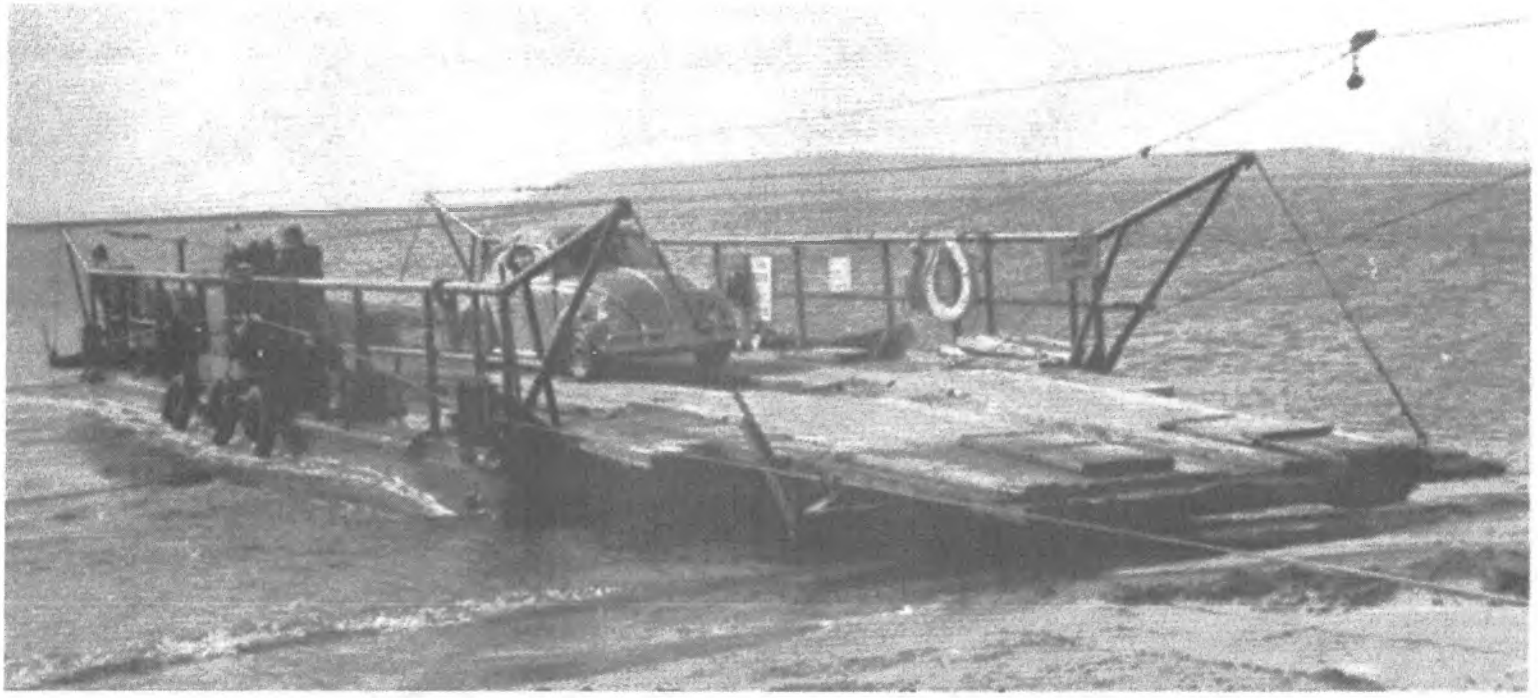
Tatiana Achirgina
Vice Chair
Chukotka

Carl Christian Olsen
Vice Chair
Greenland

10
Transportation in Nome

#9

Transportation in Nome, Alaska



A historical perspective

Compiled from the
private historical archive collection
of Cussy Kauer

Produced for the City of Nome
by
Cussy Kauer & John Handeland

July 2003

(reprinted July 2008)

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, Director

COPY OF CONGRESS

PRELIMINARY REPORT

ON THE

CAPE NOME GOLD REGION

ALASKA

WITH MAPS AND ILLUSTRATIONS

BY

FRANK C. SCHRADER AND ALFRED H. BROOKS
ASSISTANT GEOLOGISTS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

Rec'd. Dec. 27, 1901

LETTERS OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
Washington, February 1, 1900.

SIR: I have the honor to acknowledge receipt of the resolution of the Senate, dated the 3d ultimo, as follows:

Resolved, That the Secretary of the Interior be, and he is hereby, directed to submit to the Senate of the United States a report on any investigations that may have been made by the Geological Survey in the Cape Nome district of Alaska.

In response thereto I transmit herewith a copy of a letter from the Director of the Geological Survey, dated February 1, 1900, to whom the resolution was referred, inclosing a report covering the information desired.

Very respectfully, E. A. HITCHCOCK,
Secretary.

The PRESIDENT PRO TEMPORE OF THE UNITED STATES SENATE.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, February 1, 1900.

SIR: I have the honor to acknowledge the receipt, by reference of the Hon. Thomas Ryan, Acting Secretary, of a copy of a resolution of the United States Senate, dated January 3, 1900, and reading, "That the Secretary of the Interior be, and he is hereby, directed to submit to the Senate of the United States a report on any investigations that may have been made by the Geological Survey in the Cape Nome district of Alaska," with instructions to consider and make an early report.

The report is sent herewith. The delay in transmitting it has been due to the serious illness of Mr. A. H. Brooks, one of the geologists who worked in the Cape Nome district.

I am, with respect, your obedient servant,

CHAS. D. WALCOTT, *Director.*

The SECRETARY OF THE INTERIOR.

WASHINGTON, D. C., *February 1, 1900.*

SIR: In accordance with your instructions, we have hastily prepared the following brief report of the Cape Nome gold region of Alaska. It is based upon observations made during a short visit to the region last October. We fully realize its incompleteness, but believe it contains information of immediate use to those who may visit the region in the near future. With the view of making it of practical rather than of scientific interest, we have omitted theoretical discussion and avoided technical terms as far as possible.

Very respectfully,

FRANK C. SCHRADER,
ALFRED H. BROOKS,
Assistant Geologists.

Hon. CHAS. D. WALCOTT,
Director United States Geological Survey.

PRELIMINARY REPORT ON THE CAPE NOME GOLD REGION, ALASKA.

By F. C. SCHRADER and A. H. BROOKS.

INTRODUCTION.

The following report is based on a few weeks' examination of the recently discovered Nome gold-mining region, made by us in October, 1899. We collected such topographic and geologic data of this important region as the climatic conditions would permit and our limited time would allow, the trip to Nome being a hurried utilization of a delay while waiting for a steamer for Seattle after the completion of the regular field work in the Yukon Basin.

As boats, tents, and camping outfits had been left in the Yukon country, the party was dependent upon such accommodations as could be procured at Nome, or from the miners on the creeks and in the gulches. The topography was done, under direction of Mr. T. G. Gerdine, by Mr. D. C. Witherspoon, using Nome as the base of supplies, because of the severity of the climate and absence of timber for camping purposes; while the geology and photography were done by us. With our packs of sleeping bags, instruments, and provisions, we made a several days' trip into the mountains and gulches to examine the formations and diggings. On account of the cold weather and freezing up of the creeks, most of the gulch diggings had already closed down early in October and the operators had departed. Wherever we found the miners, however, their hospitality was generously extended. We would express our indebtedness to Dr. F. P. King and members of the Pioneer Mining Company on Anvil Creek for many accommodations, and to Messrs. Davidson and Ashford, United States deputy surveyors, for the magnetic variation which they had recently determined at Nome; also to many prospectors and other citizens of Nome who furnished us with valuable information about those portions of the region which we were not able to examine in person.

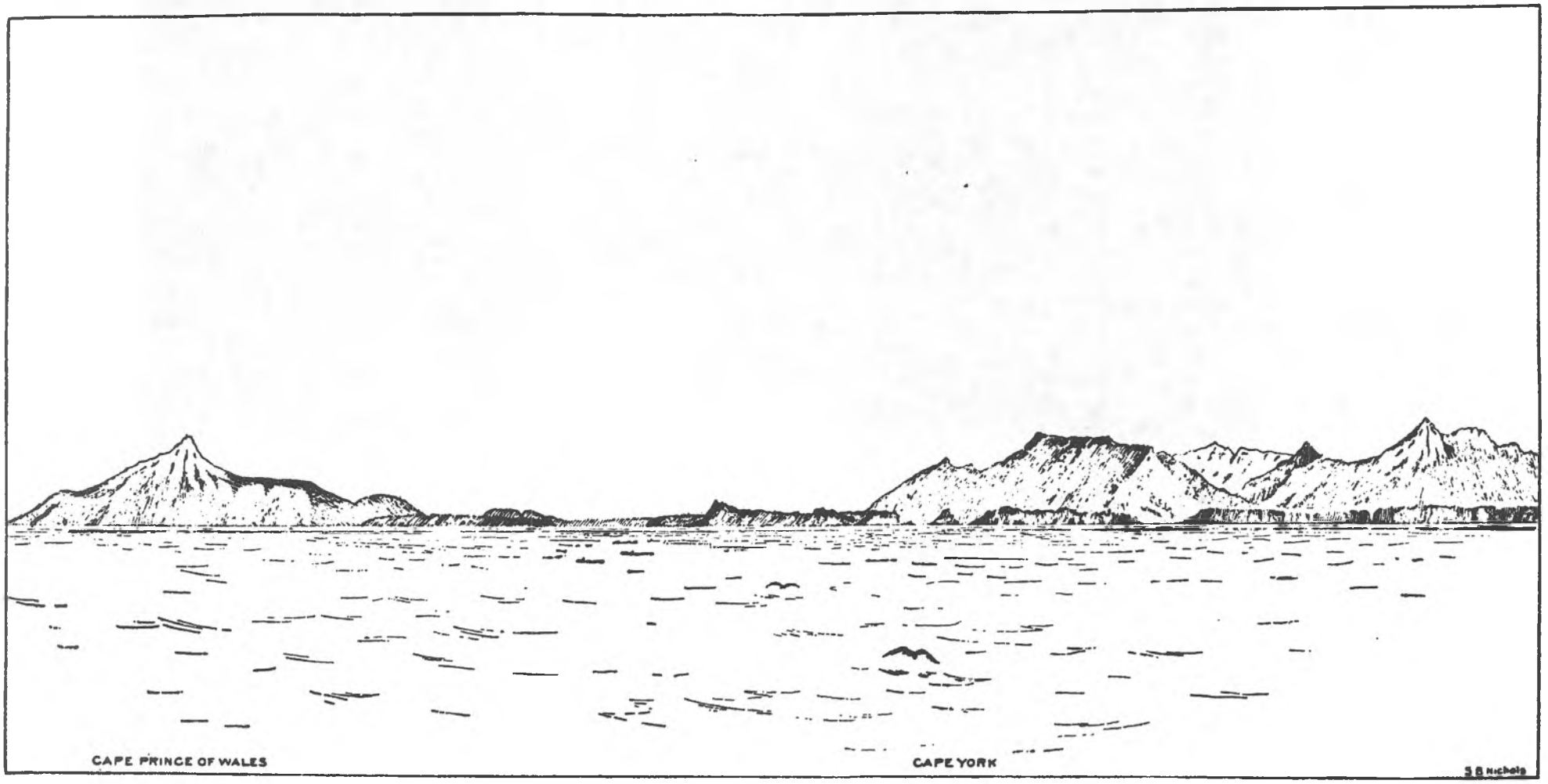
DISEMBARKMENT OF PASSENGERS IN SURF ON NOME BEACH.

UNLOADING OF FREIGHT IN SURF ON NOME BEACH.

EASTERN PART OF NOME AND BEACH, WITH CAPE NOME IN BACKGROUND 15 MILES DISTANT; FROM NEAR MIDDLE OF BEACH IN FRONT OF NOME, LOOKING S. 85° E., OCTOBER 1, 1899.

WESTERN PART OF NOME AND BEACH, WITH WEST POINT ABOUT 15 MILES IN BACKGROUND; SEEN FROM NEAR MIDDLE OF BEACH IN FRONT OF NOME, LOOKING N. 65° W.

NOME BEACH DIGGINGS, SHOWING ALSO MARINE DRIFTWOOD, EDGE OF TUNDRA, AND WEST POINT IN THE BACKGROUND 10 MILES DISTANT; FROM POINT 4 MILES WEST OF NOME, LOOKING N. 80° W.



SKETCH OF THE COAST FROM CAPE YORK TO CAPE PRINCE OF WALES, INCLUDING CAPE YORK GOLD REGION; SEEN FROM THE OCEAN, LOOKING NORTHWARD (AFTER CAPT. F. W. BEACHY'S ADMIRALTY CHART. 593).

NOME BEACH DIGGINGS, WITH WEST POINT IN BACKGROUND, 12 MILES DISTANT; FROM BEACH 2 MILES WEST OF NOME, LOOKING N. 70° W., OCTOBER 17, 1899.

The gravels of the terraces on the mountain slopes, which have been already described, have a similar origin to those of the coastal plain and are probably of a similar character. We can judge of this only by inference, as we unfortunately found no section of these gravels exposed. These terraces are probably in part the remnants of coastal plains that had a far wider extent than they have at present. The elevation and erosion of such plains produced the present topographic forms.

The gravels of the gulches and smaller valleys represent the stream deposits during the period of the deposition of the coastal plain. They lie on the bed rock and are usually of no great thickness. The material is usually coarser than the tundra gravel, and its source is easily traceable to the bed rocks of the vicinity.

Perhaps we have given a more detailed description of the origin and deposition of the unconsolidated formations than the limits of this report would seem to warrant. If so, it has been done because of the close relation of the gold deposits to the gravel, and because of the frequent popular misconception in regard to the origin of these beds. We wish to emphasize the fact that during the deposition of these gravels and sands the conditions were not materially different from those of to-day, except that the land stood at a lower elevation relative to the sea. There is no evidence whatever of glacial action in the region, and the popular idea that the gravels were brought to their present position by ice action is entirely erroneous.

MINERAL RESOURCES AND METHODS OF MINING AND EXTRACTION.

GOLD.

NOME REGION.

The gold of this region has so far all been obtained from placer deposits, which can be conveniently grouped as gulch placers, bar placers, beach placers, tundra placers, and bench placers. During last season only those of the gulches and beach have been important gold producers. No facilities were available for exploiting the tundra deposits, and the benches have not as yet been investigated.

The amount of gold produced during the last season can not be estimated definitely. While there are, as a rule, fairly reliable data as to the production of the gulches and creeks, the amount taken from the beach can only be roughly approximated. From the best information we could gather we believe that the production of gold of the entire belt during the season of 1899 will approach $3,000,000.[1]

[1] Dr. Cabell Whitehead, of the Mint Bureau, informs us that the official records of that Bureau show a receipt of more than $2,600,000 in Nome gold prior to January 1, 1900.

ground in large tracts, is essential, so that ground sluicing, stripping by horsepower, and other "dead" work may be performed on a large scale, and extensive areas of the frozen ground be bared to the thawing influence of the atmosphere and the sun. This method, in connection with ground sluicing and box sluicing, seems to be the most promising and the least expensive. In most cases it will be found advantageous to lead the water from near the edge of the mountains to insure sufficient fall, or to raise it from neighboring streams. Also steam drills and high-pressure streams and jets of hot water may prove to be advantageous, but, presumably, not so profitable when the cost of fuel and machinery and the limited area such plants may be able to cover in a given time are considered.

HISTORY AND DEVELOPMENT OF THE NOME GOLD REGION.

DISCOVERY OF GOLD.

CREEK GOLD.

Up to the time of the "Klondike rush" of 1897 and 1898 but little attention was paid to prospecting in Seward Peninsula, in spite of the fact that both gold and silver had been found in the Golofnin Bay region. According to Father F. Barnum, for many years missionary on the Lower Yukon, and one of the best-informed men of the country, the presence of gold in the Nome region was reported by natives to Yukon prospectors some six or eight years ago. These seem to have placed but little confidence in the report, and did not consider it worthy of further investigation. In the fall of 1898 a considerable influx of disappointed "Klondikers" into the Golofnin Bay district took place, and the prospecting of Seward Peninsula may be said to have been then inaugurated.

In July, 1898, a rumor is said to have reached the Swedish Mission at Golofnin Bay that gold had been found by a reindeer herder on the coast at Sinrock, about 30 miles northwest of Cape Nome. Soon after a party, consisting of the missionary, N. C. Hultberg, J. J. Brinterson, and others, set out for Sinrock in a small boat along the coast. Becoming storm bound on the way, they landed near the mouth of Snake River, at the present site of Nome. Here they are reported to have prospected some, and found fine gold on the bars in the lower reaches of the river, which led them next day to cross over the tundra to the now famous Anvil Creek, a tributary of the Snake. Here, on July 26 or 27, they found some colors of coarse gold, but the majority of the party insisted on proceeding to Sinrock, their original destination. At Sinrock, however, they were not successful, and returned to Golofnin Bay. The colors of coarse gold which had been found on

Anvil Creek during their storm-bound period were not forgotten, for they were considered a favorable prospect by Hultberg. Accordingly, a small party of Swedes or Norwegians, consisting of Eric O. Lindblom, John Brinterson, and Jafet Linderberg, one of whom was in the employ of the Government reindeer service as herder, and another a whaler from the bark *Alaska*, returned to Anvil Creek[1] about the middle of September (1898). Here they spent a couple of weeks, and on the 20th are reported to have discovered coarse gold of unquestionable economic value. They made extensive locations on Anvil Creek, and also crossed over the low divide and staked claims on Glacier Creek and one of its tributaries, Snow Gulch, which during last season proved the richest gulch in the Nome region. Ground was also located on Rock and Dry creeks. After collecting some samples, the party returned to Golofnin Bay, with ground enough staked to make all of them millionaires, as the development of the property last season demonstrated.

Upon their return to Golofnin Bay another and larger party was soon formed, which hurried back to the Nome region, and as the news spread, notwithstanding the lateness of the season, a general stampede for the new El Dorado, to secure locations, set in from Golofnin Bay, the Fish River country, and St. Michael. A meeting was held on October 18 (1898), when the Cape Nome mining district was organized, which was to comprise an area 25 miles square, with Cape Nome at its southeastern corner. Dr. Kittleson is reported to have been elected recorder. The meeting also determined that the size of all locations should be 320 by 560 feet. Nearly every individual located not only for himself, but also for his many friends, by power of attorney. These locations comprised not only mining claims on the different gulches, but also town lots near the present site of Nome. The lowest number of locations said to have been made by any one person was four and the highest thirty. To such an extent was the power of attorney here abused that more than 7,000 acres of ground were located by fewer than forty persons, for themselves and their friends, so that the several thousand Americans who arrived later, finding no unstaked ground anywhere in the vicinity, justly raised a somewhat bitter complaint.

At present the majority of the Nome miners are said to be in favor of abolishing the right to stake ground by power of attorney, of reducing each mining district to 5 miles square and making a reduction in the size of claims, and of restricting ownership to one claim per individual in each district. Such a reform would seem to be a commendable step toward the prevention of fraud and the practice of parasitism on the

[1] This creek and its adjacent mountain are reported to have been named Anvil by Linderberg from the huge anvil-like shape of the boss or knob of rock at the top of the mountain, as shown in the left of Plate VII.

miners' vocation by the great number of so-called "pencil and hatchet men," whose design is not to mine, but merely to make extensive locations for purely speculative purposes. Ground thus held has not only retarded the development of many of the mining districts of Alaska, but has been the source of unlimited trouble in many placer camps.

As it was already late in the fall of 1898 when gold was discovered, but little attempt could be made at development that season. About $2,000, however, were taken out of Anvil Creek and Snow Gulch before the creeks became tied up by frost.

BEACH GOLD.

Up to the middle of the summer of 1899 the attention of the prospectors was entirely confined to the creeks and gulches, but late in July the first discoveries of gold beach were reported almost simultaneously by a soldier from the United States army barracks, who is said to have found gold while digging a well, and by some prospectors of Nome.

One of the first reported to engage in beach diggings was an old prospector from Idaho, by the name of John Hummel, who, it is said, was afflicted with scurvy and, therefore, could not reach the gulches. Hummel prospected the beach, and, finding that it yielded a fair return, went to work with a rocker and took out $1,200 in twenty days of work.

As soon as the news of these rich finds became disseminated, a perfect frenzy for digging in the beach seized the people of Nome. The commandant of the United States army post enforced a regulation[1] that no claims could be staked within a strip of ground running along the beach, 60 feet in width, measured from high-tide limit. Within this reserved area all had an equal right to dig and wash the gravels. The good feeling and good fellowship which generally prevailed in this isolated community is attested by the fact that, in spite of the crowded condition of this public strip, few, if any, serious disputes occurred between the miners. This is rather remarkable, considering the fact that men are often working within a few feet of one another on the same pay streak. This may have been in part because of the popular fallacy that the beach furnished an inexhaustible supply of gold, and that the deposits were being constantly renewed by the action of the surf.

During the height of the excitement upward of 1,000 men were at work on the beach; by some the estimate is even put as high as 2,000. Every man at Nome, be he physician or carpenter, lawyer or barkeeper, dropped his usual vocation and went to work with a shovel and rocker. Men who had been employed in the gulches at good

[1] See circular from the General Land Office, issued June 8, 1898, page 18, section 41, on "A roadway 60 feet in width parallel to shore line."

wages flocked to the beach and went to work for themselves. This undoubtedly retarded the development of the gulch diggings very much, for it was difficult to get miners, even when the wages went up to $11 a day. The beach placers proved a veritable "poor man's proposition." No capital for development was required, any one owning a shovel and a rocker having an equal chance with the rest.

The larger part of this crowd of men were at work near the town, but the beach diggings extend for 12 or 15 miles to the west of Nome. In the fall, when this army of miners had stopped work because of the frost, an almost continuous rampart extended along the beach near Nome, which had been formed by the newly dug gravel, and gave the shore the appearance of having been fortified to repel an invasion. (Plate XII.)

The output of gold from the beach can only be roughly estimated, for no records were kept. It is fair to assume that the beach miners averaged at least good wages. Such being the case, the product of the beach must have been upward of half a million dollars, and may have been much more. There are some intelligent men, who were at Nome during the excitement, who estimate the beach output of gold at from $900,000 to $1,000,000.

ROUTES AND TRANSPORTATION.

SUMMER ROUTES.

All-ocean route.—The shortest and quickest route from the States to the Nome region is by ocean steamer, from Seattle across the North Pacific Ocean and Bering Sea direct to Nome. The distance is about 2,700 miles, and under favorable circumstances about ten days are required to make the trip. Some of the largest and most commodious steamers of the Pacific coast ply on this route. A stop for coal and water is usually made at Unalaska, between the Pacific Ocean and Bering Sea. Freight rates from Seattle to Nome are usually quoted at $40 per ton, first cabin passenger rates $100, and second cabin $60; but as circumstances often govern rates, and some companies readily deviate from the established schedule at chance of gain, the above may be no criterion for the season of 1900, when a large traffic is expected. It would seem, however, that the release of American transports from the Philippine service and the competition of Atlantic coast and other vessels which are to be placed on the line may operate toward the prevention of exorbitant rates. Certain vessels are reported to have engaged all their space last November for their first trip to Nome next June, at prices amounting to several times the usual rates, but we do not know this to be authentic. The leading companies operating on the line and at Nome last season were the Alaska Commercial Company, the North American Transportation and Trading Company,

and the Alaska Exploration Company. Other companies intending to place boats on the line are the Pacific Steam Whaling Company, the Empire Line, and the Pacific Clipper Line. Most of the companies expect to have their first boats direct for Nome leave Seattle early in June. Those leaving much earlier will, presumably, discharge their cargoes at Unalaska, or engage in other traffic this side of Bering Sea. On account of the ice in Bering Sea the season of ocean transportation to Nome is, as a rule. restricted to a period of five months, from about early June to early November. During the remainder of the year the northwest coast of Alaska is usually icebound, and not accessible by vessel.

Distances by ocean route from Seattle to Cape Nome and St. Michael.[1]

Nautical miles.		Station.	Statute miles.	
Local.	Through.		Through.	Local.
	0	Seattle	0	
130				150
	130	Off Strait of Fuca	150	
1,552				1,785
	1,682	Unalga Pass	1,935	
20				23
	1,702	Dutch Harbor, Unalaska	1,958	
645				742
	2,347	Cape Nome	2,700	
105				121
	2,425	St. Michael[2]	2,821	

[1] For these distances we are indebted to the United States Coast and Geodetic Survey.
[2] St. Michael from Dutch Harbor direct is 760 statute miles, and from Seattle direct 2,718 miles.

Yukon route.—Another route, also a summer route, and nearly all by water, is the inland or Yukon route. This is by ocean steamer from Seattle to Skagway, thence by the White Pass and Yukon Railway over the Coast Range to Lake Bennett, the head waters of the Yukon, and from here by river steamer down the Yukon to St. Michael, and from St. Michael by ocean steamer to Nome. This route is not nearly so direct or expeditious as the all-ocean route, as frequent changes and delays are usually involved. There is a change of river steamers on the upper waters of the Yukon, covering Miles Canyon and White Horse Rapids, around which the portage of about 3 miles is by horse tramway. Skagway is open to ocean vessels the year round, but as the ice does not leave the lakes and the Upper Yukon waters until early June, the route offers little or no gain to the Nome-bound passenger, so far as reaching his destination early in the season is concerned. As a return route the Yukon is not practicable for boats leaving St. Michael later than early in September, on account of the ice which forms on its upper waters later in the month. Prob-

ably the chief advantage of the Yukon route consists in its enabling the passenger to escape an open sea voyage. The principal companies operating from Seattle to Skagway are the Pacific Coast Steamship Company, the Pacific Steam Whaling Company, and the Alaska Steamship Company. Others also frequently visit Skagway. The principal company of the Upper Yukon is the Canadian Development Company, operating as far down as Dawson, where connections for St. Michael are made with the commodious Lower Yukon steamers of the A. C. Co., N. A. T. and T. Co., and other companies.

It should be mentioned that when navigation closed on the Upper Yukon waters last October hundreds of tons of freight are reported to have been accumulated at Lake Bennett, where it is said it will have to lie until the opening of navigation next spring, a point worthy of consideration by any who may contemplate the shipment of much freight over this route during the season of 1900.

Owing to the lack of harbor facilities and the precarious method of landing freight at Nome, persons making shipments to that point may do well to contract with the company of the vessel to deliver their goods ashore above high-tide mark.

OVERLAND OR WINTER ROUTES.

These routes are overland or winter routes only so far as pertains to Alaska and a portion of the Northwest Territory.

Yukon route.—One of them, the Yukon route, leaves the coast at Skagway, or the head of Lynn Canal, crosses Chilkoot Pass or White Pass, and follows the Yukon the same as the Yukon steamer route, with the exception that the transportation is by dog sled or reindeer down the river on the ice instead of on the water by boat. But at the mouth of Autokatat River it would leave the Yukon and proceed westward over the portage to Unalaklik River and the head of Norton Sound; thence across or around the head of Norton Bay to Nome. It is by this route that both the Canadian and the American mails are sent to the Yukon region at the present time, largely through the agency of the Canadian Development Company. Much of the danger formerly attending this route has been eliminated by the establishment of Northwest mounted police posts at regular intervals on the Upper Yukon, and of American posts, stations, and natives' villages on the lower part of the river. It is the only overland route in practical use at the present time. Dawson and the Klondike have largely made it what it is. The route, however, is a long one, the trail rugged, on account of the roughness of the ice on the river, and the journey arduous.

Valdes route.—For several years past some effort has been made to explore and open up a so-called "All-American route" from the coast to the Yukon country, by way of Valdes and Copper and Tanana

rivers, but as yet it has not come into practical use. As a route to Nome it is rather indirect. By it the Nome-bound passenger would proceed by ocean steamer to the head of Prince William Sound, leave the coast at Valdes, travel northward through Copper River Basin, over the divide, by way of Mentasta Pass, to the Tanana, and westward down the Tanana to the Yukon; thence down the Yukon to Nome by way of the route described above. But as relay or supply stations have not yet been established along this route, and native villages are remote between the coast and the Yukon, and the country is subject to fierce blizzards, this route should not be undertaken during the present winter except in large and well-organized parties, and then with caution.

Cook Inlet–Kuskokwim route.—This is, as yet, only a proposed route, but, according to Captain Jarvis, J. E. Spurr, F. Barnum, and other pioneers, who are most familiar with the country, it seems without doubt destined to become immediately the favorite overland route for the Nome, St. Michael, and Lower Yukon regions. This route leaves the western shore of Cook Inlet just north of Kamishak Bay and a little northwest of Augustine Island, in approximately 59° 30′ north latitude. It leads westward from Iliamna Lake, past Kakwok, and northwestward across Tikchik Lake to Kalmakof on the Kuskokwim and northwestward to Holy Cross Mission and Anvik on the Yukon, up Anvik River, and over Anvik portage to the head of Norton Sound; thence to Nome as before. By this route the distance from the coast at Cook Inlet to St. Michael and the head of Norton Sound is approximately 400 miles, with the country for the most part of easy, gentle slope and no barriers. Katmai, about 100 miles south of where the route would leave the coast, is open to vessels all winter. The same, so far as known, is true of the Kamishak Bay region. If this is correct, for smoothness of country, shortness, directness, and dispatch, as an overland route the Cook Inlet and Kuskokwim route can not be equaled. At present writing we are informed that Captain Jarvis, of the revenue service, is planning to send a party to examine the route. It seems highly commendable that the Government should without delay give the route a most thorough investigation, that the northwest Alaskan public may reap its benefits. By some it is thought that the route may be practicable in summer as well as in winter. Its early development is expected.

Bering Sea coast route.—Another route is the more or less well-known winter route along the coast, or in use to some extent by the Russians. Starting from Katmai or vicinity and crossing the base of Alaska Peninsula, it follows the coast more or less continuously around to the head of Norton Sound. At the mouth of the Kuskokwim, however, is offered an alternative of proceeding about 100 miles up this river, thence about 20 miles across to the Yukon, then up the

Yukon, and, by way of Holy Cross Mission and Anvik River and portage, to Norton Sound and Nome, as before. This route is rather circuitous and long, but has the advantage of safety, as the posts and native villages upon it, from which food and dog feed may usually be obtained, are nearly always within reach.

TRAVEL AND TRANSPORTATION IN NOME REGION.

In the Nome region, along the coast, waterways, and streams of sufficient size, travel and transportation are principally by small boats and canoes. Across the country there are as yet but few definite or well-marked trails. The country is not, however, of so rugged a character but that one can without much difficulty proceed in almost any direction. During last summer several pack trains of horses were employed in conveying freight and supplies from Nome to the gulch diggings. Some teaming by wagon was also done to these points. About Nome, during the summer season, freighting is accomplished on wheeled vehicles drawn principally by dogs and horses, notwithstanding the fact that the tundra is usually soft for horse footing. Since the larger part of Seward Peninsula seems not ill adapted for teaming and pack trains, it appears certain that horses will be very extensively employed throughout the region during the coming season. So far as experience goes, travel in winter is best accomplished by dog teams or, preferably, reindeer. The use of dogs for sledding in this region has long been too well known to require further mention. The dog, however, is reported to be much surpassed by the reindeer, recently introduced into Alaska, especially in districts where the reindeer moss abounds, as on Seward Peninsula. The chief advantage of the reindeer consists in the fact that it is not necessary to carry forage, since the deer subsists upon the moss wherever camp may be made. There are at present some 1,000 or 1,200 Government reindeer on Seward Peninsula, scattered principally in stations along the southern part and on the coast, with centers at Golofnin Bay and Port Clarence. Dogs are usually scarce in most Alaskan mining regions during the winter season. At Nome last fall an average dog was worth from $50 to $100. A fair team generally consists of about 9 dogs. In reindeer freighting the poulka, or Lapland freight sled, shaped like a boat, is employed. A collection of these was seen on Anvil Creek. They are usually drawn by one or two reindeer. Where real sleds are used the sleds are very low and the runners wide. A trained or draft reindeer at Nome is said to be worth about $150.

HARBOR FACILITIES.

Unfortunately there are no harbor facilities for ocean vessels in the Nome region. The only representative or semblance in this line is the lagoon-like inlet known as Port Safety, about 25 miles east of

Nome. It, however, is suitable only for small boats and craft not drawing over 8 feet of water. It was investigated last season by the United States Coast and Geodetic Survey, whose statement concerning it, as published in the "Notice to Mariners, No. 250" (p. 9, sec. 23), is here quoted for the information of those interested:

ALASKA.

Norton Sound—Cape Nome—Port Safety—Range beacons established.—The commanding officer of the United States Coast and Geodetic Survey steamer *Patterson* reports that on September 10, 1899, he erected two whitewashed beacons, which form a range for crossing the outer bar at Port Safety.

The outer beacon, pyramidal in shape, is located on the end of the low spit marking the western side of the entrance.

The inner beacon, also pyramidal in shape, is located on the inshore side of Port Safety Bay, and is about 2¼ miles WNW. from the outer beacon.

To cross the bar.—With the two beacons in range, bearing WNW., stand in until the breakers on both sides of the channelway are abeam; then change course for the middle of the entrance.

Port Safety is situated about 12 miles eastward of Cape Nome, Norton Sound, and affords excellent shelter for vessels drawing not over 8 feet.

As it is the only harbor in the vicinity, a preliminary examination of it has been made, and a sketch will be published as soon as practicable.

(October 27, 1899. Chart affected: T.)

Port Safety, however, as stated, can in nowise accommodate seagoing vessels such as touch at Nome with freight and passengers. The nearest harbor for such vessels is Port Clarence, about 70 miles northwest of Nome, or Golofnin Bay, more than 80 miles east of Nome. Though it seems highly probable that with continued development of the Seward Peninsula regions these harbors will eventually have railroad connections with the Nome region, nevertheless the lack of harbor facilities at present at Nome is embarrassing. Last season more than 5,000 passengers and many thousand tons of freight were landed at Nome from ocean vessels through the surf by the rudimentary means of river steamboats, barges, scows, rowboats, and canoes. (See Plates XVIII and XIX.) The inconvenience and risk of such methods will be realized when it is learned that the beach at Nome is so shallow that seagoing vessels can not approach much within a mile of shore, and that the beach during much of the time is swept by a heavy surf, with high combers, breakers, and squalls, which are frequently fatal to the various kinds of craft used in landing freight and passengers, and often result in the loss of both craft and cargo, amounting to many thousand dollars in value. Two such instances occurred while we were there in October. Last season, so far as known, no life was lost, though in a number of cases passengers received injuries or suffered broken limbs. The expense of landing freight in this way is usually $15 or $20 per ton. Moreover, the delay occasioned to large seagoing vessels in discharging their cargoes in

this manner is not only embarrassing but very expensive. It frequently happens that, on account of storm and the surf, vessels are isolated from the beach or have to put out to deeper sea for safety, and can not unload for a period of several days. Realizing the great need of harbor facilities here, it is reported that a number of enterprising men have organized a company and are negotiating to construct at Nome an extensive deep-water pier or wharf, to extend nearly a mile from shore, to a point where ocean vessels can discharge their cargoes onto it, whence they will be brought ashore by tramways to warehouses along the beach.

Until harbor facilities are provided, persons shipping freight to Nome should contract with the company of the vessel for the deliverance of freight on shore above high-water line, as the present precarious method of landing may result in loss of freight or entail risk or damage which few can afford to bear.

CLIMATE.

The climate on Seward Peninsula, though it is arctic, is milder and much more even than that in the same latitudes in the interior of Alaska, or the Yukon country. The precipitation, also, is considerably greater. The summer is not so warm, nor the winter so cold. The sea, here traversed by a branch of the Japanese Current, is the great moderator. About the only weather records we have of the region, which are of a primitive character, are those kept by the missionary and reindeer people at Port Clarence, Golofnin Bay, Prince of Wales, and those of Captain Jarvis, of the United States Revenue Service.[1] Some incomplete records were also made at Port Clarence in 1850–1852, and meteorologic observations were maintained at St. Michael (100 miles to the southeast) for many years.

According to the records of the Weather Bureau, the mean annual temperature at St. Michael is 26.1° F., and the annual precipitation (rain and snow) 14.44 inches. The extremes of temperature noted on the island are 75° F. in July and —55° F. in February. The records show freezing temperatures every month except July. The most reliable data indicate that the temperature at Nome is usually somewhat lower than at St. Michael, and that the precipitation is about the same. The winters, as noted, are not so cold at Nome as in the Yukon Basin, but are more trying, because of the dampness and of the cold winds, from which there is no shelter.[2]

The summer, which is short and generally cool, resembles spring in the northern United States. During the warmer months many

[1] The former are found in the reports on the Introduction of Domestic Reindeer in Alaska, by Dr. Sheldon Jackson, and those of Captain Jarvis in the Report of the Cruise of the U. S. Revenue Cutter *Bear* and Overland Relief Expedition in 1897 and 1898.

[2] See Reports of the U. S. Weather Bureau, Department of Agriculture, summarized in Maps and Descriptions of Routes of Exploration in Alaska in 1898, United States Geological Survey, 1899, pp. 133–135.

POPULATION.

Native inhabitants: Eskimo.—The natives of Seward Peninsula, numbering about 800, are Mahlemuts, or Eskimo. They are, in general, scattered along the coast, with several more or less centralized settlements about the missions and reindeer stations, at Port Clarence, Cape Prince of Wales, Golofnin Bay, and in the Cape Nome region. They usually live in small villages of 8 or 10 families, crowded in crude underground huts, or dugouts. Their principal support is by hunting and fishing. They are a good-natured people, and generally industrious. The youth are reported to be apt in the mission schools.

Whites.—Prior to the recent discoveries of gold, about the only whites on Seward Peninsula were the few Americans in charge of the several missions and reindeer stations, and a score or so of Swedes and Laps employed as herders. Accordingly the population of Nome, as a mining camp, is essentially unique, and as yet, for the most part, scarcely six months old. A year ago a few Eskimo huts and one or two sod houses of white men were the only human habitations along 60 miles of the present Nome coast. Last June a dozen or score of tents contained the whole population. By October a town of 5,000 inhabitants fronting the ocean was crowded for a mile or more along the beach. Hundreds of galvanized-iron and wooden buildings were irregularly scattered along two or three thoroughfares, running parallel with the coast line. There is every description of building, from the dens of the poor prospectors, built of driftwood, canvas, and sod, to the large companies' warehouses, stores, and the army barracks—a city, as it were, sprung up in the night, built under the most adverse circumstances on the barren seacoast, a coast without harbor, all the supplies being landed through the surf, as already described and shown on Plates XVIII and XIX. The country contributes nothing toward the support of the population except a few fish and a limited supply of driftwood.

The city is of the most cosmopolitan type and contains representatives of almost every nationality on the globe: Germans, Canadians, Frenchmen, Englishmen, Russians, Swedes, Norwegians, Poles, Chinese, negroes, Italians, Spaniards, Greeks, Jews, and Americans. The dominant type is the American, through whose efforts, with that inherent talent of the Anglo-Saxon race for self-government, this isolated community at once organized a city government. Before the close of the summer Nome had a mayor, councilmen, a police force, a deputy United States marshal, a United States post-office, a fire department with town well, a board of health, a hospital corps, and charitable organizations. A majority of the people consists of the shifting population of the Yukon country, which, upon hearing the news of the discovery of gold, poured itself into Nome. Hundreds also came from the Koyukuk,

Kotzebue Sound, and Kowak River regions, whence, unsuccessful in their search for gold, they reached Nome in a financially stranded condition, but soon became prosperous by mining on the beach. Many also, designing to engage in sundry lines of business and trade, came from the southeastern coast of Alaska and the United States. The influx continued until late in the fall.

By calling, the majority of the people were miners and prospectors, or hoped to become such. The professions of law, medicine, and divinity are well represented, also the vocations of surveying, real estate, insurance, and sundry mercantile branches of business. The saloon, hotel, and restaurant business is prominent and profitable. Along with the shifting population of the Yukon from Dawson and other camps came also many would-be explorers, adventurers, and especially gamblers, but good order prevails throughout. Drunkenness, disorderly conduct, and theft are promptly tried before the police justice and punished by fine and imprisonment. Copies of the official rules and regulations are kept posted before the city hall and in other conspicuous places, as a warning to all: "Ignorance of the law is no excuse." Some of the well-known "toughs" and most undesirable characters are reported to have been rounded up by the authorities late in the fall and exported to the States. There is also quartered here, in comfortable barracks, a detachment of United States soldiers, under Lieutenant Craigie, who in the early part of the season are reported to have done much toward the maintenance of order and the protection of individual rights and property.

A thoroughly energetic and enterprising American spirit pervades the business world. There are several printing presses and three newspapers—the Nome News, Nome Herald, and Nome Gold Digger. The Nugget, with printing press and equipments from Dawson, bound for Nome, went down in a gale on Norton Sound in September, and a similar Nome-bound outfit was wrecked on the *Laurado*, at St. Lawrence Island in Bering Sea, a few weeks later. The leading large companies operating at Nome are the Alaska Commercial Company, the North American Transportation and Trading Company, and the Alaska Exploration Company. There are also innumerable smaller companies and firms engaged in various mercantile lines and sundry vocations. Early in the winter, on recommendation of Mr. G. N. Wright, postmaster at Nome, effort was made by the United States Post-Office Department at Washington, D. C., to secure for the Nome people semimonthly mails during this winter, and a contract was let for the transportation of such mails by way of the Yukon country. With what success this has met has not yet been learned.

There are at least 2,500 people now wintering at Nome, and, by estimate, at least several thousand are on their way there by winter routes. Last season, as soon as the richness of the discoveries

became realized, the larger trading companies built large warehouses and shipped all the supplies possible from St. Michael to Nome, in addition to those brought from the States. Also, a considerable supply of fresh reindeer meat was imported from the Siberian coast by enterprising owners of schooners and other seagoing vessels. It is estimated that, with no accident, there will be sufficient to carry the population through the winter, but none to spare. During the fall, and especially at the close of the season, commodities and living were high. Coal was $125 per ton; wood, gathered from the driftwood on the beach, was $50 and upward per cord; lumber, $125 to $300 per M., when it could be bought at all; board and lodging, from $6 to $10 per day. The price of an ordinary meal was from $1.50 to $3; fresh meat was $1 to $1.50 per pound, and other things almost proportional. Unskilled labor received $12 per day.

IMPROVEMENTS SUGGESTED.

Government.—Since, according to the conservative estimate of those who are best situated to judge, it is believed that the Nome region will have a population of at least 30,000 or 40,000 people this year (1900), some public improvements there seem not only commendable but urgently necessary. Among these the most important are: Some municipal form of government, water supply, land-office service, and harbor facilities. As the General Government had never made provision for any form of municipal government in Alaska, the people of Nome, in response to the urgency of the hour, called a mass meeting, and organized the present government of Nome, with a complete corps of city officers, as aforesaid, though they were conscious at the time that it was without authority from the United States Government. The town was divided into three wards, with two councilmen from each. The expenses of the government were defrayed by taxing business houses and general property owners. There was also a poll tax of $5. The government, for the most part, worked admirably and was fruitful of beneficent results. However, with the large influx of people expected during the coming season, it is most earnestly hoped that, acting on the recommendation of the governor of Alaska and representatives of Nome, the present Congress will make provision for some form of municipal government, so much needed at Nome.

Drainage and water supply.—The climate, though somewhat harsh in cold weather, is generally healthful. Nevertheless, last fall Nome was visited, to a rather alarming extent, with typhoid fever. The hospitals, which were soon crowded to their utmost capacity, rendered most efficient service. However, many cases complicated with pneumonia proved fatal. The fever is ascribed by the health officers and physicians to the poor drainage and unwholesome water supply. This can be remedied at small cost, for, though the tundra about Nome is

nearly level, its elevation and relations to the beach, to Dry Creek on the north, and to Snake River toward the west, as shown on Map 2, are such that the drainage can be rendered comparatively perfect without great expenditure of money and labor. With reference to the water supply, the topography is also most favorable, as shown on Map 2. An abundance of most wholesome water could at moderate cost be drawn from the upper reaches of Snake River, or its tributaries, issuing from the mountains at some distance back from the coast, and distributed through the town. From early spring until winter these streams discharge a considerable volume of water derived from rain and the melting snow and ice in the mountains and hills. The water accordingly is of the most desirable quality. It could probably be best conducted to Nome by means of surface conduits, or flumes, especially as the streams could not be depended upon for winter use. For permanent or perennial supply a large well, to be sunk in the tundra at a safe distance back from Nome, is suggested.

Harbor facilities.—One of the most urgent needs is that of harbor facilities. Improvements in this direction will justify the expenditure of a considerable amount, and will, presumably, yield good returns. As has already been stated, it is reported that capital has been enlisted by a company of enterprising men, who are now petitioning and negotiating with the Government for right of way and certain longshore privileges, to construct at Nome a deep-water pier, and it is hoped that their efforts may meet with success. The pier is to be built in sections at Unalaska, and when erected at Nome is to extend with its tramway nearly a mile to sea, where deep-sea-going vessels can discharge their cargoes. Only with more extended discoveries of gold can Nome hope for railroad connections with the harbor at Port Clarence, which is about 70 miles distant, or Golofnin Bay, still farther away.

Life-saving station.—Unless harbor improvements are provided in the near future, the establishment of a life-saving station at Nome during the summer months seems to be of importance. It should be brought before the authorities and not overlooked.

Land office.—There has been no branch of the General Land Office at Nome during the past season. It seems beyond question that a branch of this service would be of more benefit to the public at this point during the coming season than at any other place in Alaska. It is presumed that the authorities will not overlook this important matter.

Railway and telegraphic connections.—Governor Brady, in his recent report of 1899, p. 22, has emphasized the necessity of railway connections between the Cape Nome region and Port Clarence and Golofnin Bay, in case the region produces half what is expected of it during the coming season. The importance of cable and telegraphic connections

has also been set forth by the governor, and with further development it is to be hoped that such service will be realized in the not distant future.

SUMMARY.

In the foregoing preliminary report we have attempted to sum up the existing knowledge of the Nome region and the adjacent portions of Seward Peninsula. Our notes on the Nome district proper are chiefly the result of our own observations, while those on the other mining districts are based on the most reliable information available.

We have shown that the bed rock of the Nome district consists of more or less altered limestones, mica-schists, and gneisses. The rocks are closely folded and have an east-west strike. Mineralized quartz and calcite are common. The gravels we have classified as gulch, terrace, and tundra gravels, those of the beach being closely related to the latter. The presence of these terraces indicates that the entire region has been slowly elevated.

We have noted that the important gold deposits thus far exploited are the gulch and beach placers. Gold is also known to occur in the bars of the larger rivers and in the tundra. Our theories would lead us to believe that the higher benches and terraces are worthy of investigation by the prospectors. The gulch and beach placers are extraordinarily rich. As would be expected in a new region, no bed-rock mining has been done; but as the gravels and gold are largely of local origin, there is at least a possibility that workable mineral veins will eventually be found. The methods of mining and separating in use last season are crude and imperfect, so that much of the fine gold was lost.

Of other parts of Seward Peninsula we know nothing from personal observation. The Solomon River and Bonanza River region is said to afford good prospects for gold. The Golofnin Bay region, still farther east, has produced gold in commercial quantities. Gold is said to occur on the rivers of Norton Bay and on Unaklik and Anvik rivers. To the northwest of Nome gold has been reported from near Cape York.

The geographic positions of some of these different localities suggest that they may belong to the same gold belt. The facts known to us are not sufficient to prove this, and it must simply be regarded as a working hypothesis. Should subsequent development and investigation show that the gold of all of these districts of Seward Peninsula is derived from the same series of rocks, this gold-mining region will embrace an area of at least 5,000 or 6,000 square miles. If this proves to be the case, it does not by any means follow that the entire belt will contain workable gold deposits. We should rather expect to find the gold confined to certain zones within the belt.

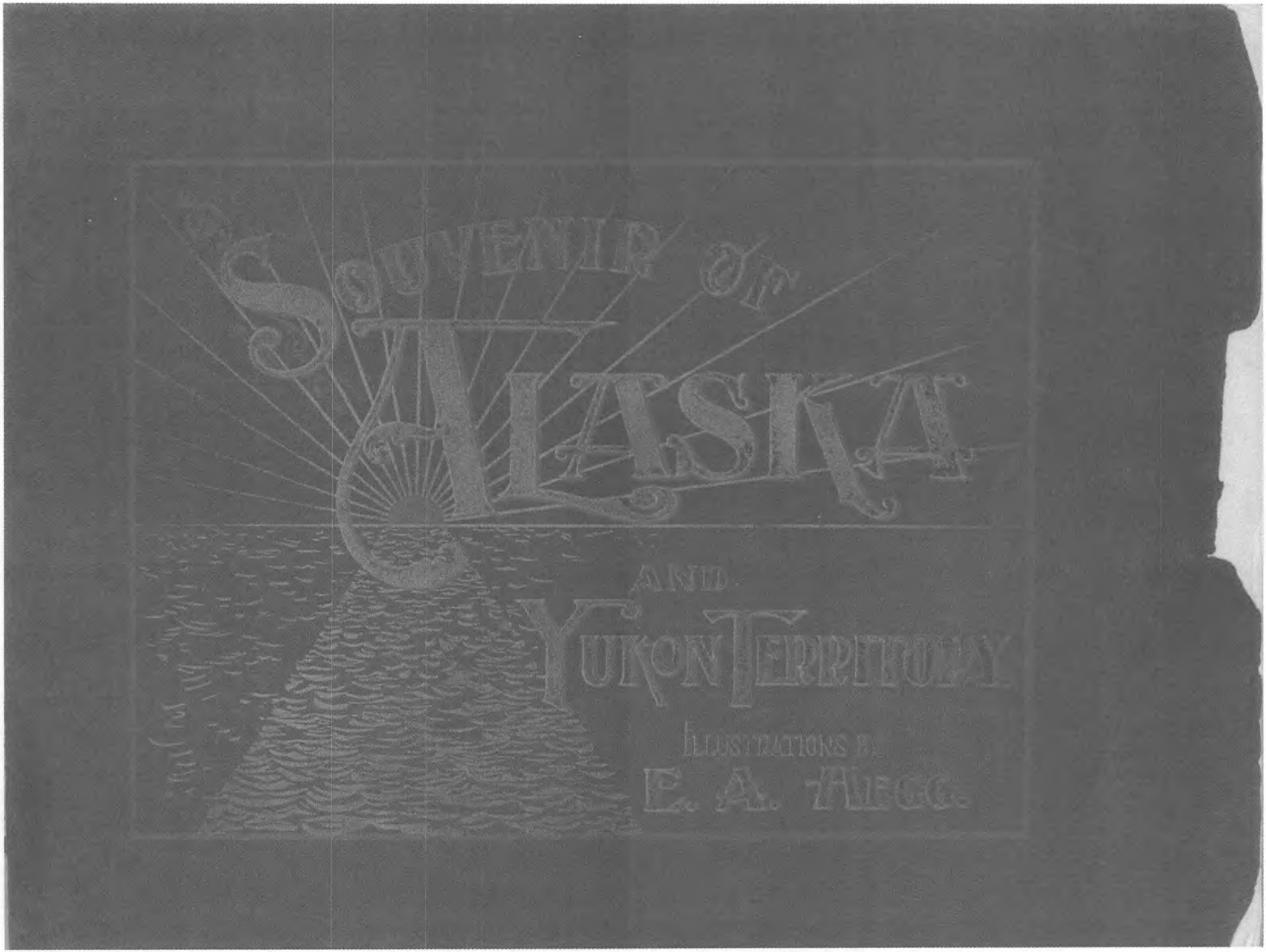
In the coming spring (1900) it is expected that there will be a very large influx of population into the Nome and adjacent regions. A conservative estimate places the number at at least 20,000 men. Several thousand miners and prospectors wintered at the various camps along the coast, and during the winter many will probably go down the Yukon on the ice. It is evident, therefore, that this region, compared with other parts of Alaska, will be densely populated, and it is not likely that the high rate of wages paid last year will be maintained.

The newcomers in the spring will find that nearly all of the known gold-bearing region has been staked. If the beach strip continues to be withheld from private ownership it will undoubtedly offer good opportunities for many men. It must be remembered, however, that the beach placers, like all others, are not inexhaustible, and that they do not, by any means, extend along the whole coast.

While the staking of new claims in the Nome region is probably nearly a thing of the past, yet those having capital to invest will undoubtedly find plenty of claims for sale. Those who lack knowledge of mining matters should invest their money very cautiously, for there is a vast army of speculators at Nome ready to "unload" when the first steamerful of "tenderfeet" arrives. It would be very wise for all inexperiened newcomers to save money for the return passage.

There will be good opportunities at Nome for experienced miners in working on shares or for wages. Good mechanics will also be in demand. We would warn the public of the danger of typhoid fever and other epidemics in the crowded mining camps, a danger which was amply proved by the conditions at Nome last season.

We believe that the Nome region has a great future, but would strongly advise men inexperienced in mining and prospecting to consider the matter carefully before joining in the mad rush which will undoubtedly take place in 1900.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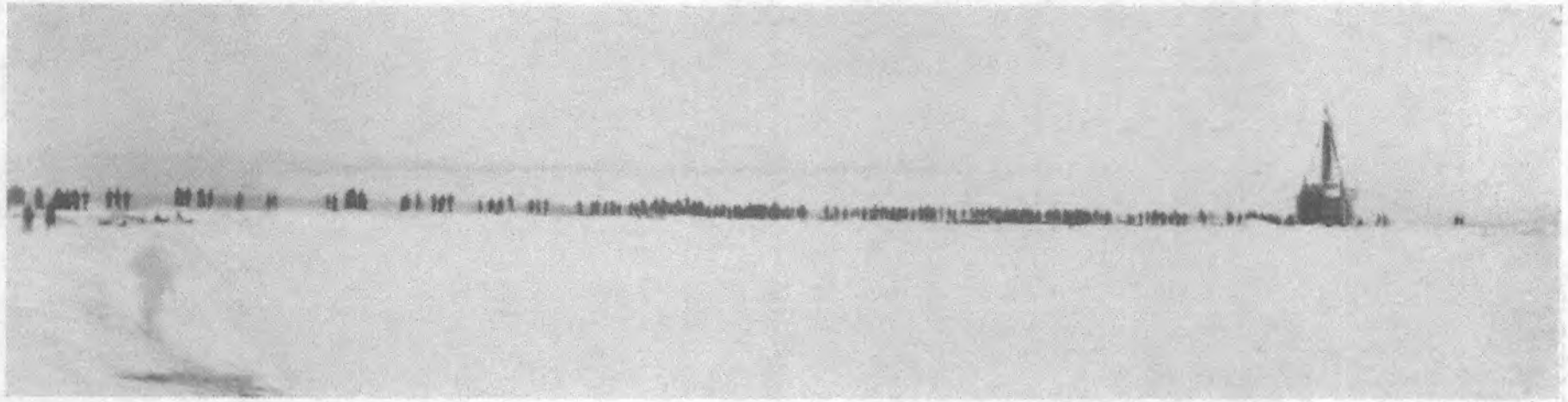
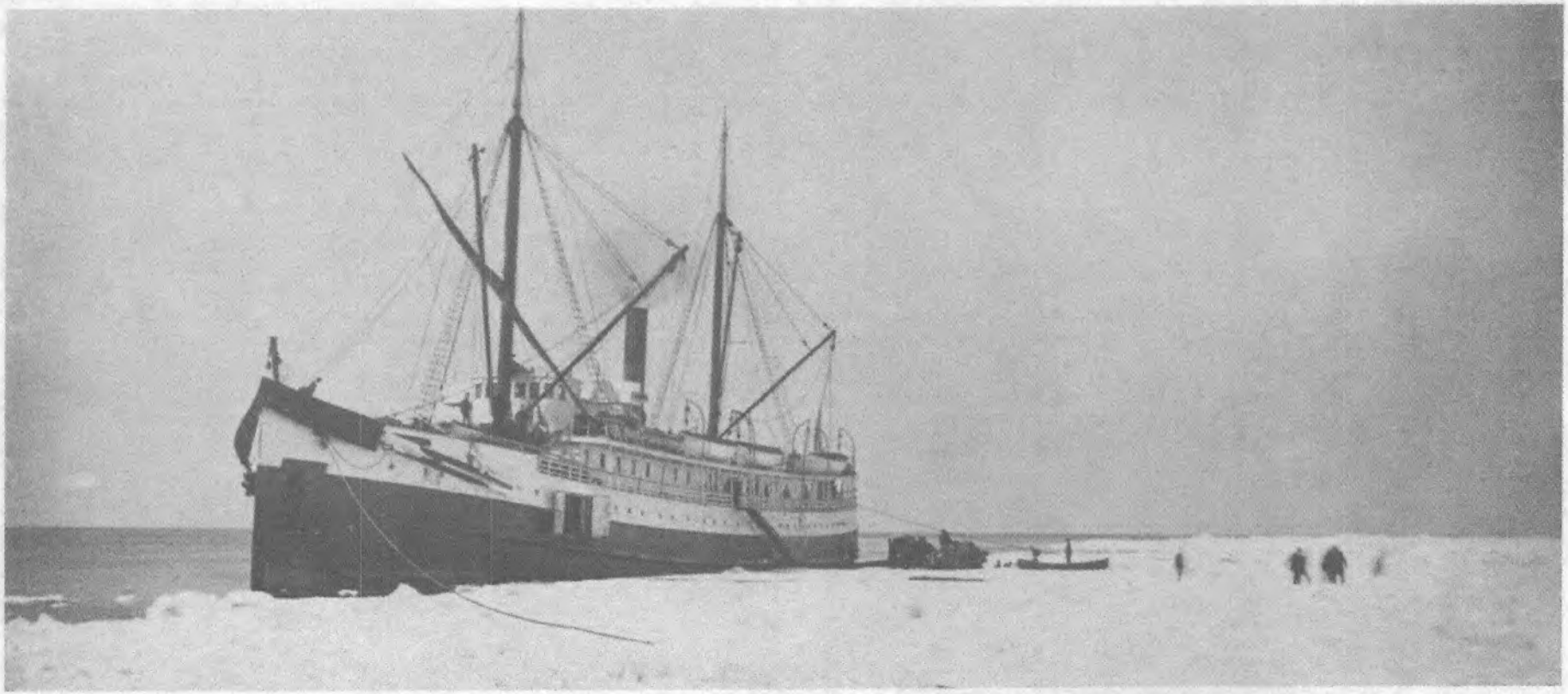
E. A. HEGG.



S. S. "JEANIE" LANDING PASSENGERS AND FREIGHT ON THE ICE TWO AND ONE-HALF MILES OUT FROM NOME, MAY 24, 1901.



S. S. "NOME CITY" LANDING PASSENGERS AND FREIGHT ON THE ICE TWO MILES OUT FROM NOME, MAY 31, 1901.

PASSENGERS ARRIVING AT NOME, JUNE, 1900.

BRIDGE OVER SNAKE RIVER, NOME.

THE FIRST PASSENGER TRAIN LEAVING ANVIL FOR NOME ON THE "WILD GOOSE R. R.," JULY 19, 1900.

KING'S ISLAND ESKIMOS AND OOMIAK AT SNAKE RIVER, NOME.

MOUTH OF SNAKE RIVER BEFORE THE STORM.

MOUTH OF SNAKE RIVER AFTER THE STORM, SEPTEMBER 10, 1900.

SOUVENIR EDITION

NOME AND SEWARD PENINSULA

HISTORY, DESCRIPTION, BIOGRAPHIES AND STORIES

BY

E. S. HARRISON

SEATTLE

Methods of Travel

THE two most important industrial features of Northwestern Alaska relate to water and transportation. Water is as essential to mining as it is to agriculture, and without proper transportation facilities a large area of this country never would be developed. When miners have to pay from $200 to $300 the ton for transporting their supplies from Nome to the mines which they desire to operate, it is apparent that these mines must contain extraordinary values in order to be profitably worked. The extensive mineral deposits which contain values designated as low grade will remain undeveloped until such time as railroads have provided a cheap method of transportation.

The necessity of railroads in this country is apparent to everyone familiar with the situation. The character of the surface of the earth, the swampy coastal plains or tundri, the hillsides covered with reindeer moss, growing in a comparatively dry crust of earth over a treacherous bog, and the miry spots to be found in the mountains as well as on the plains, are evidences of the difficulties to be encountered in constructing wagon roads. Freighting is done all over the peninsula by means of teams and wagons, but in all of Northwestern Alaska there is not a highway or anything that can be designated by the title of road. The nearest approach to a road is a river bed. When a teamster can follow the course of the stream, sometimes wading through deep fords, at other times jostling over big rough boulders, he is fortunate and happy. Where the trails cut across the hills there are frequent places where the horses flounder belly deep in muck and mire and the wagon wheels drop to the axle in the soft ground. No wonder that freighting is expensive. Horses as well as men must be adapted to this work. A nervous horse will quickly wear himself out, and a nervous man will quit the job.

But notwithstanding this physical condition, railroads are easily constructed. A narrow-guage line, where not much attention is paid to the road-bed, the object being simply to construct a road over which freight can be hauled, can be built at a cost of $5,000 the mile. For short hauls there is no question of the superiority of a narrow-gauge railroad over any other methods of transportation in this country. By ditching and draining the tundra and marshy ground of the upland, a firm and permanent road-bed for a railroad can be made. This fact has been demonstrated by the Council City and Solomon River Railroad Company, which is building a standard-gauge road from the mouth of Solomon River to Council City. Sixteen miles of this company's road which has been constructed and is in operation, is evidence of the assertion that a firm, permanent road-bed can be constructed without difficulty in this country.

The development of Seward Peninsula will necessitate the building of railroads from a seaboard terminal to every important mining camp. The men who are now building railroads in this part of Alaska are doing a great public service. They are assisting to develop the country. They are factors in the industrial work of this region second only

to the men who are digging ditches and providing the adequate water supply to wash the auriferous gravels.

Transportation in the winter time is not so serious a problem. After the snows have fallen and the trails have been broken, it is not a difficult matter to haul on sleds a load of five or six tons across the country with a team that could not haul more than a ton in the summer season. The only detriment to the work of freighting in the winter time is the cold weather and frequent blizzards. The snow storms obliterate trails and often necessitate a great deal of work to get them open for traffic. Blizzards are dangerous things to encounter. In the early days the mortality list resulting from blizzards was unnecessarily long. In later winters a better understanding of the blizzards' habits has made fewer casualties from freezing.

Stage lines run from Nome to important parts of the peninsula during the winter season. The stages are on runners and are covered completely with heavy canvas. A stove inside the vehicle has given the conveyance the name of hot-air stage. A stage line with vehicles of this description is in operation between Nome and Council City. It runs on schedule time except in few instances where severe storms interfere. There are convenient road-houses on the trails where the stage driver and his passengers may be housed when the short winter day is done.

A REINDEER IN HARNESS.

In the history of Alaska dogs are inseparably connected with the pioneers. Dog teams were the primitive method of transportation in the winter season, and they are used today where quick service is desired and light freight is to be transported. Dogs are used almost entirely for transporting the mails in Alaska. Every winter the mail to Nome is carried by relays of dog teams down the Yukon and across from Unalakleet to Nome; and from Nome it is sent to every postoffice in Northwestern Alaska by dog teams. The distance between Nome and Unalakleet is 240 miles, and it has been covered with a dog team, by mail carrier M. L. V. Smith, in sixty-nine hours total time. Mail Carrier Eli Smith has the distinction of having made the record trip with a dog team in this country. He brought the Kotzebue mail to Nome, a distance of 350 miles, in five days. If the mail service on the Yukon was as efficient as the service furnished by Calkins & Company on Seward Peninsula, the residents of Nome would get their mail in the winter time in forty days or forty-five days instead of waiting for two months or more for it.

The phase of the transportation question between Nome and the states is simply that of an ordinary ocean voyage until the steamer drops anchor in the roadstead at Nome.

It is a long voyage, the distance from Seattle to Nome being 2,350 miles. The vessels of the Nome fleet are from eight days to ten days making the trip. On this journey the passenger approaches very near to the line in the Pacific Ocean where in traveling westward, a day is gained; and where the eastbound traveler loses a day. In order to get to Nome the vessel must sail a long distance to the westward, and the traveler will cross a meridian that passes to the westward of the Sandwich Islands.

If the weather be favorable the trip will be delightful. When the vessel arrives at Nome the passenger will receive his first introduction to the difficulties of transportation in the Northland. Instead of the vessel tying up to a pier and permitting the passengers to walk ashore on a gang plank, the captain of the ship will anchor in the roadstead, two miles from shore. A little tug drawing a big black barge will steam from the shore out to the vessel. The passengers will be landed upon this barge, and the tug will haul them ashore. If the weather be favorable and the sea calm, the barge will be hauled in so that the passengers may land by a gang plank. But if the water be rough, as it frequently is, the new arrivals will be hoisted from the barge by means of a derrick and boom and slung through the air onto a wharf built at the water's edge.

Every pound of freight shipped to this camp must be lightered ashore from the vessel carrying it. In order to transact the business of discharging freight at Nome there are several lighterage companies and a small army of longshoremen. The cost of lighterage is about four dollars the ton, half as much as the cost of transporting freight from Seattle to the spot in the roadstead where the ship drops anchor.

The necessity of a pier or a dock at Nome is obvious. The question is, can one be constructed that will withstand the storms, and not be destroyed by the ice when it goes out.

I have neglected in this story, which is but a brief reference to some of the phases of transportation of the north country, to refer to the prospector with a pack on his back. In 1900 dozens might be met daily on every trial, each man with a pack on his back and a shovel on his shoulder. Carrying his pack across the swampy tundra, over the hills, through wet willow thickets, fording streams waist deep, sleeping at night in wet blankets and eating hastily prepared fare—pan-cakes, bacon and coffee,—is the experience of nearly every pioneer of this country.

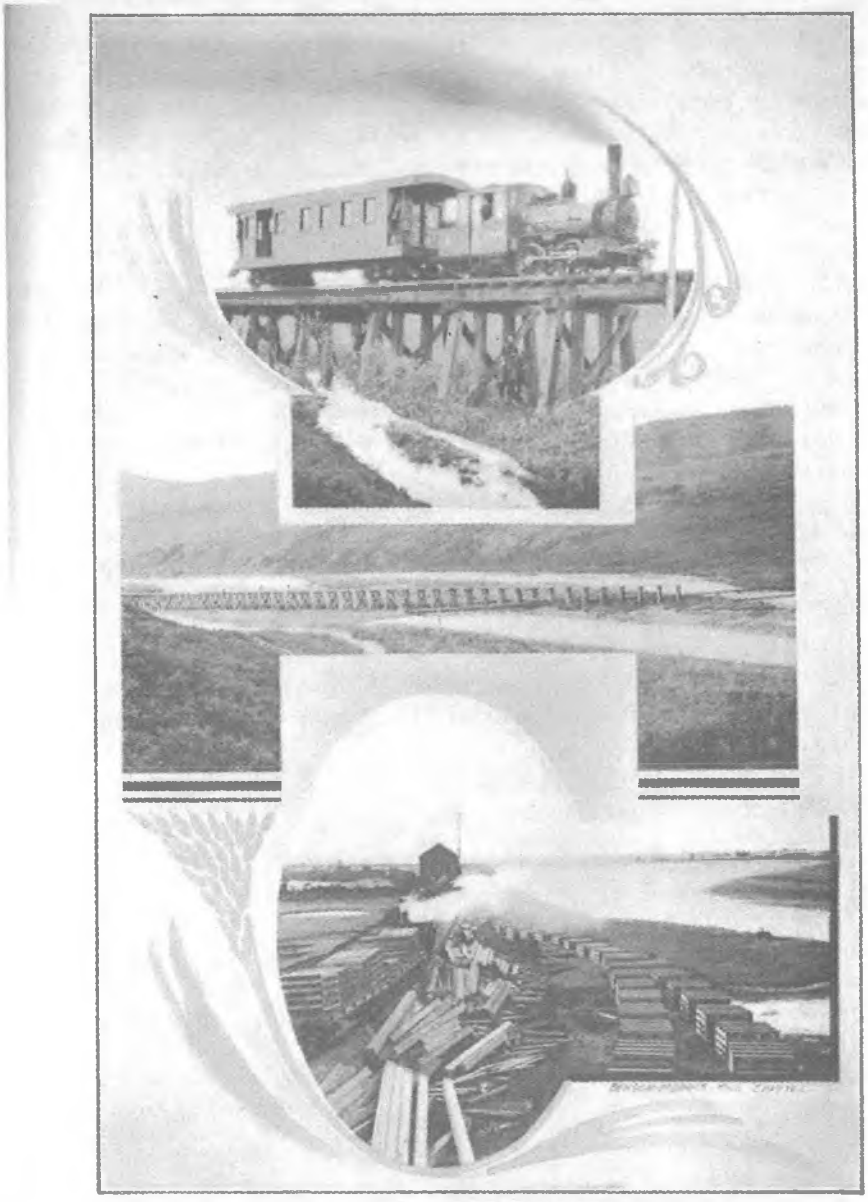
Wherever practical or possible, the rivers of Seward Peninsula have been used for transportation purposes. But none of the streams are navigable except for small, light draft vessels, and wherever a miner could reach his destination by following a water course, a means of transportation was open to him. A small boat could be poled up the river or towed up stream, men and dogs, sometimes horses being utilized at the end of the tow line. The work of poling and towing a boat up most of the streams of Seward Peninsula, is an exceedingly laborious task, but it has been the only method by which prospectors in the early days were enabled to get supplies any great distance into the interior.

Seward Peninsula Railroads

Seward Peninsula has thirty-five miles of railroads in operation. The Nome-Arctic Railroad Company has a narrow-guage line between Nome and Anvil and Dexter Creeks. This line was constructed by the Wild Goose Mining and Trading Company from Nome to Anvil Creek in 1900. It has since been extended up the left limit of Anvil Creek across the divide between Anvil and Dexter Creeks to the southeastern base of King Mountain overlooking Nome River. The terminal is ten miles from Nome. This road is pointing toward Kougarok District and may be extended to this part of the interior of Seward Peninsula as soon as the traffic justifies the construction of the road-bed.

The Council City and Solomon River Railroad is a standard-guage line planned to connect Solomon with Council City. The line has been constructed and equipped to East Fork, sixteen miles from Solomon. This road has its shops and offices, which are of a subtantial character, at Dickson, the seaboard terminal of the road just across the river from Solomon. This railroad has been constructed in a substantial manner with a view to permanency and future operations. The road-bed is level and ballasted, and all the work both in construction of the road and in the construction of the company's buildings shows painstaking care and the intention to secure lasting results. There is material on the ground to complete the road from its present terminal to Council City.

The Wild Goose Mining and Trading Company has a railroad in operation between Council City and No. 15 Ophir Creek. This road was constructed to accommodate the traffic of the company, but it has proved to be a great convenience to other operators on Ophir Creek. The line is seven miles long. It is a narrow-gauge road, the kind best adapted for short hauls in Alaska.



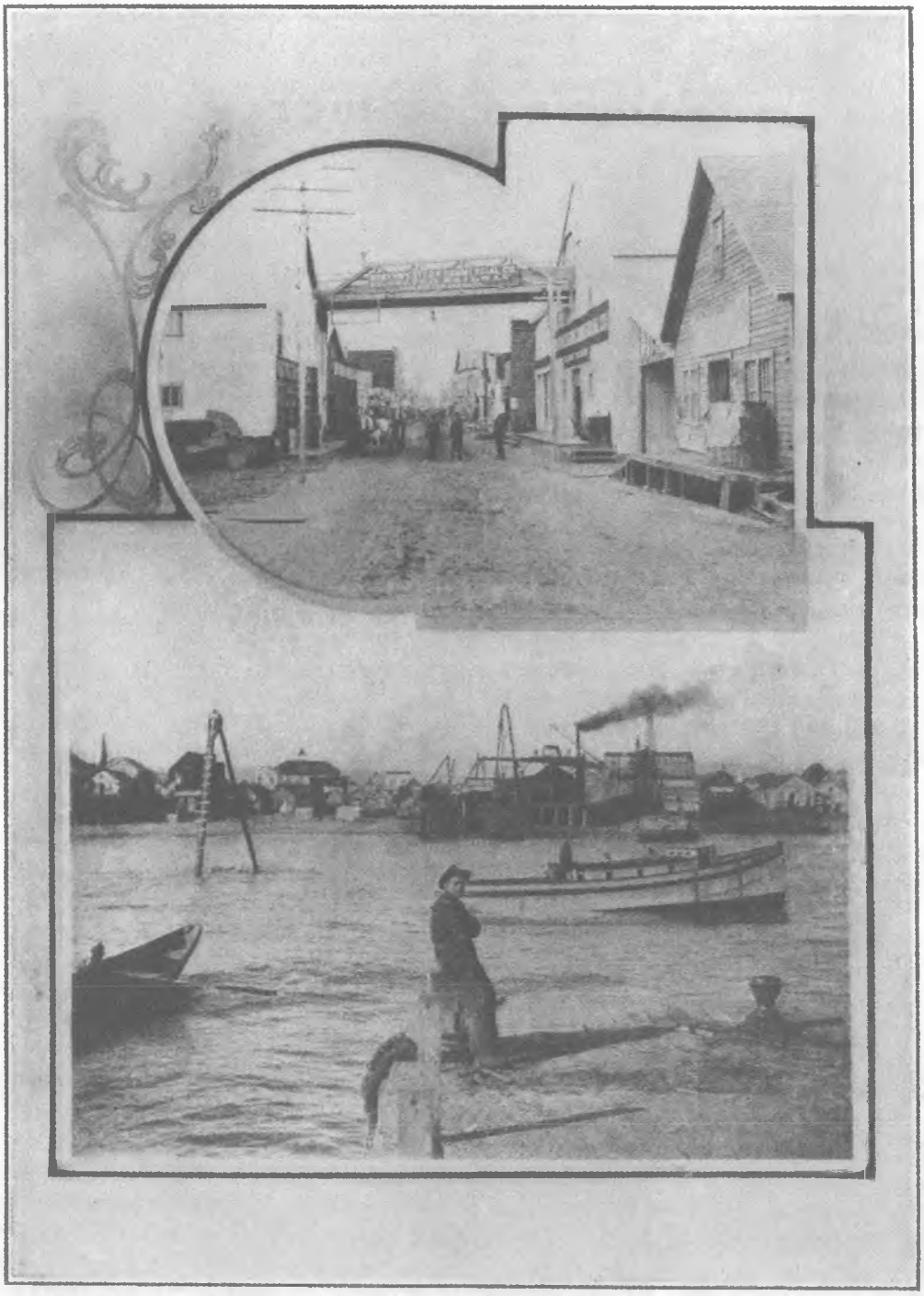
VIEWS OF THE COUNCIL CITY AND SOLOMON RIVER RAILROAD.
First Standard-gauge Passenger Car Constructed in Alaska; built in shops of C. C. & S. R. Railroad at Dickson.
A 200-foot Trestle Across Solomon River.
General View of the Terminal Grounds at Dickson.

Nome's Commerce

SIX years ago the only vessels that touched at points of Seward Peninsula were whalers and an occasional schooner engaged in trade with the natives. This year the commerce of Nome requires fourteen steamers having an aggregate tonnage of 25,000 tons and several schooners that are capable of carrying 5,000 tons every trip. Most of the steamers make from four trips to six trips in a season. In 1901 more than 150,000 tons of freight were landed on the beach at Nome, and 15,000 people accompanied these miscellaneous and heterogeneous cargoes. No such a volume of freight nor such a number of people has been transported in any of the succeeding seasons. In 1902 the cargoes landed at Nome and Solomon aggregated near 70,000 tons; but this included material for the Council City and Solomon River Railroad, which was near 20,000 tons. In 1904 the shipments to the Nome country were more than 80,000 tons. In all probability the shipments for the season of 1905 will exceed this quantity, as a great deal of mining machinery is going into the country.

Seattle, San Francisco and Portland are the principal supply stations of the Nome country. A part of the mining machinery and the material for the construction and equipment of the railroads is purchased in the East, but, with a few exceptions, the food, clothing and fuel for Northwestern Alaska is bought on the Pacific Coast. The foregoing facts furnish the basis for an estimate of the present value of Seward Peninsula to the cities where the larger amount of supplies are purchased. This value will steadily increase with the development of the country. The industries of Northwestern Alaska are in their infancy. There is every indication that there will be an annual increase of the mineral product of this country for many years. Much of the work which has been done during the past two years and much that will be done for the next three or four years is of a preliminary character. The railroads that are building and the ditches that are being constructed are preparations for more extensive mining. The mining of the future, provided with adequate facilities, will be conducted more profitably than it has been in the past. The exploitation of the tin region will add to the mineral wealth and product of this country. With an increase of the mineral product there will be a commensurate increase of commerce.

Seattle being the nearest shipping point in the United States should naturally command the largest part of trade with Nome. The distance from Seattle to Nome is 2,350 miles. The fastest steamers of the Nome fleet make the trip in eight days. Most of the commerce of Nome from the eastern states passes through Seattle. The development of this northern empire of stupendous mineral resources will be a conspicuous factor in the growth and prosperity of Seattle. The far-seeing business men of Seattle recognize this fact have organized a club composed of 700 representative citizens, and having for its object the promotion and encouragement of all legitimate enterprises for the development of Alaska. The Alaska Building, recently constructed in Seattle, is the finest struc-



Photograph by F. H. Nowell.

NORTHWESTERN COMMERCIAL COMPANY.

Store and Warehouse in Nome and a View from the Sea of the North Coast Lighterage Plant.

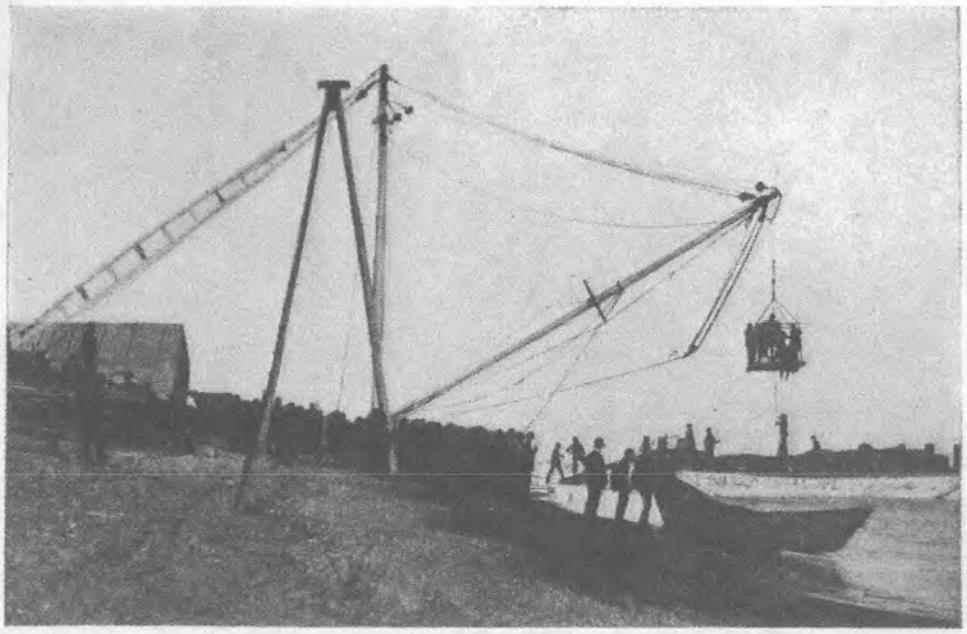
Alaska Building, Seattle.

ture in the city, and it is a prophesy of what the development of Alaska will be to the Queen City of Puget Sound.

The Alaska Club is doing a splendid work for Alaska. It is a representative body to voice Alaska's needs in Washington and it is doing commendable work to give publicity to Alaska's resources, and the great commercial possibilities of this new country which are now lying fallow.

HARBOR FOR NOME.

Better facilities for landing and loading freight at Nome will be of material benefit to the commerce of this country. Captain E. W. Johnston, who has been prominently identified with the lighterage business of Nome since 1900, has consummated plans to provide these facilities. Last winter a charter was secured from Congress to permit, under the supervision of the war department, the building of a pier at the mouth of Snake River. The Nome Improvement Company was organized in Oldtown, Me., and $300,000 was subscribed to make a harbor at Nome. The contract for constructing this harbor has been given to Captain Johnston.



Photograph by B. B. Dobbs.

THE JOHNSTON LIGHTERAGE PLANT AT NOME.

The New Harbor Will Change This Method of Landing Freight and Passengers.

The pier will consist of cribs thirty by fourteen feet tapering to twelve feet wide on top. These cribs will be filled with rock from Sledge Island and Cape Prince of Wales. They will be covered two feet above water with edge-bolted timbers, and will extend into the sea a distance of 750 feet from the mouth of Snake River. There will be two parallel lines of these cribs. The distance between them at the mouth of Snake River will be 110 feet. This width converges to eighty feet at the end of the pier, where there will be fourteen feet of water. A breakwater 400 feet long will be built in the sea beyond the pier. Piles will be driven along the easterly side of Snake River, and all the sheds and warehouses necessary for the shipping business of Nome will be constructed on this side of the river.

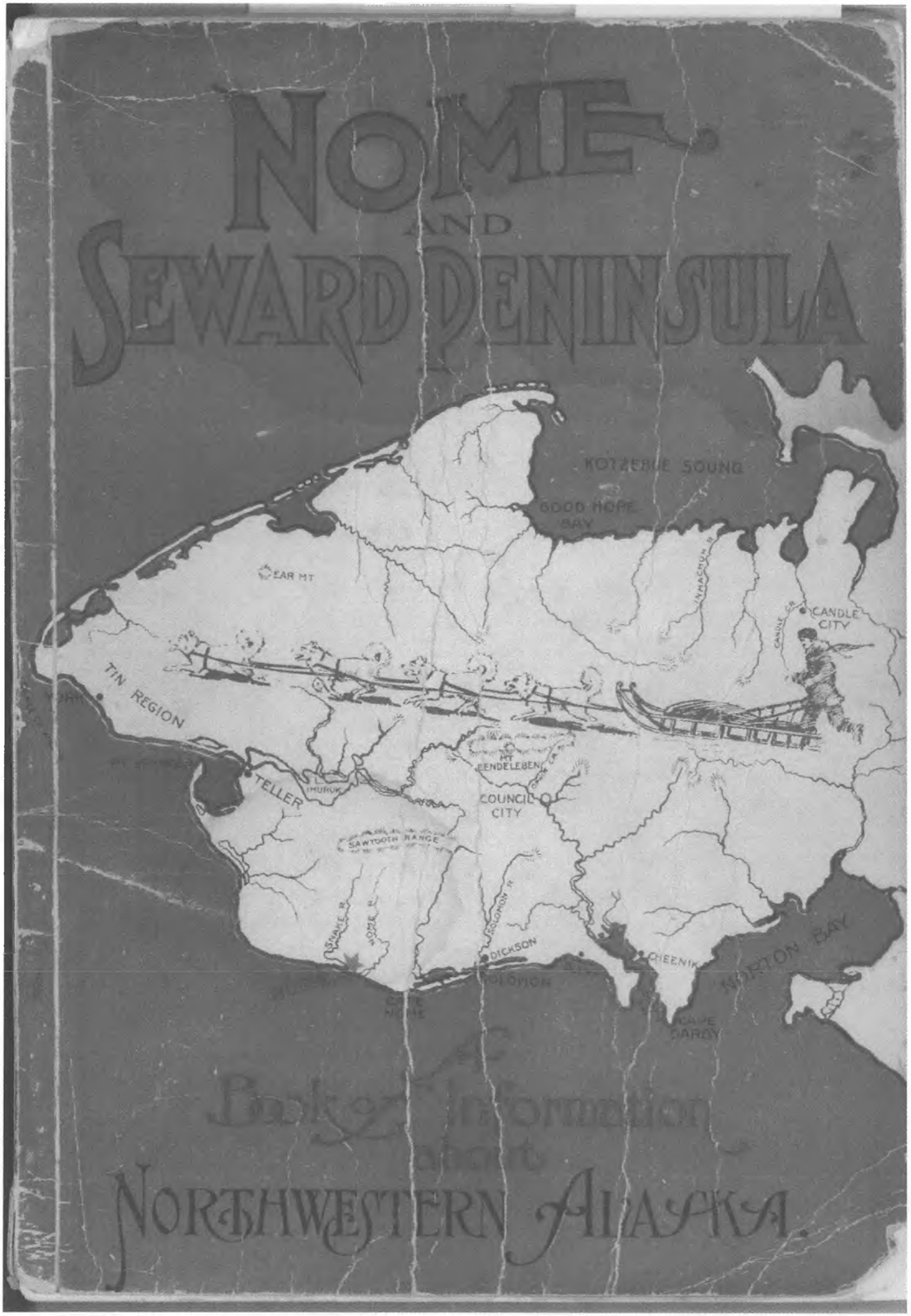
It is proposed by this enterprise to furnish a safe harbor for all the small vessels at Nome, and a means of reaching the larger steamers during the stress of the worst weather. The cost of lighterage will be reduced, and the danger to life and property on this storm-beaten shore will be lessened.

The Nome Improvement Company is a strong organization, with money subscribed to complete the work undertaken, and ample funds at command to consummate any business plans essential for the success of the enterprise that has been inaugurated. The following gentlemen are the trustees of the company: Herbert Gray, of Oldtown, Me., president and treasurer; C. P. Dam, of Nome, secretary; Mark Reed, of Seattle; George Van Dyke, of Boston; J. G. Gould, of Oldtown.

Photograph by B. B. Dobbs.

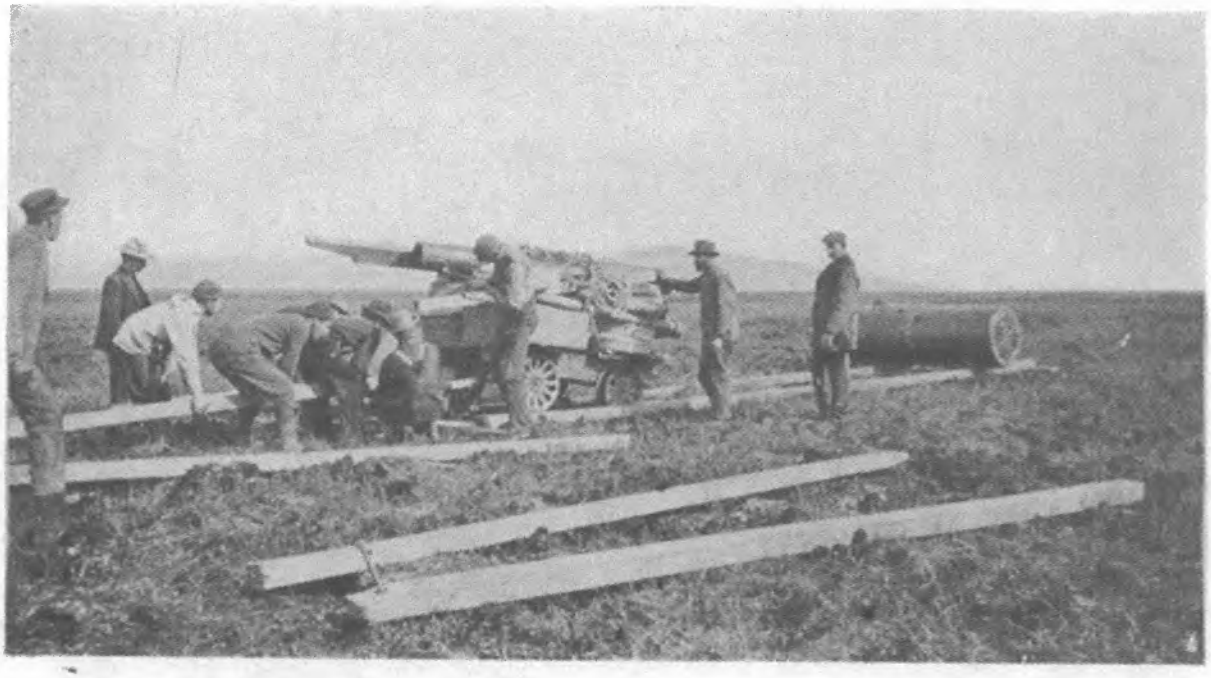
OOMIAK, ESKIMO BOAT MADE OF WALRUS SKINS.

NOME AND SEWARD PENINSULA



Booklet of information about

NORTHWESTERN ALASKA



GETTING A SMALL PUMPING PLANT OVER THE TUNDRA TO A FRESH WATER LAKE.

RAILROAD EXTENSION AND NEW LINE PROJECTED BY MAJOR L. H. FRENCH.

There is a conspicuous need of transportation facilities in Northwestern Alaska. In 1900 was the beginning of railroad construction and operation, and since then several railroad enterprises have been undertaken and consummated or partially consummated. This kind of work is proceeding as rapidly as the means and opportunities of those engaged in it will permit. All kinds of development and progress in this country are slow, but there is no question that the development of the country would be accelerated if better transportation facilities were provided. There is no question, on the other hand, of the requirements of miners, who are beginning to develop the interior country, accelerating the building of railroads.

The United States Government has a fund from the license money for the building of wagon roads, and this will add very much to the transportation facilities of the Northern country. But time is required, and the wheels of progress in this frozen land move very slowly. In the years to come, when we will ride in cars from Nome to Candle Creek,

and probably to the region of the Kobuk River, possibly to the Colville River, and from Nome to the well-known mining centers of Seward Peninsula, and see the traffic that these trains will carry, we will wonder why men familiar with the transportation business were so long in understanding and realizing the great wealth of this country, and wonder why they did not construct these railroads at an earlier date.

But substantial progress was made during the past season in the way of extending lines. The Nome-Arctic Railroad extended its line several miles up Nome River beyond the terminal of last year, and has planned to enter the Kougarok next season. The Council City and Solomon River Railroad added five miles to its line last season, making its present terminal twenty-one miles from Solomon, and within three miles of the divide between the Solomon River region and the Council City country. It is probable that this line will be completed to Council City next season. The operations of the past summer have been the most successful in the history of the road. This line has been under the management this year of Mr. Hugh F. Magee. He says that by August 15, 1906, the road will be ready to deiver freight on the Casadepoga River.

J. Warren Dickson, the promoter of the Council City and Solomon River railroad, has organized another company, and by letter and wire has informed the Chamber of Commerce of Nome that he will be in the country next season prepared to build a line from Nome to Kougarok.

One of the most important railroad enterprises of Seward Peninsula is a line to be built from the north side of Port Clarence Bay to the Kougarok region, touching the tin mines. Surveys and maps have been made of this road and the work will be undertaken next season. Charles D. Lane is the president of this company and Major L. H. French, the president and general manager of the Cedric Ditch Company, is the manager of the enterprise. During the past summer Major French has been the leader in industrial enterprises of Northwestern Alaska, and this railroad is among the most important of all the great work that he has undertaken to do. He has acquired large holdings of mining ground on the Kougarok River. These holdings comprise fifteen consecutive miles of the stream, and he has planned large dredging operations in this region. The economical consummation of these plans requires the construction of a railroad from the most available seaboard terminal to his base of operations. Primarily, it may be said that the railroad is only a factor in the extensive work he has mapped out in this part of the peninsula. But aside from its value to him and his associates in the work they are going to do, the road will be of great benefit to the country, and will assist the development of a practically undeveloped region. Eliminating, however, all of these features, there is every reason to believe that the road will be a profitable commercial venture. The prospects of the tin mines and the back haul of tin ore and concentrates from these mines, the freight to be transported to the Kougarok and intermediate points, which must now be hauled in over the snow or taken in small craft up the river, will provide a revenue that will pay interest on the investment from the beginning of operations.

The development of this vast interior region has been retarded by lack of transportation facilities. A country must be immensely rich if it can be developed when freight charges from the nearest base of supplies are $300 the ton. But the Kougarok region has been slowly and steadily advancing and growing in importance and value, notwithstanding this serious handicap. A railroad from tidewater will hasten this development, and if a road can see enough business in sight now to pay an interest on the

investment, it will be a splendid dividend property when it has opened up and made accessible the country it crosses.

The Kougarok Mining and Transportation Company is the name of the corporation that will accomplish the work just mentioned. The company will build a town on Port Clarence Bay, which is the best harbor on Seward Peninsula. Ultimately the road will be extended to Candle Creek and Inmachuck River.

WHEN THE ICE BREAKS IN SNAKE RIVER.

Photograph by B. B. Dobbs.

THE ROADSTEAD AT NOME.
Photograph Taken at Midnight in June.

SEWARD'S
LAND OF GOLD

L. H. FRENCH

BEACH AT NOME AFTER A STORM.

NOME DAILY NUGGET

MINING EDITION

NOME, ALASKA, 1908.

ERNST, ENG.

WILD GOOSE MINING & TRADING COMPANY

In considering the history of the Nome Mining District, and, in fact, that of the whole of Seward Peninsula, no single factor has been of greater importance in the development of its natural resources than the Wild Goose Mining & Trading Co.

This company was organized by that energetic and intrepid old veteran Chas. D. Lane and financed by some of the wealthiest men in California, Washington and the eastern states, and was the first organization having large capital at its command to get a foothold in Seward Peninsula.

The vast treasures of gold that lay hidden in the gravels of Anvil and Dexter and Glacier creeks were early appreciated by the experienced eye of Mr. Lane, and he rapidly acquired large interests for his company. Instituting a policy of vigorous development of the company's holdings, he soon realized the necessity of cheaper and quicker transportation of supplies from the seaboard to the diggings across the rough and boggy tundra, and in the winter of '99 he laid before the directors of his company a proposition to build a railroad from Nome to Anvil creek and backed his proposition with such substantial arguments as to its feasibility and financial success that the necessary capital was provided, and in the early spring of 1900 the rails, ties, rolling stock and other equipment was landed upon the beach at Nome, and by mid-summer the Wild Goose Railroad was in full operation.

This road has the distinction of being the first railroad built in Alaska, and has the further distinction of being the only railroad ever built which paid for itself the first year of its operation. It also has the distinction of having reduced the cost of transportation of freight from twenty cents per pound, or $400 per ton, to $40 per ton, over a given distance immediately upon its completion, and was thus the means of materially aiding every claim owner in its vicinity in the development of his property.

Mr. Lane also foresaw the necessity of obtaining a larger and more constant water supply for washing the rich gold-bearing gravels of Anvil and Dexter, and believing at that time that ditches would not be a success over the glaciated surfaces of the hillsides, he again drew upon the exchequer of the company for the necessary capital to build one of the largest and best equipped pumping plants ever built in any mining community. This plant is said to have cost over a half million dollars and is capable of pumping 3,000 gallons of water per minute through five miles of pipe line to an elevation of 750 feet.

The Wild Goose railroad was later merged into the Nome-Arctic railroad and then into the Seward Peninsula railroad, the Wild Goose company

T. M. GIBSON.

parting with all its holdings, but the great pumping plant, the twin conception of the railroad, still stands upon the bank of Snake river at the edge of town and is still the property of the Wild Goose company. Since the time that this was built it has been demonstrated not only that ditches along the hillsides are possible, but that the cost of their construction and maintenance is such as to make the water delivered by them more economical than that delivered by the pumping plant, so that the plant is now only used for delivering water to mines at low elevations on the tundra.

The Wild Goose company also secured through Mr. Lane extensive and very valuable holdings on Ophir creek in the Council district. In fact, the company owns practically all of Ophir creek from Discovery to the mouth of Crooked creek, a distance of nine miles. This valuable property is under a splendid system of ditches aggregating some fifty miles in extent and taking water from upper Ophir creek and the Pargon river. These ditches deliver 5,000 miners' inches of water, which is used under high pressure in hydraulic elevators and giants, and vast quantities of the rich auriferous gravels of Ophir creek are annually washed and their treasures of gold turned into the coffers of the Wild Goose Company.

This vast Ophir creek enterprise is probably the most valuable holding of the Wild Goose company in Alaska, and will require many years of constant effort to exhaust the stores of wealth.

Here, too, Mr. Lane showed his ability to grasp big things and comprehend their possibilities. Here, also, is another Wild Goose railroad, which takes supplies from Council to Ophir creek, and also steam boats, barges and other river equipment on the Fish and Niukluk rivers, which transport supplies from Golovin Bay to Council.

The Wild Goose company has expended a vast amount of money in exploiting this district, and is sure to reap a rich reward for its expenditure. Mr. Lane, owing to ill health and the infirmity of declining years, severed his connection with the company in the spring of 1906, and was succeeded in the management by Mr. Frank Shaw, who had been an able lieutenant under Mr. Lane in the Ophir creek district.

Mr. Shaw, however, seeing the great possibilities for individual effort in the Nome district, in the spring of 1907 gave up the management of the company to operate on his own account, and was succeeded by Mr. T. M. Gibson, whose management of the company during the past year has been eminently successful.

Mr. Gibson has acquired many additional valuable holdings for the company since he became its manager and the cleanups this spring from the winter work are the largest in the history of the company. The company owns or controls nearly a mile of the rich third beach pay streak, and besides having several very large and rich dumps from the winter's work, is daily hoisting pay gravel from several different shafts, and will undoubtedly make 1908 a banner year for the company.

The work in which the company is at present engaged and has been carrying on the past winter along the third beach line is such as only large capital can handle, as the ground is wet and requires an immense initial outlay to carry it on. Large and ex-

pensive pumps must be installed and kept steadily running to keep the mines unwatered, and a forest of timber is used in supporting the tunnels and stopes.

It is said over one million feet of lumber will be required for this summer's work of the Wild Goose Co.

Manager Gibson, with his usual foresight in handling the company's business took advantage of the good sleigh roads just before the breakup and delivered to the various mines the necessary amount of lumber to carry them through the summer season, thus saving the heavy cost of summer freighting over the tundra. He has also distributed a large amount of fuel oil to the mines which is stored in tanks set upon the hillsides above the workings and distributed by gravity to the various boiler houses through a system of pipes which not only facilitates the work, but greatly reduces the cost of handling the fuel.

In the winter season the pay gravel is mined and hoisted to the surface and placed in dumps, from which it is shoveled into sluice boxes as soon as water is available for sluicing in the spring. In the spring and summer it is hoisted and dumped into large gravel bins and drawn through chutes directly into sluice lines, and the gold is cleaned up daily.

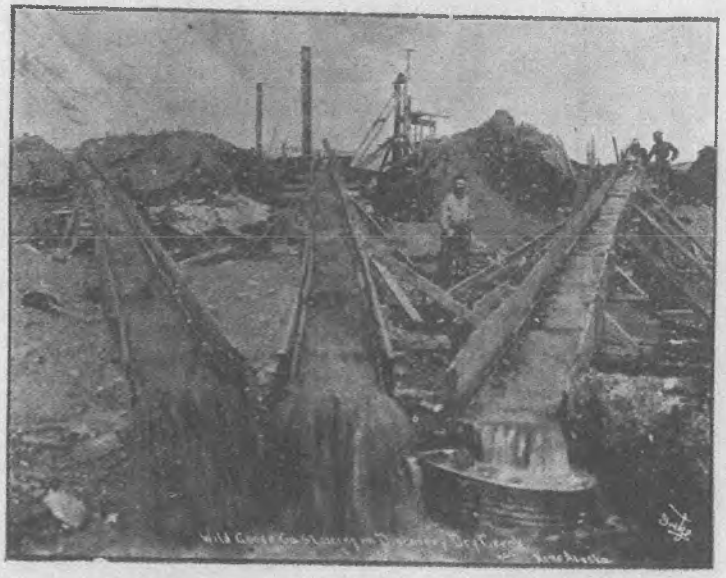
This system of handling the pay gravel is made possible by the large ditches which tap the headwaters of the rivers and bring down to the diggings a plentiful and constant supply of water for sluicing purposes.

The Wild Goose company, although at first somewhat backward about engaging in ditch building enterprises, subsequently became heavily interested in this class of investments, and is now the owner of the fine system of ditches known as the Seward Ditch, which takes three thousand miners' inches of water from Nome river near the mouth of Dorothy creek and delivers it through thirty odd miles of ditches, flumes and pipe lines to the various creeks, benches and bench lines along the front of Anvil mountain and adjacent hills. This ditch system has made it possible to work large areas of gold bearing gravel lying in the creeks and on the slopes under it, which would otherwise have lain idle, and has very materially increased, and will continue to increase, the gold output of this district.

Another enterprise which the Wild Goose company is putting through is known as the Grand Central High Pipe Line, which, when completed, will deliver 4,000 miners' inches of water under high pressure on the top of the highest divides separating the well-known gold-bearing creeks in the vicinity of Anvil mountain. This pipe line takes the waters of the Grand Central river, in the heart of the Sawtooth range, and diverts them through a wood stave pipe 52 inches in diameter at the intake and 42 inches in diameter on the grade line, and built upon a carefully prepared grade having a fall of fifteen feet per mile. Several miles of this line have already been completed at its upper end, and the work is to go steadily forward until it is finished. The entire line will be over fifty miles long, and it is estimated that it will cost one and one-half million dollars. It is the most gigantic water enterprise so far undertaken on Seward Peninsula and will have far-reaching effects and give tremendous impetus to mining on the high benches, where at present no water is available for sluicing. The well-known ability of the Wild Goose company to finance such an undertaking and the certainty of its being a paying proposition when completed are a sufficient guarantee of the early completion of the work. These water enterprises, together with the ditches of Ophir creek and the Pargon river, make the Wild Goose company by far the largest ditch owners in Alaska.

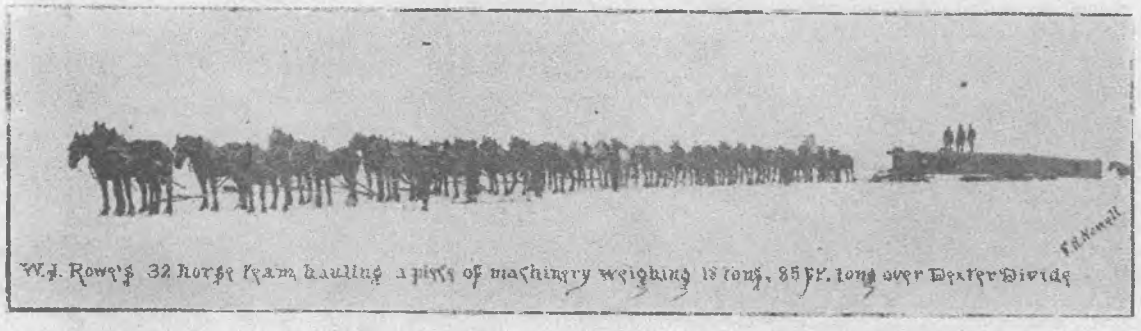
Another new and to a large extent untried field of endeavor in this part of Alaska is now being exploited by Manager Gibson on behalf of the company, and if successful will have far-reaching effects upon the mining industry in Seward Peninsula. This new venture is the development of what promises to be an extensive coal field in the vicinity of Norton Bay. Considerable work has been done during the past winter and is still being carried forward upon the Dusty Diamond coal mines at the head of Norton Bay, about one hundred and fifty miles east of Nome, and the results are sufficiently encouraging to justify the prediction that before the close of navigation this year the Wild Goose company will be shipping coal to this port for general consumption, and it is firmly believed that the local coal will largely supplant the outside coal for household and mining purposes. The coal has been tried in stoves and boilers and found to burn freely and give satisfactory results. It is believed it can be handled here and sold in the market for about half the price of outside coal used at present for the same purposes.

This is a matter of the utmost importance to the miners of this district, as the fuel consumed in thawing the frozen ground and pumping water from the thawed areas forms a very heavy item of the expense of mining, and cheap fuel will make possible the working of large areas of low grade gravel which cannot be worked under the conditions that have heretofore prevailed.



WILD GOOSE CO. SLUICING ON DISCOVERY, DRY.

W. J. ROWE



W. J. Rowe's 32 horse team hauling 2 pkgs of machinery weighing 18 tons, 85 ft. long over Dexter Divide

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The Seward Peninsula Railway

It is safe to say that the most important factor in the development of Seward Peninsula at the present time is and in the future will be the Seward Peninsula Railroad. It has opened to the prospector districts which were formerly practically terrae incognitae and it has enabled owners of properties on the beach lines to operate with much less expense.

The road has a mileage of 100. In its equipment are included 109 freight cars, 16 passenger cars, 5 locomotives aided considerably in the development and 1 motor car.

In the year 1907 it expended for improvements and construction the sum of $100,000 and the warehouse they constructed at Lane's Landing have

TRESTLE AT LANE'S LANDING.

of the Kougarok.

The company intends to extend the line toward the Kougarok for a distance of 25 miles from the present terminal. It is also the intention to install two passenger motor cars, each able to accommodate 20 to 30 passengers, which will be able to make the round trip each day between Nome and Lane's Landing.

At Nome will be established first class machine shops and as the country grows the road will advance apace. On its line today are quartz ledges for which transportation facilities are required, and the effect of the construction of the railroad on them is already becoming apparent. For the placer miners of the Kougarok and sections less remote the road has performed Trojan service, and its period of usefulness has only begun.

Mrs Elizabeth D Adams

Vol. IV No. IV

OCTOBER

MINING AND DREDGING EDITION

THE NOME DAILY NUGGET

1913

NOME, ALASKA

Nome as Base For Arctic Exploration Supplies

THAT Nome is destined to be a most important base of supply for Arctic exploration is a fact which may be deduced from the circumstances relating to the expedition of Steffansson and other expeditions which outfitted here this summer. George Phillips, the fiscal agent of the Canadian government, who accompanied the expedition as far as this city, and Mr. V. Stefansson himself have declared that in no other city on earth could they have secured the supplies which they obtained here and their words are borne out by the fact that supplies to the value of $30,000 or $40,000 were purchased here by that one party alone. The Lane expedition which had scientists and hunters aboard also outfitted in Nome for a winter in the Arctic and various smaller fishing, hunting and scientific expeditions recognized the advantage of purchasing here the supplies which Nome's merchants alone kept in stock.

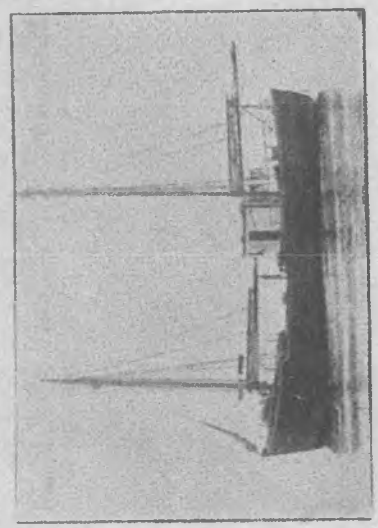
The Stefansson expedition left here this summer for the Arctic in three vessels which are the Karluk, the Alaska and the Mary Sachs. It is the intention to spend at least three years in Arctic waters during which time Mr. Stefansson will make a closer study of the people who have come to be known as the Blonde Eskimos whom he is accredited with discovering during the former trip which made him famous. With the expedition were several scientists, geologists and others who hoped to secure some valuable information along various lines and who during their three years in the Arctic will probably add considerably to the world's knowledge of that strange and practically unexplored region. The Karluk is commanded by Captain Bartlett who commanded the ship of Peary when he reached the North pole.

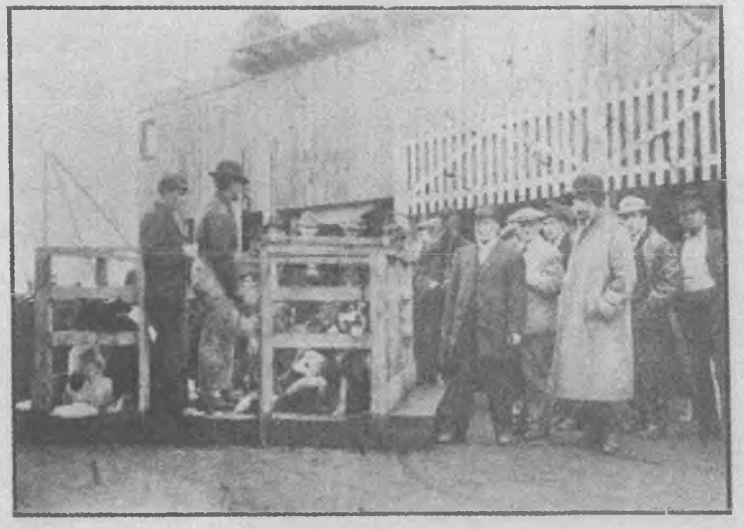
During their stay in Nome while they were outfitting the members of the expedition were guests at several functions and at various times they asserted that their decision to outfit here was one of the wisest.

After his historic voyage through the Northwest passage Amundsen, later the discoverer of the South pole, landed at Nome and it was here that he first saw real civilization since he departed on his famous journey and it was here that he enjoyed his first taste of the pleasures of the world he had left.

Nome is only a little more than 100 miles from Bering straits, the entrance to the Arctic ocean, and the supplies kept in stock here contain all the articles necessary for Arctic travel because the travelers on the trails on Seward peninsula in the coldest part of the winter wear and eat what Arctic travelers wear and eat. Amundsen is now about to secure here the dogs to be used in his search for the North pole to which he intends to drift with the ice and from Nome he will set sail into the Arctic desolation.

Nome is really the gateway to the boundless seas and lands beyond the Arctic circle. It is the last port of call and the natural base of supply.





Steffanson Party and the Alaska, one of Three Boats which were Outfitted in Nome.

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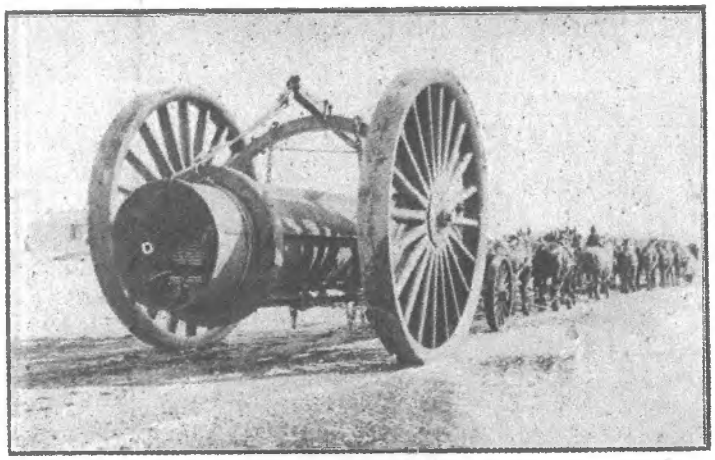
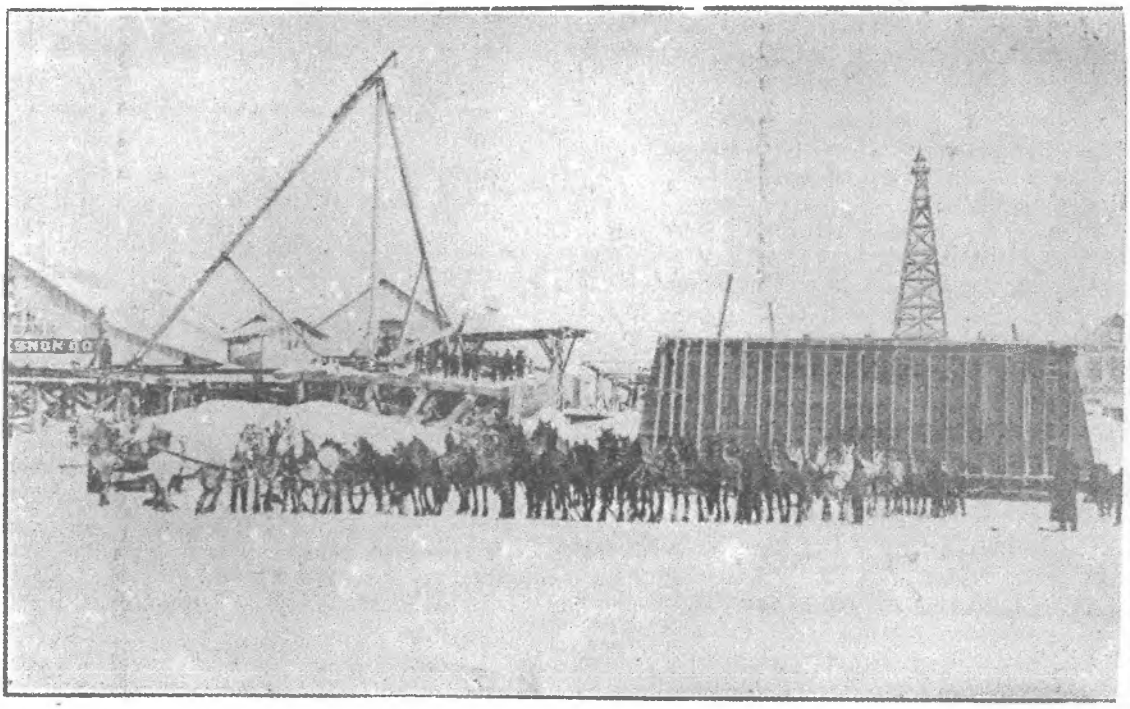


Top—Wheels 12 ft. in height are used during the summer Season to transport heavy loads over soft tundras where there are no roads.

wer—In the Winter Season, Round heavy skids are used to transport heavy weight over the country.



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NOME, : : : : ALASKA.

ROADS AND TRAILS

In Northwestern Alaska

THE MATERIAL development of all sections of the world depends no less upon the richness and extent of their resources than upon transportation facilities. The first systematic work done in road construction in the Seward Peninsula was in 1900 by private interests and public subscription. In June, 1900, work was begun by the Wild Goose Mining, Trading, and Transportation Company to build its railway from the western end of Nome where the company supplies were stored, to the scene of its main operations near the upper end of Anvil Creek, a distance of approximately three and one-half miles.

Simultaneously with the Wild Goose railroad construction, a party of mine operators, assisted by public subscription, began to build a road from Nome to upper Dry Creek and to Dexter Creek, a distance of seven miles. The work was difficult and expensive because of the soft ground to be traversed. This road today constitutes the main arterial from which branch roads lead to the Osborn Creek region, the Anvil Creek region, Glacier Creek, and the upper Snake River basin. The next road to be constructed was from Nome to Fort Davis. It was built by public subscription and by the local military authorities.

In 1905, the Federal Board of Road Commissioners began to function. It cooperated with the various mine owners and was assisted by public subscription. New roads were constructed and the older roads were extended, to many mining localities, as the limited means at the disposal of the Board would possibly permit. This agency had exclusive charge of our roads and trails until 1915, when the Alaska Legislature created the Territorial Board of Road Commissioners. By this act four road boards were established, one for each of the Judicial Divisions into which the Territory of Alaska is divided. The Road Board for the Second Division had its headquarters at Nome, where the Federal Road Board was also maintaining its offices. These two road boards functioned independently, the one procuring its funds from the Federal Government, and the other from the Territory. In 1919, however, the Legislature enacted a law whereby the Territorial Road Board was to form a working agreement with the Federal Road and was to be under the supervision and direction of the latter Board. This was to secure cooperation and efficiency at less cost.

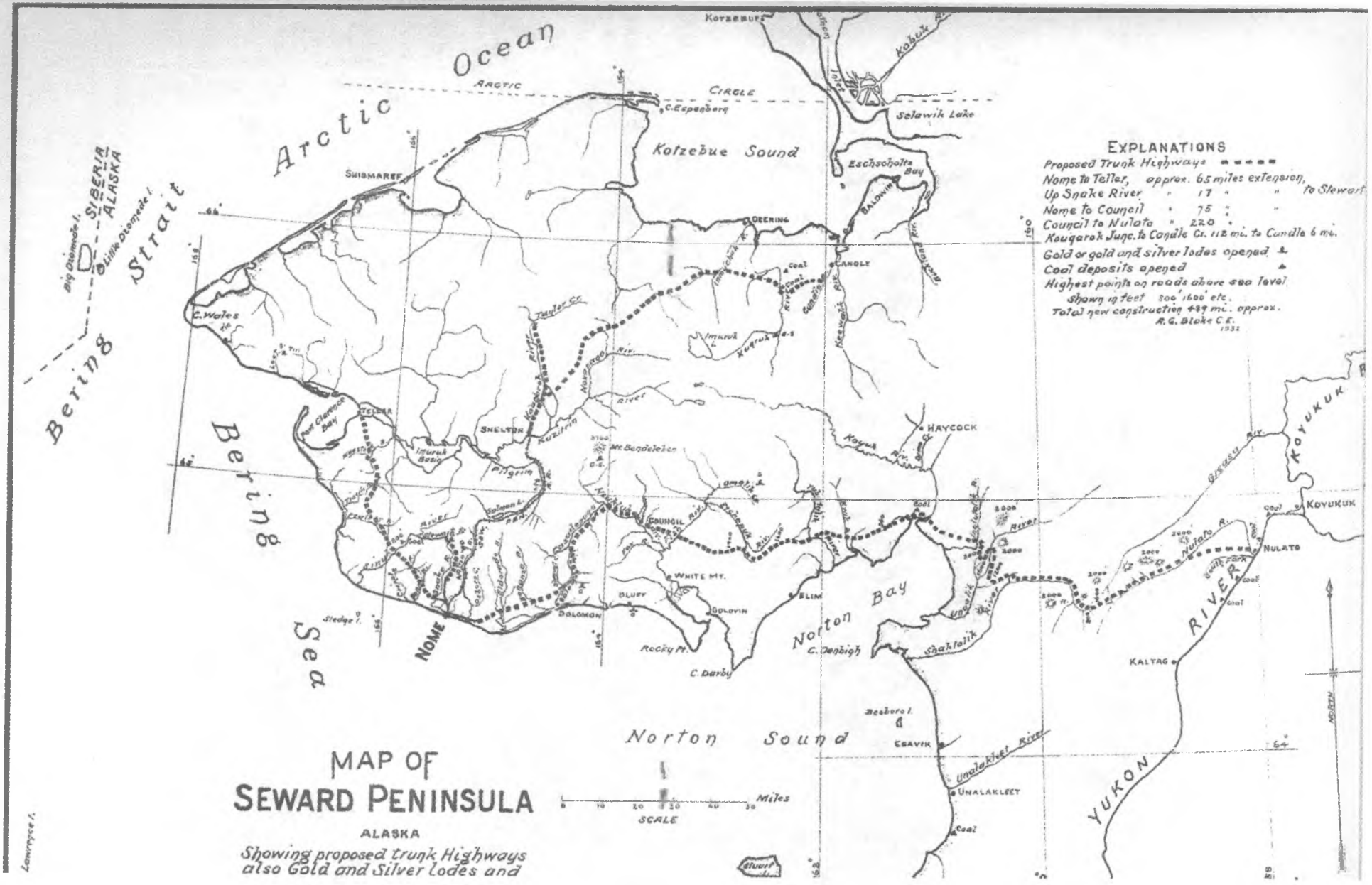
Since 1919 all road construction, extension and repairs, as well as all trail staking and building of shelter cabins at needed places on the trails, have been done by the Alaska Road Commission, which is a Federal agency using Federal and Territorial funds.

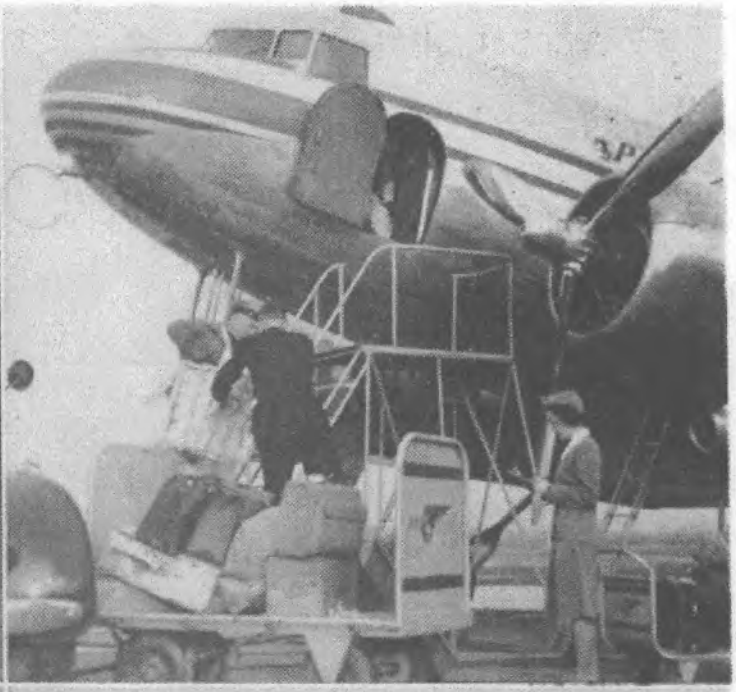
In this connection, too much emphasis cannot be placed upon the outstanding fact that Nome has had and still possesses the largest and best equipped transfer outfit ever assembled in Alaska. During the past thirty years no operator can truthfully say that he was delayed for a single day on account of unavailable transfer equipment.

The Northwestern Alaska Chamber of Commerce has outlined an extensive program for road extension and construction, whereby all centers in each of the four Divisions of the Territory of Alaska which are known to possess extensive and valuable resources would be connected by arterial highways. Branch roads from these arterials could be built from time to time as local developments would warrant them.

Reference is now made to the two-page map on page 20 and 21, as it shows the Chamber's Arterial Road Project, and, also, the proposal of the International Highway Commissioners for the construction of a road connecting the Pacific States, British Columbia, Yukon Territory, and passing through the Interior of Alaska to Cape Prince of Wales, and from there crossing Bering Straits into Asia!

FROM EVERY PORT in Northwestern Alaska, roads are being extended and maintained, as rapidly as available funds will permit. It is the policy of the Alaska Road Commission to cooperate with financiers of worthy enterprises to facilitate the moving of freight to the scene of operation. This map shows the project of road extension as adopted and vigorously advocated by the Northwestern Alaska Chamber of Commerce.





PAA; Alaska Airlines; Jacobs; Bill Munz

AVIATION. Left column: *A load of vegetables is checked out on a PAA flight to Nome.* • *Ship of the Alaska Airlines fleet.* • *Wien plane on the beach at Wales.* Right column: *Baggage being loaded into a Pan American Clipper.* • *Stinson Tri-Motor operated by Munz Airlines.* • *A Munz plane being used on a big game hunt, with one of the victims in the foreground.*

AVIATION

ON THE afternoon of August 17, 1920, The Black Wolf Squadron of the United States Army, composed of four DeHaviland planes under the command of Captain St. Clair Street, flying from Mineola, New York, landed on the sand spit at the mouth of Nome River, where a landing field had been hurriedly prepared for them in response to an order from Washington.

These were the first planes to come to Seward Peninsula, and were objects of great curiosity to the Eskimos and whites alike, very few of whom had ever beheld an airplane before, and had assembled en-masse to see and greet the aviators. The landing was made amid scenes of the wildest enthusiasm, and an ovation was tendered the pilots.

THE "LINDYS" VISIT NOME

Today the arrival or departure of planes from the aviation field near Nome is commonplace, and excites little or no comment. Within the last five years transportation by air in Alaska has passed the experimental stage, and from being almost prohibitive in cost, has now become so reasonable that plane travel, especially during the winter, is cheaper than any other mode of transportation. Where formerly only those to whom haste was vital made use of the planes, they are now used by all classes, even the Eskimo traveling by air in preference to going by dog team.

The lower rates were brought about by the construction of landing fields throughout

An N.A.T. Plane Based at Nome

Seward Peninsula by the the Federal and Territorial governments, enabling the operators of commercial planes to land passengers and express loads in the outlying districts without risk.

At the present time the traveler disembarking at Nome, can take a plane and fly to the borders of Alaska, or if need be into Canada. Point Barrow, the most northerly point on the North American continent, is only six hours from Nome by air, and planes have been there as late as the end of October,

and as early as the middle of February, and these were not stunts, for a record, but flights made in the regular course of business, for the purpose of bringing out passengers, thirty-nine of whom were taken out from the immediate neighborhood of Barrow by one company.

The planes used are almost all modern, closed, cabin monoplanes, heated for the comfort of the passengers and driven by the latest types of powerful air cooled, radial mot-

An Alaskan Airways Plane Based at Nome

ors, which experience has demonstrated to be the most suitable for this climate. All planes are under Federal inspection by the United States Department of Commerce.

In case of sickness of distress, all communities in Northwestern Alaska are just across the street from Nome and a plane is on the spot in a short time to convey the patient to the nearest hospital, or to rush a doctor to the scene. In this respect the planes have saved many lives and much suffering has

Laiblin & Graham Plane based at Nome

been alleviated. They also enable the crews in outlying sections to work up to the day before the last steamer sailing, thereby lengthening the mining season from ten days to two weeks, with an increased gold production resulting. They carry all sorts of cargoes, fur to the markets for the traders, freshly caught fish to the cities, first class mail as a matter of course on all flights, with large quantities of freight and express matter, from wedding rings to mining machinery.

A cargo of furs valued at a quarter of a million dollars was transported from a trading vessel frozen in at North Cape, Siberia to Nome and advantage taken of a rising market.

Before the advent of commercial planes such a thing as securing a head of lettuce in the winter would have been impossible. Today planes arriving from points on the Alaska Railroad bring fresh fruit and vegetables, celery from California, tomatoes from Mexico, bananas, strawberries, in fact anything the market offers.

Another phase of plane activity which is developing, is that of placing prospectors and the necessary tools and supplies for their use, in the interior at points which under the old conditions, were almost inaccessable. This can now be accomplished in a few hours by flying, and contact maintained at predetermined inter-

Pontoon Planes Land on the Beach at Nome

vals with the men in the field. In this way more can be accomplished in one season than formerly could be done in three years, at a fraction of the cost. New country, hitherto practically impossible to reach is by this means being opened up, and affords an attractive opportunity for the speculative investor.

A unique use to which the airplane has been put is that of assisting in the locating of reindeer lost, from the herd, or in locating an entire herd prior to a round-up. The plane covers a given unit in a matter of a few hours' flying time, returns to headquarters and gives the information enabling the herders to go direct to the animals, eliminating from ten days to two weeks' search on the ground.

(Continued on Page Thirty-Three)

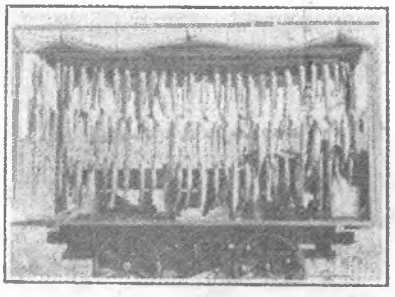
AVIATION

(Continued From Page Seven)

Where natural landing fields are located in the vicinity of the herd, the plane has taken the herders direct to the deer. Planes have been used in contacting the herd of 3,000 reindeer which are being driven into Canada for the Canadian government; this drive is traversing a country almost inaccessible at certain periods of the year to those using any other means of transportation than airplanes.

The companies engaged in commercial aviation are prepared to move all kinds of freight, within certain piece weight limits, to any points where landings can be effected on either land or water. During the summer the planes operate on wheels or pontoons depending on the landing conditions, and during the winter the wheels or pontoons are replaced with skils, as the country after snow begins to fall, is a nearly continuous landing field for a plane so equipped.

Nome is geographically situated very close to the western edge of Alaska and being directly on the Great Circle from New York to the Orient, is the logical point of arrival and departure for trans-continental flights. In the year 1931 a number of flights of this kind occurred; that of Post and Gatty on their record-breaking flight around the world; Colonel Lindbergh's flight to the Orient; Moyle and Allen on their flight from Japan to Tacoma, as well as the non-stop flight from Seattle to Tokyo, attempted by Robbins and Jones, which ended here. A number of others are projected and some of these will be made in the near future.



GREYLING FISHING ON NOME RIVER

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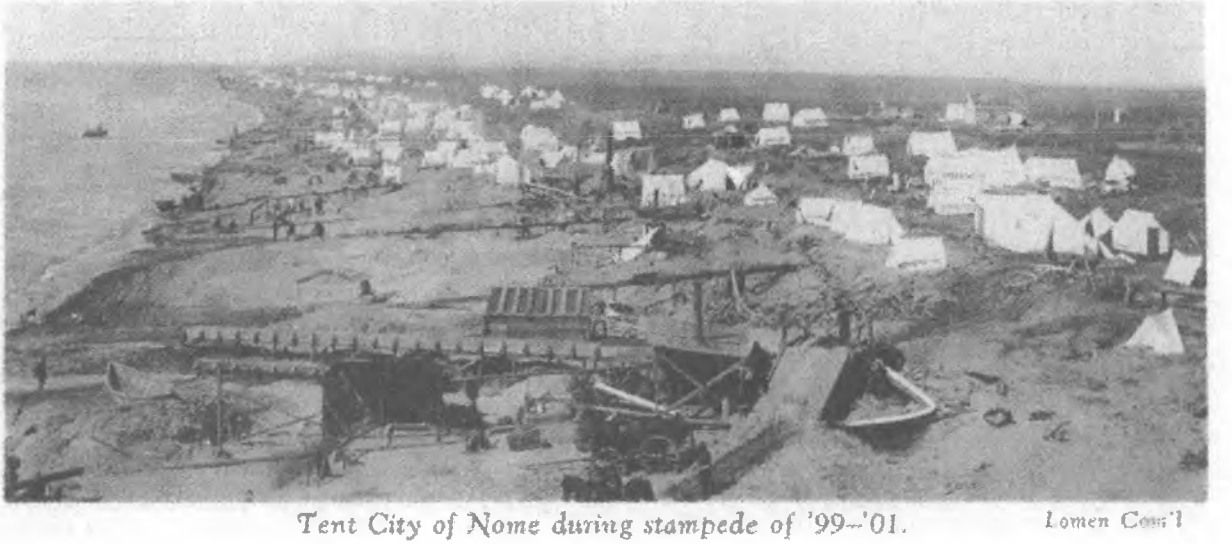
Nome has year-'round radio telegraphic communication with other parts of Alaska and the States, the U. S. Signal Corps maintaining a station which handles commercial business. The telephone system extends from Nome to various towns and mining districts. Passengers, freight and mail reach Nome by boat from Seattle during the open season. Ocean-going vessels lie at anchor a mile from shore and passengers and supplies are brought to town on lighters with tugs. Small coastwise boats ply from Nome to points up and down the coast from St. Michael to Kotzebue. A harbor at the mouth of the Snake river at Nome shelters small boats and lighterage equipment.

Aviation is an important factor in the lives and economy of the residents of Nome and Northwestern Alaska, giving surprisingly good air transport service to this section. Both in winter and summer the planes of Pan-American World Airways, Alaska Airlines and Wien Airlines include Nome on their regular schedules. Munz Air Service and local pilots cover the Seward Peninsula. Planes come and go from Nome almost daily. Pan-American has recently added to their service by delivering fresh farm produce to Nome merchants. Dog teams are still used to some extent in winter but this mode of transportation is rapidly being replaced by planes equipped with skis and pontoons.

Aside from mining, Nome's foremost industry, there are very promising indications that fishing will in the near future add materially to the city's prosperity. A survey of the fish resources in the Bering Sea will undoubtedly be made at an early date, and development of this industry will result in marketing of king crab, shrimp, cod, halibut, herring, and salmon. Cargoes of fish to the States will reduce freight rates northward, as ships now return without freight, thus increasing costs of the long haul to Nome.

The thriving city of Nome, which serves as a gateway to the highly important Seward Peninsula, is well represented by progressive merchants whose stores would be a credit to a larger community. Socially and spiritually the city has various clubs and churches. There are many things yet to be desired but with the indomitable spirit of its citizens, backed by the wide-awake Northwestern Alaska Chamber of Commerce, prospects for the community's future growth and prosperity are exceedingly bright.



Tent City of Nome during stampede of '99–'01. Lomen Com'l

The headquarters of the Reindeer Service is located at Nome.

TOURIST ATTRACTIONS

A trip to Nome and Seward Peninsula is one never to be forgotten. Tourists and sportsmen will find this section of Alaska little changed since the gold rush days. Nome and other well-known mining towns and villages have retained much of the flavor and color that intrigued past generations. Gone are most of the famous characters of yesteryear; the Dan McGrews and the dance-hall girls are but memories; in their place are a pioneer people, kindly, progressive. They offer a hearty welcome to the stranger, go out of their way to make his sojourn most enjoyable.

Sportsmen with gun and rod will find game in abundance in this section. One of the greatest sports—and a most useful one—is hunting of wolves by plane. Local planes can be chartered for this purpose or for an exciting fishing trip to one of the many spots where the limit of Arctic trout, and other members of the finny tribe can be caught.

The scenery of Northwestern Alaska is for the most part entirely different from that found in other parts of the Territory. Much of the terrain is comparatively level with countless little lakes and mountain streams. Here and there lofty mountains rise above the billowing tundra, their snow-capped peaks piercing the sky. The Bering Sea, Norton Sound, Kotzebue Sound, and the Arctic Ocean which borders the extreme northwestern coast, provide many a beautiful picture. Sometimes placid, sometimes turbulent and troubled, other times in the grip of winter's glistening ice, these famous waters are awe-inspiring to behold. Here the Eskimo, in all his glory, with his tiny skin boat, wrests fish, seal, and walrus from the challenging sea. To witness his primitive yet ingenious method of seeking a livelihood is an unforgettable experience awaiting the tourist to Nome and Northwestern Alaska.

TOWNS AND VILLAGES

There are 50 or more towns and villages in the Second Division of Alaska which comprises all territory from Nunivak Island on the south to Point Barrow on the north, from Cape Prince of Wales on the west to the Koyukuk Divide and the Endicott Mountains on the east. More than three-fourths of the population of this vast area, whites and Eskimos, live outside of Nome. A brief description of the principal communities follows:

Jacobs

HOMES. *Nome homes are well built, comfortable. They are heated largely by oil, coal being rather expensive because of the transportation difficulties. The picture in the lower right corner is indicative of the taste with which many of the homes are furnished and decorated. Utilization of native artcrafts is common for homekeepers who strive for character in their rooms.*

Introducing SPONSORS OF NOME and NORTHWESTERN ALASKA BOOKLET

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Department store; pioneer merchant, starting in Nome in 1900; member of new Territorial Development Board and Grand President of Alaska Pioneers; features and encourages native artcrafts.

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Groceries, meats, fresh vegetables and fruits, clothing, beverages; established 42 years; one of leading firms of Northwestern Alaska; owned and operated by L. Seidenverg & Sons, Inc.; Edward M. Seidenverg, manager.

MINERS & MERCHANTS BANK OF ALASKA

Established Nome 1904; general banking business, serving the financial needs of the Second Division; gold dust bought; G. R. Jackson, president and manager; Ira D. Orton, vice-president; H. G. Gabrielson, secretary and cashier.

NORTHERN COMMERCIAL CO.

Closely linked with the history and development of the Territory; 34 mercantile branches in Alaska and Yukon, including Fairbanks, Anchorage, Nome, Circle, Nenana, Tanana, Ruby, Fort Yukon, Eagle, and Hot Springs; everything for the household; serves the mining, logging, fur, and farming industries.

LOMEN COMMERCIAL CO.

Nome, Fairbanks, Anchorage, Juneau; for 36 years serving business interests of Alaska; distributors of nationally-known dependable equipment, supplies for miners, contractors, industrial uses; lighterage service covering Seward Peninsula area; staff of expert mechanics and technicians ready to help with individual problems.

PAN AMERICAN WORLD AIRWAYS

Provides Nome with direct service to Fairbanks, Whitehorse, Juneau and Seattle, with 21-passenger Clippers; stewardess service; Rita Travis, traffic representative, Nome.

ALASKA AIRLINES

U. S. mail and passenger service to Anchorage, Homer, Kodiak, Juneau, Nome, other points; fleet of modern planes insures comfort, safety, provides connections throughout Alaska and the States; headquarters in Anchorage.

GLENN CARRINGTON CO.

Fairbanks, Nome, Seattle; Alaska distributors and jobbers of nationally-known industrial and mining machinery; complete outfitters for placer, hard-rock miners; International trucks, tractors, power units; farm machinery and building material of all kinds; serving Alaska since 1915.

WIEN ALASKA AIRLINES

"The Pioneer Line"; passenger, mail, express service to practically all points in Interior Alaska, including Nome, Galena, Seward Peninsula, the Yukon, Point Barrow, Circle, Forty-Mile country, Wiseman, Big Delta, Tanacross, etc.; charter trips available; Boeing and other first-class planes, flown by experienced pilots.

NORTHERN LIGHT & POWER CO.

Nome, Alaska; serving Nome and vicinity with electric light and power; established since early days of city; electrical supplies; furnishes winter power for operations of U.S.S.R. & M. Co.; O. S. Weaver, president and general manager.

LARRY GALVIN

Diesel Oil Sales; delivery of oil six days a week regardless of weather; G.-E. heating plants; Dodge and Plymouth car dealer; established five years and owned-operated by Larry Galvin.

NOME MOTOR CO.

Modern garage and office building constructed after Nome's two fires; auto repairs and service of all kinds; Chevrolet and Buick dealers; agency G.-E.-Delco heating systems; established 1934; H. F. Harper, proprietor.

POLAR CURIO SHOP

Featuring a large stock of the finest in Eskimo ivory and needle arts; beautiful display of souvenirs and curios of various kinds; owned and operated by George Madsen and Keith Hedreen.

NORTH POLE BAKERY AND RESTAURANT

Pioneer of Nome since the gold rush days; known far and wide as a good place to eat, best of foods; everything the market affords; when in Nome the North Pole is a "must"; owned and managed by Mr. and Mrs. Garnet Martin.

WALLACE HOTEL

Modern, comfortable hotel of Nome, where courtesy and Alaskan hospitality prevail; on the shores of the Bering Sea; owned and operated by Mr. and Mrs. Joe Wallace.

NOME GRILL

Serving Nome and vicinity with good restaurant service; meals and lunches at all hours; fine service; quality foods, well prepared; established six years; owned and managed by Monte Ferguson and A. E. Lord.

LINCOLN HOTEL

"Where the Sourdoughs Meet"; operated continuously since the early days and now a landmark of Nome; owned and operated by Joe Mullins and Emile Laurin, pioneer freighting and mining men.

NOME HARDWARE CO.

Established in 1900; now housed in fine, modern building; general hardware and building materials; managed and owned by Guy Mish and Andrew Sather.

NOME NUGGET

Founded in 1900 by former Gov. J. F. A. Strong; one of oldest newspapers in the Territory; a tri-weekly, it is owned and edited by W. A. Boucher.

THE NEVADA

Oldest tavern in Nome, operating since early gold rush days; associated with the color and romance of the Nome stampede; owned by H. G. Gabrielson, cashier of Miners & Merchants Bank.

MAY'S TAVERN

A unique place where the accent is placed on refreshments and entertainment; owned and managed by May Bale, 20-year resident, winner of dog team races and ski prizes; "Try a glogg at May's."

MODERN CLEANERS

All that the name implies; first class cleaning and pressing; prompt, courteous service; Mr. and Mrs. Carl Mickleson, props.

DREAM THEATER

Nome's amusement theater, where latest available motion pictures are shown; be sure to visit the Dream when you visit Nome; Charles Code, owner.

THE GLUE POT

Recreation headquarters; all kinds soft drinks, cigarettes, cigars, tobaccos; a place to spend an idle hour; a real Alaska greeting awaits you here; owned by Nick Simeon and Charles Goetzenberger.

R. J. SOMMERS CONSTRUCTION CO.

Built Army air fields at Galena, Lake Menchumina, Moses Point, Unalakleet, two fields at Nome; important construction jobs at Ladd Field, Annette, Juneau, Ketchikan, Seward, etc.; Gordon Wildes, superintendent; Ivor Kriken, superintendent Nome projects.

MUNZ AIR SERVICE

Serving Seward Peninsula; Stinson 10-passenger plane and three Stinson Juniors; regular trips to Pilgrim Hot Springs, Taylor, Deering, Kotzebue, Candle; William Munz, well-known pilot, established line in 1938; chartered planes for fishing and hunting trips.

POLAR BAR

"Meet the Boys at the Polar"; finest of refreshments and courteous treatment; owned and managed by George Madsen and Keith Hedreen, old-time residents of Territory; other interests mining and aviation.

TELLER MERCANTILE CO.

General store and post office; pioneer firm of Teller, established since 1903; serving entire Teller area; owned and operated by Mrs. Peterson and Mrs. Marx.

NORTH STAR MERCANTILE CO.

General merchandise, quality goods; furs, ivory, mukluks; large mining interests of Teller district; operated by N. B. Tweet & Sons, pioneer Alaskans.

GEORGE R. GOSHAW

Fox fur farm, Shishmaref, Alaska; pioneer in the fox industry of Northwestern Alaska; started first white fox farm of record and originated platina fox furs; also raises blue fox; 150 to 200 pelts shipped annually.

MOLLIE DEXTER

Trading Post, Golovin; successor to her father, John Dexter, pioneer; general store and roadhouse, serving the Golovin district for many years.

This booklet is a reprint of a special section of Alaska Life Magazine for May, 1945.

APR 11 1947

Come Home to Nome

All School Reunion

Nome, Alaska

Celebrating 100 years of Nome School History

1901-2001

Nome Oyster

...and...

Grill Room

Everything First-Class
and Up-to-Date

BEN E. HERSEY
BEN F. MILLER

124 FRONT ST.

Nome-Arctic Railway

Daily Trains for

LITTLE CREEK, DISCOVERY, BANNER, DEXTER
AND END OF TRACK

Sunday Excursions, Round Trip $1.00

W. N. MONROE, MANAGER

Alaska Telephone & Telegraph Co.

Nome, Council, Chinik, Kougarok,
Teller, and all Intermediate Points.

Dispatches will be received and delivered within a radius of ½ mile from any of our establishment offices at any of the above named points at the following rate:

$1.25 for first ten words, 10c. for each additional word.

Arrangements have been made with the U. S. Signal Corps to receive dispatches at any of our outlying stations to forward to any part of the world.

A. E. BOYD, Manager

EUGENE CHILBERG, Pres. J. S. KIMBALL, Vice-Pres. C. G. COWDEN, Cashier
A. W. KAH, Assayer

Miners and Merchants Bank of Alaska

216 Front Street

Will remove about July 15th, to new building now occupied by the "Commerce."

General Banking Business Transacted.

Gold Dust Purchased and Assayed.

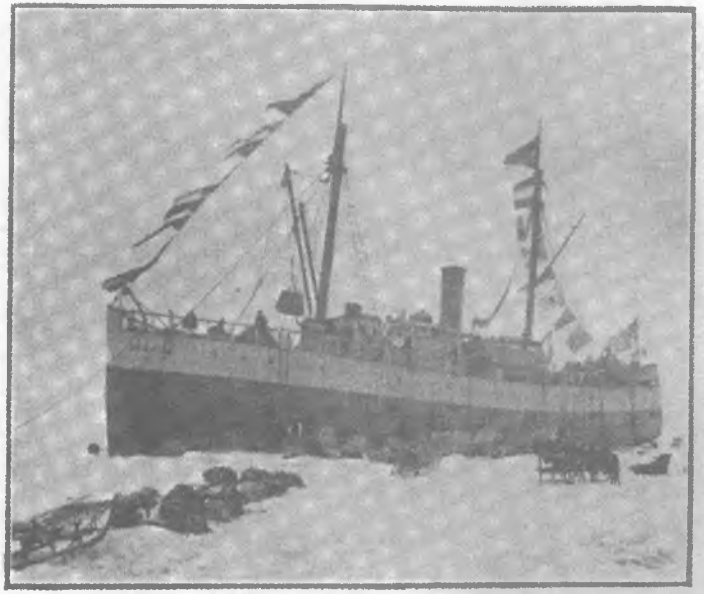
The Corwin

ALTHOUGH the Corwin has opened navigation for us in Nome every year since the spring of 1903, nothing has ever been mentioned of it in our annual.

The Corwin, a wooden steamer of .... tons, is much less than half the size of the other ships that come up to Nome. Under the able command of Captain West, who has had wide experience in these waters, this little steamer has plowed through ice fields that have punched holes in large steel ships and even taken them up North toward Bering Straits.

We "sourdoughs," who have been isolated in this little town of Nome without any communication to the states except through the mails brought by dog teams which travel over a month to reach here, and by wireless telegraphy which serves as communication for the papers, appreciate the arrival of the "first boat." On it come the "cheechacos" and the fresh fruit and vegetables, all of which get a hearty welcome. The town becomes alive with people for everybody, after not seeing a ship for seven months, gets out to view the Corwin.

The Corwin leaves Seattle every year on or about the tenth of May. The first five or six days of travel by the inside passage bring the steamer to "points" in Alaska, from which the people are as anxious to hear of its progress in the papers, each day, as they are the progress of the dog teams on the "dog dope" boards during the annual sweepstake race. For five or six days and even two weeks before the Corwin arrives, people begin to "see things," that is, they think they see the Corwin coming in



S. S. CORWIN ARRIVING AT NOME JUNE 1, 1907.

when it is really nothing but black cakes of ice, that look like spots, floating on the horizon.

One thing noticeable during the breakup of the ice are the beautiful and rapidly changing mirages. It was by these that the Corwin was discovered out in the ice floes in the spring of 1907 when it was miles away from Nome. First the black spot representing the hull showed and then the smokestack with the smoke pouring downward. The mirage then disappeared but showed up again and the whole boat was in plain view. It disappeared again and soon the real smoke of the real steamer was seen coming in slowly among the ice fields, and the Corwin dropped anchor on June third at the edge of the ice about three miles off of Nome.

Since the spring of 1903 the Corwin has steadily opened navigation for us, some years coming in when the ice was still fast in the roadstead, and in other years when the ice was floating about in cakes or had left altogether.

The steamer makes only one trip from Seattle every year. After it arrives at Nome it sails at almost regular intervals to different points along the coast of Bering Sea. It is the largest of the coasting fleet.

CHARLES DEYETTE.

1909

TWIN SCREW SCHOONER

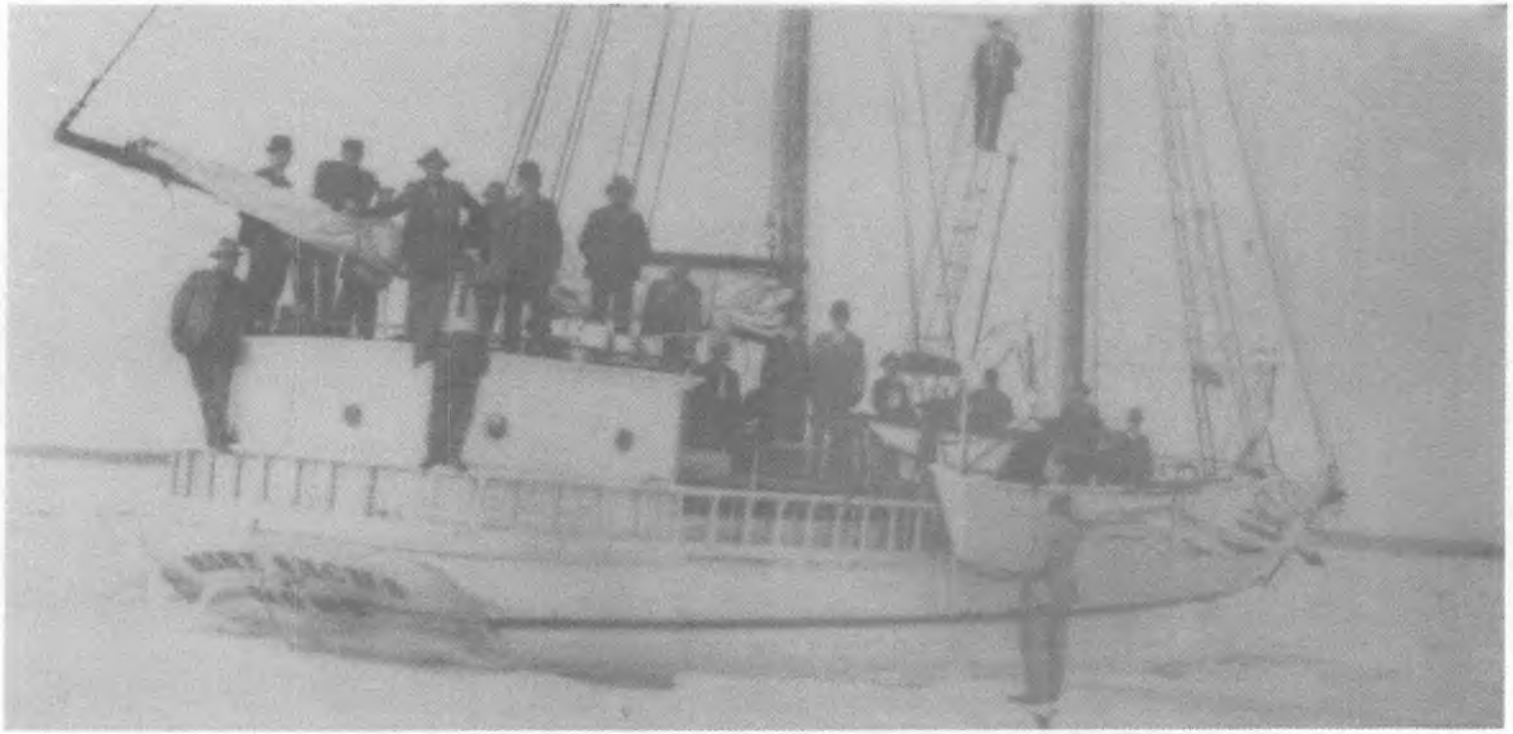
"MARY SACHS"

Making regular trips between
NOME, TELLER, LOST
RIVER, YORK, TIN CITY
and KOTZEBUE

Trips Made to the Kuskokwim Phone Red 103

Office on East side of Barracks Square, Nome

PETER BERNARD



Moving Gold Beach Dredge from Dry Creek to Osborne Creek, weight 50 tons; March 12th, 1911

C. L. Morris Co., J. H. Montgomery, Manager

Heavy Freighting.

In March 1911, hundreds of spectators gathered to see the transporting of one of the largest pieces of machinery ever moved on Seward Penin ula. This was accomplished by means of horses. It was the Dry Creek dredge, which was taken to Osborne Creek, a distance of fourteen miles. The barge was ninety feet long and thirty-two feet wide, and was divided into two sections, each weighing fifty tons. Each section was raised at the front end by means of jacks; two pairs of skids were then placed under the section, with two large cabin sleds under the skids, while the other end of the section dragged over the snow.

Owing to the heavy fall of snow and continuous storms, thousands of dollars were expended in breaking trail for the barge. As many as seventy horses were engaged at one time for this purpose.

At the sound of a whistle, blown by Mr. Montgomery, the manager of this undertaking, every one of the sixty-eight horses threw his weight into the collar, and the massive barge moved slowly forward without a stop until it reached Nome River, a distance of nine miles, in three hours.

No heavier freighting, in all probability, is done anywhere than in Nome.

The Caisson, weighing eighty-three tons, was successfully moved by thirty-two head of horses. Several large dredges have been transported, to say nothing of the numerous tons of freight hauled to the creeks, during both summer and w nter.

One outfit employed in this heavy freighting cost over $100,000. Hydraulic jacks, reputed to raise over 2,000 tons at one time, are a part of the W. J. Rowe equipment, as well as several heavy moving sleds, trucks of thirty tons capacity, and a set of huge wheels, twelve feet in diameter, guaranteed to carry one hundred tons.

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Alaska Road Commission

Report ... 1917

ANNUAL REPORT OF THE

Board of Road Commissioners for Alaska

1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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GRADING WITH CATERPILLAR TRACTOR, ESTER CREEK ROAD.

NOME-BESSIE ROAD.

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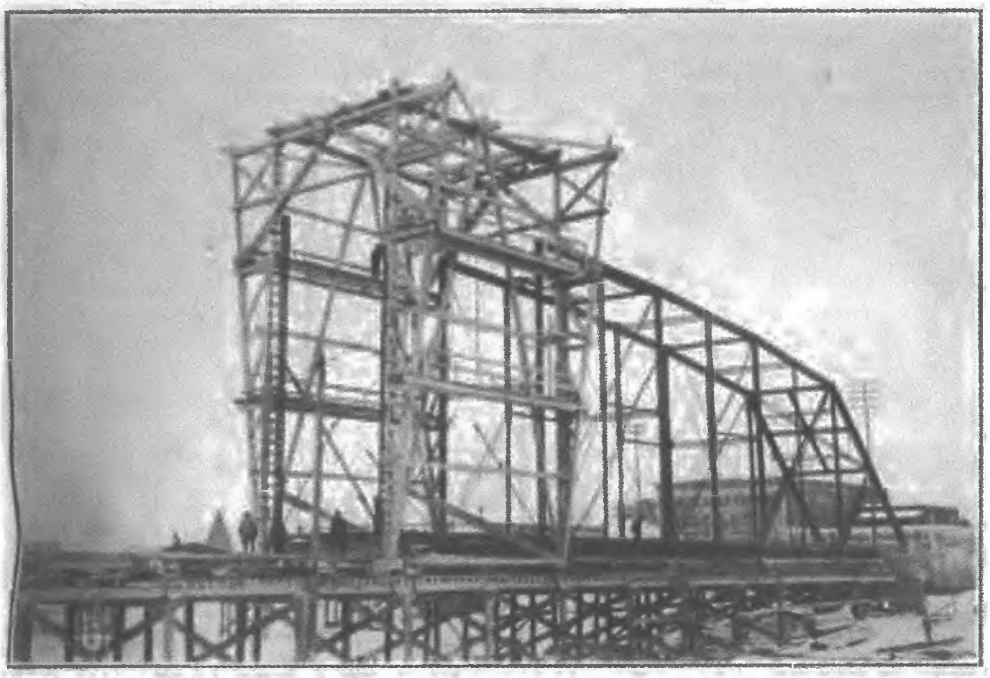

FAIRBANKS BRIDGE DURING CONSTRUCTION.

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NOME DISTRICT.

(Mr. DANIEL A. JONES, Superintendent.)

Route 8—Nome-Council Road (approximately 82 miles; 57 constructed).—Maintenance work on the Nome-Fort Davis section included blasting the ice under bridges in the spring and resurfacing 3,300 feet of road with gravel. The Rocker Creek Bridge was repaired by constructing two new crib supports and replacing old stringers.

No expenditure was made on the Fort Davis-Cape Nome section, which, as noted in previous reports, was very badly damaged by the storm of 1913. The Territorial road commission is now engaged upon the reconstruction of this section.

Work on the Cape Nome section, which was reconstructed in 1915 by the Territorial road commission, consisted of removing slides, cleaning ditches, and constructing 1,575 feet of approaches to the new road, at a cost of $2,826.99.

General maintenance and the construction of 6,945 feet of gravel-surfaced corduroy constituted the year's work on the Solomon-East Fork section. The total expenditure was $5,041.23.

Maintenance of the Fox River-Council section, which is entirely corduroy, cost $445.10 per mile.

The maintenance and operation of the Safety Ferry cost $885.80, of which $385.80 was expended for new cable and minor repairs to the scow.

The cost of maintaining and operating the Bonanza Ferry was $537.70; of this amount, $162.70 was for new cable and repairs to the ferry scow.

Route 13A—Nome-Bessie Road (3.3 miles).—General maintenance on this route, including resurfacing 7,335 linear feet with gravel, cleaning ditches, and opening channels through the ice under bridges during the spring, cost $696.97 per mile. In addition, 400 cubic yards of material in the fill over Dry Creek, washed out by high water, was replaced at a cost of 51 cents per cubic yard. The maintenance cost for the year was greater than usual, largely because of the heavy rains during the summer of 1916.

During June of this year 1,200 tons of freight were transported over this road, and the daily average freight movement throughout the year was approximately 30 tons.

Route 13B—Bessie-Banner Road (3.5 miles).—The work of the year on this route was confined to surfacing 2.3 miles with gravel, at a cost of $3,797.07.

Route 13C—Bessie-Little Creek Road (1.25 miles).

Route 13D—Bessie-Dry Creek Road (1.25 miles).

No work was done on these routes during the year.

Route 13E—Dry Creek-Newton Road (0.33 mile).—Repairs to culverts on this road cost $27.

Route 13F—Nome-Osborne Road (4 miles).—General maintenance work on this route cost $45.18 per mile.

Route 13G—Grass Gulch Road (1.75 miles).—No work was undertaken on this route during the year.

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Route 13H—Center Creek Road (1.37 miles).—The cost of resurfacing 625 feet of this road with gravel was $386.84.

Route 13I—Nome River Road (5 miles).—The protection of this road during the spring break-up cost $13.05 per mile. No other work was done during the year.

Route 13J—Wonder-Flat Creek Road (2 miles).—General repairs and maintenance on this route cost $178.05 per mile.

Route 13K—Bessie-Buster Road (5 miles).—The work of the year on this route consisted of general maintenance and surfacing 1 mile with gravel 12 inches thick, at a cost of $0.36 per foot.

Route 18—Kaltag-Solomon Trail (248 miles).—On the Topkok-Unalaklik section of this trail 2,818 permanent stakes, each 3 inches in diameter at the butt and 9 feet long, were cut and set. In addition the permanent stakes on 79 miles were repaired and reset where necessary and 4½ miles of new trail cleared through timber. The total cost was $961.85.

Route 21—Unalaklik-St. Michael Trail (approximately 65 miles).—The temporary staking of 18 miles on the ice between St. Michael and Klikitarick cost $16. The remainder of the work embraced restaking 27 miles with permanent stakes and the construction of a light tram over the Golsovia River, at a total cost of $381.40.

Route 25A—Cripple River Road (13.5 miles, total A and B).

Route 25B—Penny River Road.

Route 25C—Nome-Wireless Road (0.25 mile).

No work was done on these routes during the year.

Route 25D—Mouth of Center Creek Road (2 miles).—General maintenance and repairs on this road cost $87.66 per mile.

Route 25E—Submarine Paystreak Road (2.5 miles).—As originally built this road extended from near the mouth of Snake River for a distance of approximately 1 mile along the submarine paystreak. A total of only $620.84 has been expended on it since its location in 1907, and no work has been done on it for several years. At the present time a new road, following a better location, is being constructed from the Snake River bridge to the submarine paystreak. This road will be designated by the same name and route number as the old road, which has been abandoned.

The work of the year consisted chiefly in the construction of fills leading to the Snake River bridge approaches, containing 1,460 cubic yards of material. A branch road 1,200 feet in length was also constructed from the west approach to a point near the mouth of Snake River. The total cost of all work was $1,765.07.

Route 25F—Anvil-Glacier Road (3 miles).—General repairs to this route included cleaning ditches and hauling 480 cubic yards of gravel surfacing. The average cost was $395.85 per mile.

Route 25G—Snake River Extension Road (3 miles).—The work of the year on this route embraced general repairs and the surfacing of 2,380 linear feet of road with gravel. A suspension foot bridge over Snake River at the mouth of Boulder Creek, having a span of 130 feet, and two 18-foot bridges over Sledge Creek were constructed at a cost of $294.73. The material used was largely obtained from the old Snake River bridge.

Route 25H—Otter Creek Road (1.25 miles).—No work was done on this route during the year.

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Route 25—Sinrock Ferry.—The total cost of maintaining and operating this ferry was $321.90, of which $71.90 was expended for minor repairs to the scow.

Route 26—Candle-Candle Creek Road (5 miles).—The year's work on this route consisted of cutting and tying 3,382 fifty-pound bundles of willows, which were hauled and distributed along the road during the winter for use in constructing corduroy this year.

Route 27—Deering-Inmachuck Road (25 miles).—General maintenance covering the whole route, together with some new construction on the left bank of the Inmachuck River, eliminating seven crossings of the river, constituted the work of the past year. The center pier of the bridge over the lagoon near Deering had been undermined and was removed and replaced by piles. Eight new culverts were constructed, 0.5 mile of road graded and ditched, and 2,700 feet of corduroy laid and graveled.

Route 28—Dahl Creek-Candle Trail (140 miles).—The repair and replacement, where necessary, of permanent stakes throughout the entire length of the route cost $1 per mile.

Route 37—Topkok-Candle Trail (141 miles).—Twenty-six miles of this route were restaked with permanent stakes and 3 miles cleared through timber, at a total cost of $460.

Route 42—St. Michael-Kotlik Trail (approximately 70 miles).—Those portions of this route not on the ice were marked with permanent stakes, 40 to the mile. The work was done by contract and cost $350.

Route 49—Davidsons Landing-Taylor Creek Road (40 miles; 24 constructed).—This road extends from the head of navigation on Marys River to Taylor Creek, in the Kougarok mining district. Only light construction work was undertaken, covering the first 24 miles of the route, and consisting of clearing out the road, eliminating creek crossings by grading, and laying gravel-surfaced willow corduroy over soft spots. Since the work was done teams have been able to haul loose loads 1,500 pounds greater than the average before the improvement was made.

Marshall Road.—This road when completed will extend from a tributary slough of the Yukon to the placer mines of the Marshall district and will be about 3 miles in length. The work done during the past year consisted of cutting and hauling poles for approximately 2 miles of corduroy. Only a part of the accounts covering this work have been received, and the total cost can not be reported.

This project has been taken over and will be completed this year by the Territorial road commission.

Flagging trails.—Approximately 550 miles of trails, in addition to those permanently marked, were temporarily staked or flagged for the guidance and safety of winter travel. The total cost, including cost of inspection trips by the superintendent of the district, was $4,225.30.

Snake River Bridge.—The construction of this bridge (see annual report 1916, p. 18) was begun June 17 and completed August 19, 1916. Nearly all of the material used, including piles, lumber, and steel, had to be obtained and shipped from Seattle, largely increasing the cost. The two 100-foot spans are of the combination Pratt truss type. All truss timbers, stringers, and planks are Douglas fir.

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The total cost, including the expenditure reported last year, was $16,949.93, distributed as follows:

Material	$5,646.72
Equipment	400.21
Freight on material and equipment	8,441.05
Engineering	600.00
Labor	6,188.39
Hire of animals	453.31
Miscellaneous (fuel, telegraph, etc.)	220.25
Total	16,949.93

Of the above amount $526.50 was expended during the winter in protecting the piers by cutting away the ice and placing riprap around them.

ACCOUNTING.

The expenditures of the Alaska Road Commission during the fiscal year July 1, 1916, to June 30, 1917, amounted to $576,747.90, of which $76,716.15 was received from the Alaska fund, $500,000 from a special appropriation made by Congress, and $31.75 from collections reverting to that fund.

As the Territory of Alaska covers approximately 590,000 square miles, and road work is done in all parts thereof, it is, of course, impossible for the disbursing officer to make all disbursements personally, although all accounts eventually pass through his office and are verified there before being forwarded to the War Department.

In order to pay promptly all accounts in outlying districts, each superintendent, one at Nome, Fairbanks, Seward, and a disbursing clerk at Ruby, acts as disbursing agent for his district.

Checks on local banks or commercial companies are given by the local disbursing agent for bills as they are incurred, and at the end of each month the total amount of checks cashed in payment of bills is telegraphed and the disbursing officer issues a Treasury check to cover the overdraft.

Proper vouchers to offset the overdrafts are forwarded by the superintendents, who are held responsible for a proper accounting for the indebtedness incurred by them.

The above system has been in operation for several years and has proven satisfactory and has enabled prompt settlement of accounts.

On June 11, 1917, the main office of the commission was moved from Valdez, where it had been for several years, to Juneau, the capital of the Territory. This transfer became necessary on account of certain additional duties being assigned to Lieut. Col. Davison, secretary and disbursing officer, in connection with the militia affairs of the Territory, which required his presence at the capital.

The office at Valdez was left in charge of a disbursing clerk, who handles all accounts of the Valdez-Chitina-Fairbanks Road.

On June 29, 1917, at a meeting of the entire board, funds to the amount of $420,000 were allotted for various projects in the Territory for the period July 1, 1917, to June 30, 1918. Several small allotments have been made since that date.

The following statement shows in detail the receipts and disbursements from July 1, 1916, to June 30, 1917, inclusive:

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STATEMENT OF RECEIPTS AND DISBURSEMENTS.

This report covers vouchers received and placed in the account, including June 30, 1917:

Balance on hand July 1, 1916	$54,137.28
Received from the Treasurer of the United States:	
Appropriation "Military and post roads, bridges, and trails" (act Aug. 29, 1916)	500,000.00
Alaska fund	50,000.00
Correction of vouchers:	
Alaska fund	1.00
Special appropriation	31.75
Sales of property, Alaska fund	2,375.40
Total	606,545.43
Disbursed as per tabulated statement below	576,747.90
Balance on hand	29,797.53

Expenditures in detail.

Routes, etc.	Wagon roads, bridges, and trails, Alaska fund.	Construction and maintenance of military and post roads, bridges, etc., Alaska.	Total.
Offices	$2,536.93	$13,414.08	$15,951.01
Auto trucks	3,542.32	2,394.74	5,937.06
Route 1	50.00	626.09	676.09
Route 2	1,939.30	10,724.18	12,663.48
Route 3	236.35	3,126.89	3,363.24
Route 4A	251.10	932.01	1,183.11
Route 4B, first section	4,321.20	12,312.20	16,633.40
Route 4B, second section	3,201.12	10,211.11	13,412.23
Route 4B, third section	3,120.00	10,200.00	13,320.00
Route 4C	1,087.60	10,140.82	11,228.42
Route 4D	5,041.88	12,490.30	17,532.18
Route 4E	1,560.25	13,107.41	14,667.66
Route 4F	928.09	11,684.02	12,612.11
Route 4G	670.47	11,077.12	11,747.59
Route 4H, first section	2,320.32	13,322.19	15,642.51
Route 4H, second section	2,232.44	11,414.10	13,646.54
Route 4I	2,919.94	6,251.37	9,171.31
Route 4J, first section	422.33	17,452.50	17,874.83
Route 4J, second section	332.30	10,541.41	10,873.71
Route 4K, first section	2,025.42	15,511.25	17,536.67
Route 4K, second section	2,027.20	12,500.32	14,527.52
Taalina Bridge	74.05	17,550.75	17,624.80
Route 5	48.00	2,584.35	2,632.35
Route 6A	1,693.43	6,185.08	7,878.51
Route 6B, first section	1,409.11	10,528.04	11,937.15
Route 6B, second section	1,306.12	8,608.40	9,914.52
Route 7A	9.10	.....	9.10
Route 7B	9.09	.....	9.09
Route 7C	9.09	.....	9.09
Route 7D	9.09	1,900.00	1,909.09
Route 7E	9.09	.....	9.09
Route 7F	9.09	.....	9.09
Route 7G	9.09	237.10	246.19
Route 7H	9.09	.....	9.09
Route 7I	9.09	.....	9.09
Route 7J	9.09	.....	9.09
Route 7K	9.09	.....	9.09
Route 8	552.14	12,181.33	12,733.47
Route 9	.....	1,000.00	1,000.00
Route 10	2,730.86	10,451.59	13,182.45
Route 11A	100.00	1,348.08	1,448.08
Route 11B	.....	194.00	194.00
Route 11E	.....	502.00	502.00
Eagle-Circle Mail Trail	.....	206.00	206.00
Route 12	7.00	4,519.35	4,526.35
Route 13	4.00	.....	4.00

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Expenditures in detail—Continued.

Routes, etc.	Wagon roads, bridges, and trails, Alaska fund.	Construction and maintenance of military and post roads, bridges, etc., Alaska.	Total.
Route 13A	$649.83	$1,927.46	$2,577.29
Route 13B	154.03	3,694.38	3,848.41
Route 13E		27.00	27.00
Route 13F	60.00	133.20	193.20
Route 13H		388.80	388.80
Route 13I	50.00	65.25	115.25
Route 13J	28.50	71.50	100.00
Route 13K		1,986.55	1,986.55
Route 14	18.00	1,401.29	1,419.29
Route 15	166.00	4,493.32	4,659.32
Route 16		500.00	500.00
Route 17		300.00	300.00
Route 18		573.85	573.85
Route 19		4,769.08	4,769.08
Route 20A		120.00	120.00
Route 20B		130.00	130.00
Route 21	51.00	881.00	932.00
Route 22		1,140.51	1,140.51
Route 24	46.22	8,824.03	8,870.25
Route 25D	64.00	78.25	142.25
Route 25E		1,780.07	1,780.07
Route 25F	154.02	1,039.36	1,193.38
Route 25G	104.03	2,281.95	2,385.98
Route 25, Sinrock Ferry	98.36	206.50	304.86
Bull Creek Bridge		49.50	49.50
Snake River Bridge	10,925.90	5,241.73	16,167.63
Route 26	121.35	1,142.85	1,264.20
Route 27	14.00	3,061.99	3,075.99
Route 28		139.00	139.00
Route 30		359.49	359.49
Route 32B		4,500.00	4,500.00
Route 35		7,822.80	7,822.80
Route 35A		1,003.50	1,003.50
Route 38A, first section	653.19	18,115.50	18,768.69
Route 38A, second section	489.89	16,901.25	17,391.14
Route 38A, third section	293.96	15,750.04	16,044.00
Route 38A, fourth section	195.95	16,150.00	16,345.95
Route 38B	18.50	13.50	32.00
Route 39	1,675.75	3,918.64	5,594.39
Route 40		414.10	414.10
Route 43		2,285.70	2,285.70
Route 44	627.99	4,394.40	5,022.39
Route 45	850.25	1,729.26	2,579.51
Route 46		4,571.63	4,571.63
Route 47		5,000.00	5,000.00
Route 48		328.50	328.50
Route 49		5,009.82	5,009.82
Chisina Trail		500.00	500.00
Taylor Creek Bridge	184.49		184.49
Gastineau Channel Bridge investigation	286.67	2,732.98	3,019.65
Fairbanks Bridge	9,190.61	42,632.55	51,823.16
Brooks-Terminal Sled Road	71.00	4,468.57	4,539.57
Taku Road reconnaissance		60.00	60.00
Flagging trails	681.39	3,543.89	4,225.28
McDougal-Cache Creek Trail		1,622.15	1,622.15
Matanuska reconnaissance		353.75	353.75
Palmer-Mile 26 survey		113.70	113.70
Marshall Road		320.25	320.25
Long-Ophir survey		1,537.18	1,537.18
Total	76,716.15	500,031.75	576,747.90

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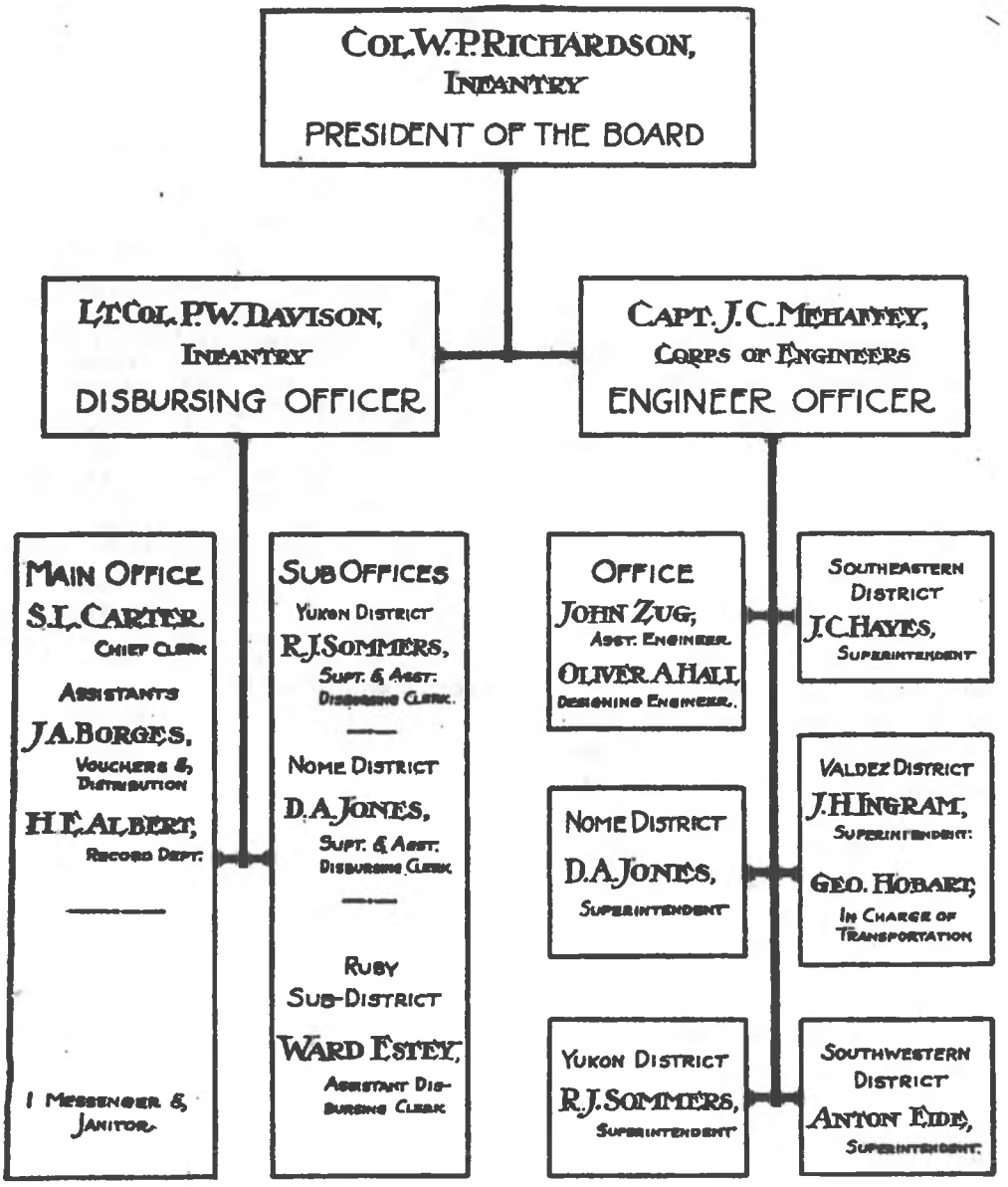

ORGANIZATION AS OF JUNE 30, 1917

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NEW ALASKAN RAILROADS.

Road from Nome to Port Safety Nearing Completion—Other Lines Planned.

Special to The New York Times.

TACOMA, Wash., June 16.—Railroad building in the Far North is one of the features of the rush to that country which began with the discovery of gold in the Klondike in the Fall of 1896, followed by the discoveries at Nome, Koyukuk, and other places in Alaska. What will be, perhaps, the most northerly railroads in the world will be the Nome and Port Safety Road, and the line to the Wild Goose mining district from Nome, both of which are expected to be completed and in operation during the present Summer.

Next to these lines is the proposed road from Nome, or rather from the end of the Nome and Port Safety line, at Port Safety, to Katmai, around by the mainland and across the mouth of the Yukon River and through the Kuskoquim country, reaching the coast at a point opposite Kodiak Island, which is open to navigation generally at all times of the year, thus putting the Nome country in direct communication with the outside world.

The White Pass Railroad is rapidly pushing on to Dawson, the division between Caribou and Le Barge being completed and in operation, sixty cars and four locomotives having been put on the line ten days ago.

Another possible line is the Copper River Road, for which a survey has been made, but on account of the progress of the White Pass Road, the Copper River project has been allowed to rest owing to the recent report of rich discoveries on the Christiechina, a branch of the Copper River, by Melvin Dempsey, a Colorado miner, the railroad project is again being revived. This line is planned to run from Valdes, on Prince William's Sound, up Copper River and down Forty-Mile Creek to the Yukon, near Dawson.

Half a million dollars' worth of goods were lost last season at Nome in attempting to land them on the beach from the vessels out in the sea. At high tide steamers of light draught can lay alongside Nome in the river and on the seaside, but oceangoing vessels have to anchor off from shore, and goods are carried ashore in lighters. By the construction of the Nome & Port Safety Road, a distance of 100 miles along the beach, a harbor is reached with six to ten fathoms of water where oceangoing craft have ample room to load and discharge cargoes, and where docks are to be built for that purpose in connection with the railroad. The road will do an immense local business, the promoters say, in addition to the through traffic to Nome. Material for the road is on board the barge Skookum, built at Tacoma, and the largest barge on the Pacific. The extension to Wild Goose Mines will be built this season, and an extension to Cape York, or in that direction, is promised.

The Nome and Southern Road, a preliminary survey or reconnoissance for which was made this Spring, is considered a certainty, if the Nome goldfields turn out anywhere near as rich as they promise. This line would put Nome in communication with the outside world at all times of the year, and when it is remembered that Bering Sea is full of ice from October to June, and sometimes is only open three months in the year, the importance of this project is apparent.

The New York Times
Published: June 17, 1900
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Unalaska Meeting, Aug. 24, 2011

<TARGET><BILL></BILL><SUBJECT>Unalaska Meeting, August 24, 2011</SUBJECT><COMM>ANW27</COMM></TARGET>

NWTF Meeting

Unalaska

August 24th, 2011

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AK Marine Pilots – CPT Carter Whalen

4 Arctic Salvage Operations
Magone Salvage – Dan Magone

5 Law of the Sea Convention
US Coast Guard – Rear Admiral Kenny

6 Bering Sea Fisheries Overview
Citv of Unalaska – Frank Ketlev

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AVERY® READY INDEX® 600087

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Agenda

Alaska Northern Waters Task Force (ANWTF)
Agenda for Unalaska: August 24, 2011
Grand Aleutians Hotel

August 24thth, Wednesday, Grand Aleutians Hotel

Presenters on the following Arctic fishing and shipping topics:

- **8:30 to 9 a.m. Presentation by U.S. Coast Guard on Arctic Summer Operations: Rear Admiral Ostebo, United States Coast Guard 17th District**
- **9 to 9:30 a.m. Presentation by City of Unalaska on Aleutian Islands Risk Assessment, emergency towing systems, and the mooring buoy project: Shirley Marquardt, Mayor of Unalaska**
- **9:30 to 10 a.m. Presentation by Alaska Marine Pilots on pilotage in Arctic waters: Captain Carter Whalen, Alaska Marine Pilots**

-15 minute break-

- **10:15 to 10:45 a.m. Presentation on Arctic salvage operations: Dan Magone, Owner Magone Salvage**
- **10:45 to 11:30 a.m. Presentation by U.S. Coast Guard on United Nations Convention on Law of the Seas: Rear Admiral Kenny, Judge Advocate General and Chief Counsel, U.S. Coast Guard**

Lunch break from 11:30 to 1 p.m.

- **1:00 to 1:30 p.m. Presentation on the Arctic's Future: Senator Lisa Murkowski**
- **1:30 to 2 p.m. Presentation on Bering Sea Fisheries: Frank Kelty, Natural Resource Analyst, City of Unalaska**
- **2 to 3:00 p.m. Presentation on Development and Implementation of an Arctic Fishery Management Plan: Steve MacLean, North Pacific Fisheries Management Council, Protected Species Coordinator and Fisheries Analyst**
- **3 to 3:30 p.m. Presentation on Arctic fisheries research: University of Alaska, Gordon Kruse, President's Professor of Fisheries, School of Fisheries Division**

- 3:30 to 4 p.m. Presentation on invasive species and border control: Jeffrey J. Lisius, Assistant Port Director Trade
- 4:00-5:30 p.m. Presentation by Rep. Edgmon on Northern Waters Task Force followed by public testimony on Northern Waters Issues

Legislative Fly-In August 25-27th

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Presenters

NORTHERN WATERS TASK FORCE PRESENTERS
AUGUST 24, 2011
DUTCH HARBOR, ALASKA

REAR ADMIRAL OSTEBO, UNITED STATES COAST GUARD 17TH DISTRICT

Rear Admiral Thomas P. Ostebo assumed the duties as the Commander, Seventeenth Coast Guard District in May 2011. He is responsible for all Coast Guard Operations throughout Alaska which includes protecting life and property, enforcing federal laws and treaties, preserving the living marine resources, and promoting national security. Headquartered in Juneau, AK, the Seventeenth District includes portions of the North Pacific Ocean, Arctic Ocean, and Bering Sea. As the Commander, U.S. Naval Forces Alaska, he provides operationally ready maritime forces to both Coast Guard and Department of Defense Commanders for Coast Guard, joint, and interagency operations both domestically and internationally.

In his previous assignment, Rear Admiral Ostebo was the Coast Guard's Assistant Commandant for Engineering and Logistics (CG-4). He was responsible for all naval, civil, aeronautical, and industrial engineering and logistics for the Coast Guard's $25 billion capital plant which includes 23,000 facilities, 230 ships, 1,800 boats, and 200 aircraft. RADM Ostebo is responsible for executing an annual budget of $1 billion and leading 2,200 personnel at Coast Guard Headquarters and three major Headquarters commands.

Rear Admiral Ostebo's other assignments include Executive Assistant to the Commandant of the Coast Guard, Executive Assistant to the Chief of Coast Guard Operations, Commanding Officer of Air Stations Cape Cod and Traverse City, and Chief Aeronautical Engineering Officer at Air Station Clearwater, Florida and Air Station Sitka, Alaska. He has also served as Chief of Inventory, Logistics, and Finance at the Coast Guard's largest industrial depot, the Aircraft Repair and Supply Center, in Elizabeth City, North Carolina and as First Lieutenant aboard USCGC ACTIVE in New Castle, New Hampshire.

Rear Admiral Ostebo completed Naval Flight Training in 1984 in Pensacola, Florida and completed tours of duty at CGAS Cape Cod, CGAS Sitka, CGAS Clearwater, CGAS Traverse City, and the CG Aircraft Repair and Supply Center. During this time, he flew 4,000 flight hours, attained qualifications on the HH-3F, HH-60J, HC-130H, HH-65A/B and the HU-25, and qualified as an Aircraft Commander and Instructor Pilot. Admiral Ostebo also completed his Civilian Airline Transport Rating and Airframe and Power Plant Authorization.

A native of Kings Park, New York, Admiral Ostebo graduated from the U.S. Coast Guard Academy in 1981 with a Bachelors of Science in Mathematics and Computer Science. In 1993, Admiral Ostebo earned a Master of Science in Industrial Administration from Purdue University's Krannert School of Business. He has completed a Senior Fellowship in National Security at Harvard University in 2002 and a Senior Fellowship at the Naval War College in 2005. Additionally, he has earned a Program Manager Level III Certification in Acquisitions and a Program Manager Level I Certification in Logistics. Admiral Ostebo was promoted to flag rank in July 2008.

His military decorations include two Legions of Merit, the Distinguished Flying Cross, three Meritorious Service Medals, two CG Commendation Medals, and the CG Achievement Medal

SHIRLEY MARQUARDT, MAYOR OF UNALASKA

I came to Unalaska in 1980 for the summer, fell in love with the people and the lifestyle, and never left. I worked in seafood shore plants and on offshore factory vessels for the first 10 years and then moved to the surface transportation and fishing logistics field for the last 20. I have been employed by Samson Tug and Barge for the last 17 while raising daughter Emma and son Rex with my patient husband Bob. I was first elected to the City Council in 1994 and served in that capacity until being elected Mayor in 2004. I currently serve as a member of MTAB, as a

member of the Aleutian Islands Risk Assessment Advisory Panel, as a member of the American Seafoods Community Advisory Board, as the President of the Unalaska Senior Citizen's, as President of the SWAMC Board of Directors, and as the incoming 2012 President of the Alaska Municipal League. In my spare time I take long hikes with my dog Shadow, and experiment in the kitchen. I choose to stay busy, because if I don't', I will just be tired and chubby.

CAPTAIN CARTER WHALEN, ALASKA MARINE PILOTS

Captain Carter Whalen is the President of Alaska Marine Pilots and works as a licensed state pilot in the waters of Western Alaska. Carter has been affiliated with the Alaska Marine Pilots for 9 years. Prior to joining the Alaska Marine Pilots, Carter worked in the service of the state as a licensed Federal pilot with the Alaska Marine Highway for 7years.

Born in Ketchikan Alaska, Carter attended the Massachusetts Maritime Academy graduating with a degree in marine transportation. Earning his Master mariners license by the age of 27, Carter has worked all but one year of his 16 years going to sea in Alaskan waters.

DAN MAGONE, MAGONE SALVAGE

Mr. Magone has been a small business entrepreneur since his early childhood. As an avid teenage sport diver his first career inspiration was to become a commercial deep sea diver. To this end he completed a six month course in Wilmington, California and went directly to work in the Gulf of Mexico on oil rigs and pipelines.

He started his own company in California in 1974 and gradually built up a clientele of fishing vessels doing welding, machine work and underwater repairs. In 1978 he was called to Dutch Harbor to repair a rudder on a king crabber and seeing an opportunity moved to Dutch in February of 1979 with the dream of building a shipyard. Magone Marine evolved from there.

In 1980 Magone Marine Service was incorporated in the State of Alaska with Mr. Magone as President, operations manager and principle stockholder along with his wife Sue. Today the shipyard acts as a base for Magone salvage vessels, barges and cranes that are also utilized in construction and logistical support of contractors operating in remote areas within a 1,000 mile radius of Dutch Harbor. Since 1991 Magone Marine has been an independent oil spill response contractor in Dutch and has been a Basic Ordering Agreement contractor for the USCG since 1993. Because of the versatility of the company, annual revenues are over $5,000,000 and the company employs over 40 trades people and operators.

Accreditations: Commercial diving certificate from Commercial Diving Center (now the College of Oceaneering) 1971. Explosives handlers' license for the State of Alaska since 1990. Underwater welding certification to AWS standards, HAZWOPER, incident command and controlled use pesticide certificates (to control rats from shipwrecks).

Education/Training: After graduating from high school in 1970 Mr. Magone attended the Commercial Diving Center in Wilmington, California and graduated in 1971. Other than a welding course at the same time, that was the end of formal education. In recent years Mr. Magone has brought trainers in from the mainland for himself and crew to maintain certificates required by OSHA for normal shipyard safety and spill responder regulations. Mr.

Magone's expertise in marine operations and salvage is due to the experience gained working on the front lines for his entire career, with experienced people, studying on his own, and learning by figuring out what works.

Accomplishments: In 1998 and 1999 Mr. Magone received Public Service Commendations from the USCG Commander of the 17th District for his company's response to the Kuroshima and Hekifu incidents. Marine salvage is somewhat glamorous to the world at large and Mr. Magone is mostly know for over 60 significant marine salvage operations in western Alaskan waters that he personally directed plus a number of others where his company was the subcontractor. His most significant accomplishment is surviving in business and by the grace of God having the faith to get up every morning and keep trying.

General: Mr. Magone's normal job duties include job planning, estimating, job managing, report writing, permitting, mechanical drawing, supervising the dive team, directing the vessel crews and marine operations. He has the support of his wife, his shipyard operations manager that takes care of the day to day shipyard work and an in-house Controller and staff to keep the office functioning during his frequent offsite operations.

REAR ADMIRAL KENNEY

Rear Admiral Kenney serves as Judge Advocate General and Chief Counsel of the Coast Guard, responsible for the delivery of all legal services in support of the Coast Guard's missions, its units and its people. He leads a dedicated, agile corps of legal professionals, including 184 military attorneys, 92 civilian attorneys and 87 legal support personnel. He was commissioned in 1981 after graduating from Officer Candidate School. He is a graduate of Michigan State University and the University of San Francisco School of Law, where he served as Editor-in-Chief of the *Maritime Law Journal*.

Rear Admiral Kenney's other legal assignments include duty as Chief of the Office of Maritime and International Law, Washington, DC, where he was the head of the United States delegation to the International Maritime Organization's Legal Committee and an appellate judge on the Coast Guard Court of Criminal Appeals; Executive Assistant and Chief of the Coast Guard's Office of Legal Policy and Program Development, Staff Judge Advocate, First Coast Guard District, Boston, MA; Coast Guard Liaison Officer to the Office of Oceans Affairs, U.S. Department of State, Chief of the Marine Safety and Environmental Protection Law Branch in the Office of Maritime and International Law; and Assistant Legal Officer, First Coast Guard District.

Operational assignments include service as Commanding Officer of Coast Guard Pacific Area Tactical Law Enforcement Team, San Diego, CA; Officer in Charge, Coast Guard Law Enforcement Detachment, Alameda, CA; and First Lieutenant and Operations Officer aboard Coast Guard Cutter WESTWIND, a polar icebreaker. Extended temporary operations assignments include duty as Senior Coast Guard Officer, Allied Forces Southern Europe, and in the Office of Law Enforcement, Seventh Coast Guard District, Miami, FL.

Rear Admiral Kenney's decorations include the Legion of Merit (three awards), the Defense Meritorious Service Medal, the Coast Guard Meritorious Service Medal with Operational Distinguishing Device (three awards), the Coast Guard Commendation Medal with Operational Distinguishing Device (two awards), the Coast Guard Achievement Medal and the NATO Medal. Non-military awards include the U.S. Environmental Protection Agency's Gold Medal, the Department of State Superior Honor Award, and the Department of Justice Certificate of Commendation.

Rear Admiral Kenney is a member of the bars of the State of California, the Court of Appeals for the Armed Forces, and the U.S. Supreme Court. He and his wife, Cassi, reside in Washington, DC. They have two college-age daughters, Elizabeth and Charlotte.

FRANK KELTY, NATURAL RESOURCE ANALYST, CITY OF UNALASKA

Professional Achievements:

Frank Kelty has lived and worked in Alaska for 41 years, almost all of that time has been spent in the Aleutian Islands in Unalaska, Alaska. During his working career Frank spent 30 years working in the Alaska seafood industry with two shore-based companies where he rose to the rank of plant manager at both operations and over-saw the production millions of pounds of crab, cod and other species. In December of 2000 Frank left the seafood industry to work full time for the City of Unalaska as their Fisheries Resource Analyst.

Community Achievements:

Frank became involved with city government in the early 1980's and served three terms as a city councilman; in 1991 he was elected Mayor of Unalaska and was reelected four times served ten years before resigning in December 2000 to begin his new full time fisheries position with the City of Unalaska. During Franks ten years as Mayor, he was a strong proponent of quality of life upgrades in the community, the city completed projects well in excess of 100 million dollars, they include new city hall, community center, museum, library, public works facility, road paving and harbor expansions.

In addition under Frank's leadership the City took strong positions in fishery issues, supporting rationalization programs for both the Bering Sea Pollock and Crab Rationalization Plan.

Throughout the years Frank, has also been involved with many other boards and commissions in Southwest Alaska, he was appointed by two Governors and served six years on the State of Alaska Coastal Policy Council. Frank served two terms as President of the Southwest Alaska Municipal Conference and has been a board member for ten years, this organization promotes responsible economic development an opportunities for the people of Southwest Alaska. Currently Frank is Chairman of the Board of Directors of the Aleutian West Coastal Resource Service Area, which is a part of the State of Alaska Coastal Zone Management Program. Frank is a former President and a current board member of the Marine Conservation Alliance and alliance of harvesters, processors, fishery associations and fishery dependant communities, that promote the conservation and sustainable use of the marine resources in the North Pacific by supporting a sound science based policy. He has also Chairman the local Fish & Game Advisory Committee, and has served on the local AC committee for over 25 years. Frank, also just completed serving six years on the North Pacific Research Board, Advisory Panel. Frank is married to Nancy Kelty and they one daughter and three granddaughters who all live in Unalaska.

U.S. SENATOR LISA MURKOWSKI (R – ALASKA)

Senator Lisa Murkowski is the first Alaskan born Senator and only the sixth United States Senator to serve the state. The state's senior senator, Lisa Murkowski is a third generation Alaskan, born in Ketchikan and raised in towns across the state: Wrangell, Juneau, Fairbanks and Anchorage. Since joining the Senate in 2002, Senator Murkowski has been a strong advocate for Alaska on the important issues facing the state, including energy, health care, education, military/veterans' affairs and infrastructure development.

Only the 33rd female to serve in the United States Senate since its founding in 1789, Senator Murkowski has assumed leadership roles quickly. She is the senior Republican member of the Senate Energy and Natural Resources Committee and also serves on the Senate Appropriations Committee, where she is the ranking Republican of the Interior and Environment Subcommittee. Senator Murkowski is a member of the Senate Health,

Education, Labor and Pensions Committee -- the first Alaskan to serve on that panel – and also is a senior member of the Senate Indian Affairs Committee.

She earned a B.A. in economics from Georgetown University in 1980 and a law degree from Willamette University in 1985. Prior to her appointment to the United States Senate, Senator Murkowski practiced commercial law in Anchorage and served three terms in the Alaska State House of Representatives. She was elected to a full six-year U.S. Senate term in 2004, and was re-elected in 2010 in a historic write-in campaign, the first successful write-in effort to the Senate since 1954.

Senator Murkowski is married to Verne Martell and they have two sons. She enjoys spending time with her family in the Alaska outdoors.

Brief Biography:
Senator Lisa Murkowski
Born: Ketchikan, AK
Husband: Verne Martell
Children: Two sons, Nicolas and Matt

Education:
High School: Monroe High School, Fairbanks, AK
Economics Degree, Georgetown University
Juris Doctor, Willamette College of Law

Senate Committee Assignments:
- Ranking Member of the Senate Energy and Natural Resources Committee
- Member of the Senate Appropriations Committee
  - Ranking Member of Interior-Environment Subcommittee
- Member of the Senate Health, Education, Labor & Pensions Committee
- Member of the Senate Indian Affairs Committee

STEVEN MACLEAN, NORTH PACIFIC FISHERIES MANAGEMENT COUNCIL, PROTECTED SPECIES COODINATOR AND FISHERIES ANALYST

Stephen Ahgeak MacLean is the Protected Species Coordinator and Fishery Analyst for the North Pacific Fishery Management Council. Steve joined the Council staff in May, 2011. Before joining the Council staff, Steve spent six years as the Bering Sea and Polar Marine Program Director for The Nature Conservancy where he worked closely with Bering Sea commercial fishing interests to reduce potential impacts to protected species and habitat. Steve has also worked for a private ecological consulting firm and State and University wildlife management departments. Steve has extensive experience living and working in rural Alaska. Steve received a Bachelor of Arts degree in Biology from Whitman College in Walla Walla, Washington and a Master of Science degree in Wildlife

and Fisheries Sciences from Texas A&M University. Steve's MS thesis concerned the occurrence, behavior, and genetic diversity of bowhead whales in the Sea of Okhotsk in the Russian far east.

GORDON KRUSE, UNIVERSITY OF ALASKA, PRESIDENT'S PROFESSOR OF FISHERIES

Dr. Gordon Kruse is the President's Professor of Fisheries at the School of Fisheries and Ocean Sciences (Juneau Center), University of Alaska Fairbanks. He earned his B.S. in Biomathematics from Rutgers University and M.S. and Ph.D. in Fisheries from Oregon State University. Prior to joining UAF in 2001, he worked for 16 years with the Alaska Department of Fish and Game, where he headed their marine fisheries research program. For the past 26 years, Gordon has conducted a wide variety of applied fishery research in Alaska involving a variety of species such as king and Tanner crabs, scallops, shrimp, sea cucumbers, pollock, herring, and spiny dogfish. His research focuses on stock assessments, population dynamics, fishery oceanography, and fishery management. He has mentored 16 current and former masters and doctoral students and teaches courses in fisheries management, marine ecosystems, and other topics. Among his many external activities, he is a long-term member of the Scientific and Statistical Committee that provides scientific advice on federal fishery management to the North Pacific Fishery Management Council and he is vice-chairman of the Fishery Science Committee for the North Pacific Marine Science Organization (PICES), an international marine science organization involving Pacific Rim countries.

JEFFREY J. LISIUS, ASSISTANT PORT DIRECTOR TRADE, US CUSTOMS

Jeffrey Lisius started his federal career in 1986 with the U. S. Navy. After his discharge in 1994 he accepted a position with the United States Customs Service in 1995.

Jeff worked as a U.S. Customs Inspector at the Port of Entry in Blaine, WA until September 1999. From there he moved to the Progreso, TX Port Of Entry as a Journeyman Inspector. In 2000, he became the Chief Steward of the Nation Treasury Employees Union (NTEU) and served in that position until May of 2002.

In 2002, he accepted an appointment to the Customs Academy and was detailed to the Federal Law Enforcement Training Center (FLETC) as a Physical Techniques Department Instructor/Course Developer (PTD CD/I). In this position he assisted with the merger of U.S. Customs, Immigration and Naturalization Service, Border Patrol, and U.S. Agriculture and the creation of U.S. Customs and Border Protection. Jeff assisted with the development of the new national Office of Field Operation Academy for CBP. He was also instrumental in the development of the CBP Baton and Oleo Resin Caspian Spray (OC Spray) training and policy. After four years as a PTD CD/I he moved to the academic side of the academy as a CBP CD/I. There he taught new and advanced officers, Title 8 and Title 19 law, use of force, and IT systems such as TECS, IDENT, NSEERS, and USVISITS.

While assigned to the OFO Academy, Jeff was selected to open the Container Security Initiative office in Liverpool U.K. He stood up the office and served as the team leader for five months in a TDY capacity. He was also selected to serve as a special advisor to the Narcotics Affairs Sector of the United States Embassy in Peru. While there, he instructed the Peruvian Customs agents in seaport enforcement operations and the use of Non-Intrusive Inspection (NII) devices, both small and large scale.

Jeff volunteered and was selected for the collateral duty of coordinator for the CBP Agriculture Academy located in Frederick, Maryland. He oversaw all CBP course material and maintained all administrative functions from 2006 until 2008.

In August of 2008, Jeff was selected to his current position as the Assistant Area Port Director Trade for the Area Port of Anchorage, Alaska. He is responsible for all trade activities within the state. He has direct over sight of the fifth largest commercial airport in the world, two express consignment hubs (FedEx and UPS), trade operations at ten seaports, three airports, three land border ports, two seasonal ports, and one pre-clearance port. He also has direct oversight of the Agricultural Specialist, the Fines Penalties and Forfeiture, Entry, and Import Specialist branches.

Jeff is married to his wife of two years, Kim, and has two children, Rachael, twenty and, Steven, nineteen. Jeff and Kim also share the joys and responsibility of raising their granddaughter, Rhylie.

REPRESENTATIVE BRYCE EDGMON

Representative Bryce Edgmon was born and raised in Dillingham, where he fished commercially for salmon and herring for more than twenty years. He has also worked as the Community Development Quota Manager for the Department of Commerce, Community & Economic Development and is a former Chief Operating Officer for the Bristol Bay Economic Development Corporation.

Presently, the representative is Chairman of the Board of Choggiung Ltd., the Alaska Native village corporation for Dillingham, Ekuk, and Portage Creek.

A legislator since January 2007, Rep. Edgmon is presently seated on the House Finance Committee, with chairmanships of the Department of Transportation and Department of Corrections Budget Subcommittees. In the 26th Legislature, he was Chairman of the House Special Committee on Fisheries and Co-Chair of the House Energy Committee. Additionally, he has served on the Resources and Education standing committees and the ADF&G, Revenue, CCED, and Transportation budget subcommittees.

Rep. Edgmon's experience also includes service at the Legislature prior to holding elected office, in staff positions for a number of lawmakers representing coastal communities across Western Alaska.

Throughout his career, the representative has worked to foster the responsible development of economic opportunities in his district and beyond while also promoting conscientious stewardship of our natural resources. He has also been effective in bringing infrastructure projects to Southwest Alaska that meet crucial immediate needs at the same time they become valuable investments in the region's future.

He lives with his wife Melody and their son Evan and daughter Emma in Dillingham.

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Comments of Captain Carter Whalen AK Marine Pilots

ALASKA MARINE PILOTS LLC
P.O. Box 920226 - Dutch Harbor, AK 99692
Office (907)581-1240 - Fax (907)581-1372
www.alaskamarinepilots.com

To be good Stewards over the waters which we are licensed to protect

Comments of Captain Carter Whalen, President, Alaska Marine Pilots to the members of the NWTF at the Grand Aleutian Hotel Dutch Harbor Alaska, Made on 8/24/2011

Good morning, my name is Carter Whalen and I am the president of Alaska Marine Pilots (AMP). First off, I'd like to thank you for inviting me to speak here today. My purpose in speaking here this morning is to introduce my organization (AMP) and to briefly

- Describe the profession of piloting
- Talk about AMP and the specific regional service we provide
- Discuss how we can help with respect to the increased ship traffic in our Northern Waters

AMP is the regional pilotage organization responsible for providing pilotage services in Western Alaska. Our pilotage district spans West of Kodiak Island out to the end of the Aleutian Islands and North to the Canadian Arctic border. Our mandate by law is "To protect life, property, and the marine environment."

Compulsory pilots are advisors whose sole responsibility is to ensure the safe conduct of all vessels operating within the confines of a state's designated pilotage waters. Pilots are able to do this because we possess intimate local knowledge for the region in which we're licensed. This knowledge of local waters and geography, combined with extensive training and experience specific to the safe and responsible conduct of ships are put to use on a variety of ship types in a variety of conditions in our effort to mitigate the posed risks to Alaska's coastal waters and coastlines.

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Within the various pilotage systems spread around the world there are two types of marine pilots. They are: compulsory marine pilots and non-compulsory or volunteer marine pilots. In the context of what is about to take place in the Arctic, it's important that you understand the primary difference between the two, which is: the compulsory marine pilot has accountability to the state he works in whereas the volunteer marine pilot has accountability only to the company that employs him or her. In Alaska we have compulsory marine pilotage. Under state law an Alaskan pilot is not allowed to be an employee of a steamship company and the reason for that is he or she remains outside the steamship company's economic control. This arrangement insures independent third regulatory oversight and stands in stark contrast to the volunteer pilot who is simply another employee of the shipping owner and as such is subject to his company's bottom line. Because of this relationship the volunteer pilot's ability to focus and act purely on safety is compromised from the beginning.

In summary, compulsory pilotage is not about response, it's about prevention. To sound cliché' "An ounce of prevention is worth a pound of cure.

At present AMP have ten members with varied backgrounds that hail from all sectors of the maritime industry. My personal background began when I was born in Ketchikan Alaska, raised on an Island in Washington State, and graduated from Massachusetts Maritime Academy with a degree in Marine Transportation. I've been going to sea for close to twenty years with fifteen of those years spent sailing in Alaskan waters as a pilot, aboard the Alaskan Marine Highway, and aboard tow boats.

What makes piloting in Western Alaska both unique and challenging is the sheer size and unconventional nature of the geography combined with a lack of infrastructure.

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For the past twenty years the primary economic engine of our pilotage district **has been** the fishing industry. I say **has been** because with the rapidly receding ice pack in the arctic coupled with the oil industries plans for drilling operations in the US Arctic OCS we believe that engine is about to change.

With this change there will not only be new opportunities but new risks as well. Since Risk mitigation is our business, it is our responsibility to be involved in any new shipping activities which take place in our region that pose risk to that which we are mandated to protect. AMP's involvement with the anticipated offshore shipping activities in the Arctic began almost five years ago in the summer of 2007 with the arrival of a drill ship and other support vessels in Dutch Harbor. Considering the size and scope of the intended operation, we asked ourselves, "If it's not safe to do this sort of operation inside of three miles without a pilot then why is it safe to conduct these sort of operations outside of three miles absent an independent state licensed marine pilot?"

Our answer was, and remains, "It's not"

How we can help in the Arctic

At present the Arctic has only a three-mile protective covering of state mandated pilotage. Outside this thin, three-mile boundary are volunteer pilotage waters. To date we have asked the state to consider the expansion of compulsory pilotage into the unregulated / offshore waters of the Arctic to cover the areas of recent federal oil and gas leases. Predictably, the extension of compulsory marine pilotage has met stiff resistance from industry.

This campaign continues to encounter significant opposition from both industry and the state of Alaska, yet as unpopular as our position may be we continue to maintain the position that independent marine pilots in the

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Arctic would significantly contribute to preventing marine casualties in the OCS of the Arctic Ocean.

Now, having said this I believe it's important for me to share with all of you today that while our advocacy of arctic pilotage remains,

AMP no longer sits top dead center on this issue. In other words, over the course of the last five years we have come to recognize the fact that independent marine pilotage in the Arctic will not work without the cooperative effort of the oil industry. In other words, it's not a system that can be just "regulated" into being.

Some of the primary reasons for this are *logistics, a lack of infrastructure, and the sheer size and remoteness of the area.* I can not overstate that these hurdles are significant in nature and if pilotage is to become a component in the overall safety net that will be deployed in the Arctic, overcoming them will require a collaborative effort by all parties who have a vested interest in protecting the Arctic.

We believe such an undertaking should incorporate all available assets to set the standard of risk mitigation above and beyond in the interest of prevention and not just response. A cooperative effort, built around a strong sense of both respect and humility when considering the challenges and consequences.

AMP has grown into our existing region over twenty plus years.

Some examples of that growth would be our participation in developing and implementing an emergency towing system for rendering assistance to disabled vessels in and around Dutch Harbor and the Eastern Aleutians. This towing system serves as a protective shield designed to protect the community of Dutch Harbor from the numerous stricken and disabled vessels that transit through Unimak Pass each year.

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Our port parameters and severe weather guidelines serve to give definition to what we can and cannot do safely. The severe weather guidelines were developed cooperatively with the USCG. All of these serve as excellent examples of our commitment to safety.

This summer we've had several pilots working in the Arctic aboard eco cruise ships, ore ships, and a Crowley ATB delivering fuel to remote regions near Barrow.

With these examples in mind AMP put together an initial pilotage plan for the proposed 2011 drill season. With this plan, it was our hope that the oil industry would also be amicable to the adoption of these best industry practices and that this document would allow AMP to participate in what we had thought would be the first of many open water drilling seasons to come.

I have that document with me here today and will make it available to those of you who may be interested in reviewing its contents.

Over the years AMP has been successful in our efforts to protect Western Alaska's sensitive marine environment. This is due to the fact that we exercise conservative risk management. It is also due, in no small part, to the fact that we have taken the time to involve and work with the various community leaders in Western Alaska.

Considering all I've said here today I think on a number of levels it would be beneficial for all stakeholders in the Arctic if pilots were invited to provide an active presence not just inside this states current three mile limit but outside three miles as well. I encourage all of you to learn more about my profession so that you can make an informed and independent decision about the value of marine pilots in the arctic and how we might best help prevent tomorrows maritime casualty from becoming today's headlines.

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In closing I would offer this.

AMP's mission statement is:

"To be good stewards over the waters which we are licensed to protect."

And since those waters include the Arctic, we stand ready to help when and where we can. Having said that, the choice to use our particular expertise in the Arctic is left entirely up to you, industry, the state of Alaska, and last but not least, the publics good will.

Captain Carter Whalen
President
Alaska Marine Pilots

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Alaska Marine Pilots Arctic Pilotage Plan

A first year pilotage model designed specifically for the 2011 open water drilling season in the U.S. Arctic Ocean

FORMALLY SUBMITTED FOR CONSIDERATION BY ALASKA MARINE PILOTS LLC

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Alaska Marine Pilots (AMP) Pilotage Plan for Shell Oil's 2011 Open Water Exploration Season for the Beaufort and Chukchi Sea.

Introduction

This plan is based on Shell Oil's 2010 Outer Continental Shelf Lease Exploration plan(s) and as such may be amended as necessary for the 2011 drill season. Vessels identified as "high risk" carriers are the tanker *Affinity* (or vessel with similar liquid storage capacity) that will be staged near the prospect area of drilling operations. The second vessel taken into account is the proposed drill ship *Frontier Discovery*. When selecting vessels of "high risk", considerations taken into account were: vessel size, maneuverability, oil and fuel capacity, draft, ice classification / capabilities', and mission of craft. Normal and customary duties of the pilot have been listed. It should be noted however that this "list" is by no means fully descriptive and is only meant to provide a general overview of a pilot's responsibilities for those unfamiliar with a pilot's role.

2011 Pilotage Plan for Shell Oil's Arctic Exploration Fleet.

For the initial entry into the Arctic Ocean, AMP will board the tanker "*Affinity*" (or any other tanker being utilized for the purposes of lightering operations and / or spill response) and the drill ship *Frontier Discovery* (or any other drill ship being utilized for the purposes of oil exploration) at one of the designated pilot stations located in either Nome, Adak, or Dutch Harbor. Upon boarding, AMP will ride / pilot the vessel(s) through the Bering Straits to their designated anchoring positions in either the Chukchi or Bering Sea. After anchoring the vessel(s), AMP will disembark the tanker / drillship.

Upon completion of the drilling season and prior to vessel(s) southbound voyage from Arctic waters AMP will embark the tanker / drillship at their designated anchorage area and ride / pilot the vessel(s) until clear of the Bering Straits. After clearing the Straits, AMP will disembark at one of the above-mentioned pilotage stations. Due to Logistics and transportation availability it is understood AMP may not always be able to leave immediately after a maneuver or transit. Every effort will be made to secure the earliest possible transportation mode.

During Arctic operations the need to raise the anchor and maneuver is likely to occur. Good faith effort will be made to embark AMP for these maneuvers. Due to logistics and operational area it is understood that this may not always be possible but every effort will be made to board a pilot. During the course of the drilling season if the drill ship *Frontier Discovery* should be required to be maneuvered alongside the tanker (or vice versa) AMP will be embarked for such maneuvers.

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To accomplish the above AMP will utilize transportation services provided by Shell Oil which will include aircraft AW 139 or EC 255 along with personal / crew boats of suitable size and configuration. Furthermore, to be on station for such services AMP will position pilot(s) at one of Shell Oil's shore side operations center located at either at Wainwright or Barrow, Alaska.

Normal and customary duties of the pilot

Master / Pilot exchange to include: Master's written assurance that all appropriate pollution prevention measures have been complied with and that the vessel is not leaking any oil. Recommend also for Arctic operations the inclusion of certification / proof demonstrating that vessel has been vetted for Arctic operations by a responsible 3rd party. (e.g. the vessel agent, or the USCG, DEC or other regulatory entity)

Route planning

Ensure that all bridge, engine room, and deck equipment are in proper working order

Exchange of all pertinent information relating to the safe navigation of vessel over intended route.

Review of vessels operating / handling characteristics.

Conning the vessel(s) for all maneuvering, mooring, anchoring and transiting evolutions.

Provision of additional advice as needed / requested

Pilot Training

Prior to the 2011 drilling season all AMP pilots who are to be engaged on either the tanker or drill ship will take an ice management class similar in scope to *The Fundamentals of Ice Navigation* course conducted at Centre for Marine Simulation (CMS) Marine Institute St. John's NL. For the 2011 drill season Shell agrees to sponsor two AMP Pilots to attend such a class.

Conclusion

The above outlined procedures / services may be provided under either a memorandum of understanding between Shell Oil and AMP or through a federal permitting process

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and which shall be in place prior to the commencement of the 2011 drilling season. Upon completion of the 2011 drilling season AMP and Shell Oil will continue to refine and develop the above pilotage operations. The goal of this work will be to develop an independent and comprehensive system of marine pilotage that is both acceptable and accountable to the State of Alaska.

Respectfully Submitted,

Captain Peter S Garay
President
Alaska Marine Pilots, LLC

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Arctic Salvage Operations

ARCTIC SALVAGE OPERATIONS

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ARCTIC SALVAGE OPERATIONS

This discussion is intended to provide an overview of marine salvage methodology in the arctic and subarctic to promote the safe and effective means to conduct these operations based on the experience Magone Marine has had over the last three decades.

TRANSPORTATION

The arctic and subarctic coastal areas and seas are some of the most remote, least populated areas on the planet. Assisting a casualty or conducting extensive wreck removal operations require mobilizing and supporting personnel and equipment over great distances where challenging weather and environmental conditions are the norm.

Typically, emergency response to a vessel adrift, minor groundings and small vessel casualties would be handled directly by the nearest tug/salvage operator. When these casualties are too remote or complex and with vessels getting larger and regulatory requirements being what they are, it is more common for a national or international salvage contractor that has a salvage/lightering/firefighting contract in place with the Responsible Party to respond by mobilizing a small team by air directly to the casualty or to the nearest port with available support vessels.

VESSELS

I will not address the issue of tug classes required for arctic salvage work as that is a subject big enough for its own paper but I will address the various types of vessels that would be available and their applicability.

Salvage Vessels

Dedicated salvage vessels are specialized in that besides towing capacity, they have stowage for all the typical tools of the trade including beach gear, purchase tackle, grapple hook, chasing ring, Orvil hook, messenger, transfer and floating tow lines, tow bridles, line gun, davit mounted small boat, helicopter pad, immersion work suits, dive station, portable dewatering and lightering pumps and hoses, oil absorbent materials and PPE etc. as well as bunk space for a salvage crew and the vessel operating crew.

At present, there are not many dedicated salvage vessels in the world as a whole, let alone being available for immediate response in the arctic and even when a salvage vessel is available it will often need the support of other vessels so it is common to use vessels of opportunity for primary or support roles in a salvage operation.

Tugs And Barges

Barges of various types are typically available in most ports; they provide a very stable work platform and can quickly be loaded with large quantities of equipment and supplies. Mobil cranes, multiple point mooring winches and associated equipment can sometimes be found already set up on construction barges.

Tug and barge units are relatively slow when compared to unencumbered salvage vessels traveling at 5 to 7 knots typically in fair weather and much slower in rough weather. Barges under tow are vulnerable to heavy weather especially in strong currents and restricted waters. Barges onsite even on four point moorings are vulnerable to gales and sea ice so operational plans utilizing barges must be limited to appropriate weather windows and with consideration given as to the nearest safe port or mooring site.

One specialized barge utilizes "spuds", large heavy wall steel columns that pass through the hull and stake into the seafloor to locate the barge in position. This system will only work in the most protected waters since only a slight sea state will damage the spuds and or barge. A jack up barge or boat is similar but the columns are powered such that the entire hull is jacked up off the water. The great advantage with this is that the wave or surf action does not affect the hull of the vessel as it passes underneath. Although these units are common in the Gulf of Mexico, they are indeed rare to the northern waters and are slow and vulnerable in transit.

General Support Vessels

A useful workboat could be anything from coast guard buoy tender to a fishing boat with the more open deck space and cargo handling gear the better. An offshore supply vessel or OSV

with a deck crane is probably the best example of a workboat well suited to support a salvage operation with the large vessels providing the best platforms in potentially rough water.

Landing Crafts

A landing craft is a common workboat in the arctic with their shallow draft and tunnel hulls they can navigate the shallow rivers and approaches to coastal villages carrying supplies, equipment and fuel to land on beaches where there are no docks. On a salvage job they can be very useful attending a casualty aground in shallow water or landing equipment such as dozers or excavators on the beach. However when the summer is over they are hauled out or head south since they are not suited to fighting either gale weather or ice.

Accommodation Vessels

Although some salvage operations could take place in shallow coastal areas or even rivers, the long distances involved traveling to and from the north as well as weather considerations require a blue water type accommodation vessel. Examples would include converted deep sea fishing vessels, scientific research vessels and some icebreakers.

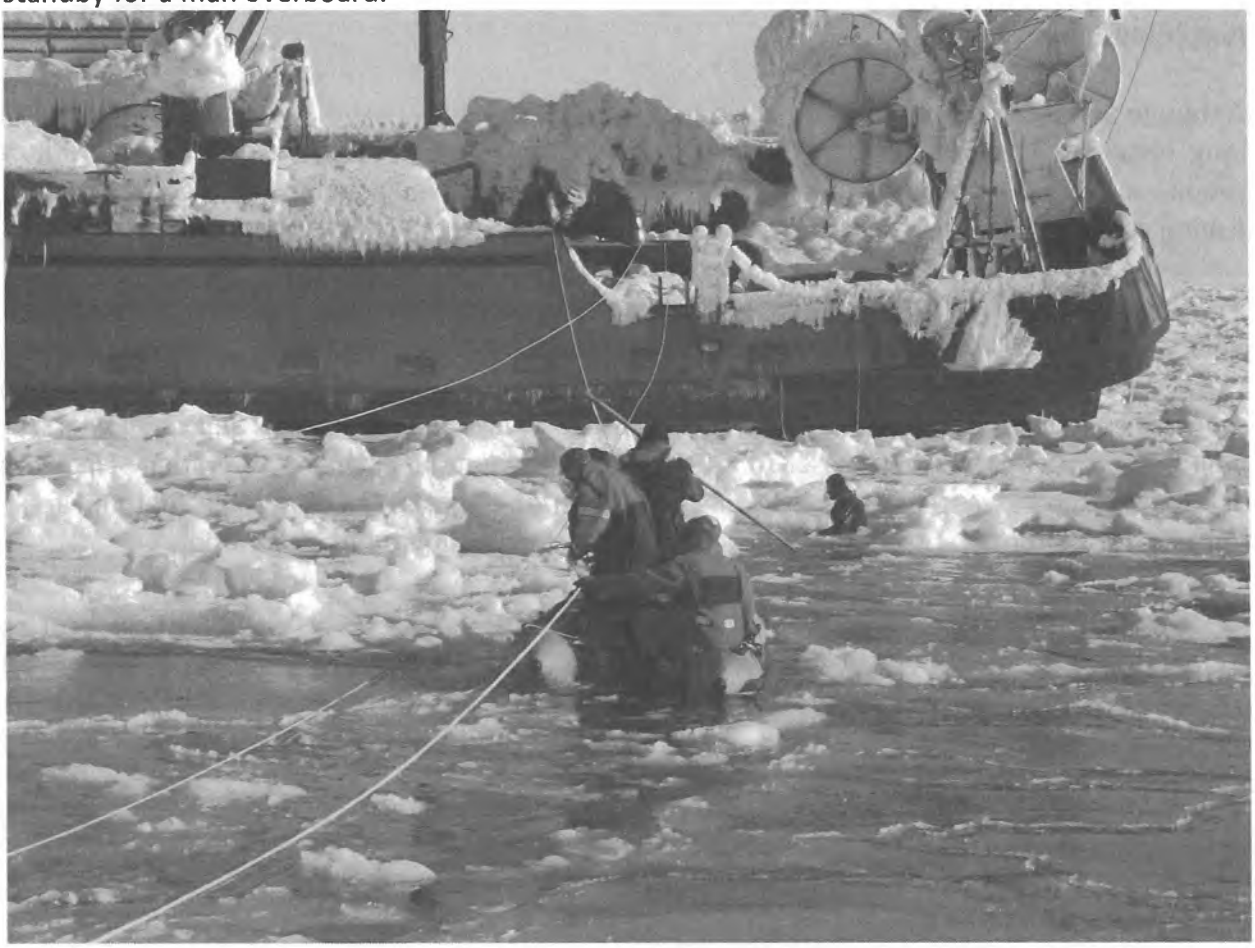
An example of a multiple vessel response in the far north would include one or more tugs for pulling, towing or handling the casualty. A tug and barge unit to provide crane and various support services. A workboat such as an oil field supply boat with a large open deck on which modular connex type units can be stowed for diving, salvage, pollution gear, and small boats, as well as an accommodation vessel to support the manning level of the operation. Finally, a suitable re-supply vessel for transporting materials, equipment and especially fuel and fresh water for the support vessels so they can stay on station throughout the operation.

Of course, if a group of vessels supporting a casualty are expected to operate in light to moderate sea ice conditions (heavy sea ice is not an option) then each vessel will need to meet ice class hull requirements, and possibly an icebreaker from the Coast Guard to support the operation.

Cargo stowage for arctic operations is very important since deck loads can be subjected to rolling in heavy weather, spray and freezing spray. Equipment and materials stowed on deck are best kept in "connex" shipping containers or sturdy watertight totes. Tarps can blow off and typical steel basket type equipment totes can turn into solid blocks of ice.

Small Boats

Small boat operations are an important component to most salvage and pollution response operations; these would include transporting personnel from the response vessels to the casualty, from one support vessel to another. To perform depth sounding and reconnoitering ops in shallow water, connecting messenger or floating tow lines to the casualty or as a safety standby for a man overboard.



The types of small boats are as varied as the tasks they perform. On one hand the largest small boat that the support vessel can safely and efficiently handle makes the most stable and efficient platform to handle personnel. On the other hand, if the boat needs to be pulled out on a beach or around, through, or up on over the sea ice, it needs to be light enough for personnel to handle.

Safety considerations for small boat ops in the arctic would include:

Dependability, if a boat motor shuts down you are immediately at risk. Clean moisture free fuel is essential. Water in fuel drums is the nemesis of small boats ops in the north. Water in the new 4-cycle fuel injected outboard motors will ruin injectors and effectively take the engine offline for the operation. In cold conditions, ice in the fuel can shut down an engine by blocking the fuel system anywhere between the fuel tank, the injectors or carburetors. It is essential that everything be done to protect the integrity of the small boat fuel supply.

A secondary small boat and operator is generally a requirement as a back up to recover the primary boat and personnel if it loses power, is swamped or mechanically damaged and as backup to the primary boat to prevent the stranding of a deployed salvage team.

Besides the applicability of the small boat design to the task, the types of operations that can be safely conducted depend solely on the skill and experience of the operator.

AVIATION

While the heavy lifting in Marine Salvage operations is carried out with various types of vessels, aviation is usually a component on various levels.

1. Mobilizing personnel from around the country by the big name scheduled airlines to the nearest port or air charter hub to the casualty.

2. The Charter of cargo aircraft to carry specialized equipment to the port where support vessels can be loaded.

3. Small fixed wing aircraft to transport personnel to small local airstrips or beaches on wheels or skies and floats for protected water landing.

4. Helicopters have a multitude of uses in salvage operations and are usually onsite to provide close air support.

Everyone who lives or operates in the north understands that flying is completely dependent on the weather. Fog, wind, blinding snow, darkness, and cloud cover frequently make flying conditions untenable. Salvage ops planning and operational expectations need to take this into consideration, the fact that flying can come to a sudden stop and stay that way for days. Back up plans that utilize surface craft or vehicles must be in place if any progress is to be made during unflyable conditions. When salvage teams are deployed by air the safety plan must include a plan to recover the team by surface vessel or other means to prevent them being stranded in a deteriorating circumstance. If a wreck is ashore and safe from breaking up it may simply mean having sleeping and survival gear on the casualty so they can wait out the weather and avoid undue risks in the surf or dangerous flying conditions.

One common problem at remote sites is adequate protection for aircraft that are kept near the operation. Without a hanger aircraft are subject to high winds so adequate tie downs are essential but damage can still be caused by flying debris, sand or gravel. Another problem with uncovered aircraft is icing, deicing in cold conditions is problematic to say the least therefore just having a helipad on a vessel is not adequate to support helicopter ops in cold weather, typically the USCG are the only ones set up for remote arctic helicopter ops with their hanger equipped cutters.

It is important when planning remote salvage operations to stow aircraft fuel on a salvage vessel for emergency use if not for planned operations. Of course the integrity of this fuel is even more important than was mentioned concerning small boat fuel.

As problematic as helicopter operations in north may be they are still a very important asset in many if not all complex salvage operations therefore the salvage contractor will often have a helicopter lined up and onsite. What can be the case is where pollution SCAT teams or other interested parties are in need of helicopter ops as well and while the salvage contractor may wish to cooperate there is a limit what they can do without compromising their main responsibility. We have seen where there is a serious shortage of helicopter time available for the tasks at hand so it is important for all parties to plan ahead and avoid being left in limbo.

Ground Transportation

This is the land of 4-wheel drive trucks, all terrain vehicles (ATV's) and snow machines. A Nodwell is one of several manufacturers of special tracked vehicles used like a truck to carry equipment over tundra, ice and snow.

EQUIPMENT OPERATION AND MAINTENANCE

The difference with operating equipment in the north is all about temperature, the colder it gets the more trouble you will have. Of course the large vessels will need to protect their cooling systems from freezing and deal with ice forming onboard but the real problems come with operating portable equipment at a wreck site.

As was previously mentioned small boat engines are susceptible to fuel problems in cold weather, which increases the exposure danger to personnel. These same fuel problems will plague any portable equipment if steps are not taken to insure the fuel is kept clean and moisture free.

Generators, hydraulic power pac's and the like can be difficult to start without oil pan heaters and without protection from freezing spray and heavy snow portable equipment can be rendered completely inoperable. Air control systems commonly found in crane and winch controls must be diligently protected from moisture in the air systems with the clutch and brake mechanisms on this type of equipment being prone to freezing solid from melting ice and snow between operations. Sometimes the only way to keep this kind of equipment available for use is to cover it with tarps with one or more diesel fired torpedo heaters blowing underneath.

By far the most troublesome equipment to operate in the cold is water pumps. The small diesel engines are hard to start and ice will quickly form in suction and discharge hoses soon after they are shut off. Thawing out the frozen hoses in freezing weather can be an exercise in futility so back up hoses need to be on hand. If the pump housing freezes it will crack the housing so it is good to have spare pumps, parts and replacement housings on hand.

PERSONAL PROTECTIVE EQUIPMENT

Of course PPE is an important and expensive aspect to all operational planning in the north when personnel are expected to work outside.

For small boat operations or any time personnel are working around open water a watertight immersion suit is required. Float coats, water resistant insulated overalls (Mustang suits) and PFD's in general are not designed to provide any thermal protection for someone in the water or wet out of the water.

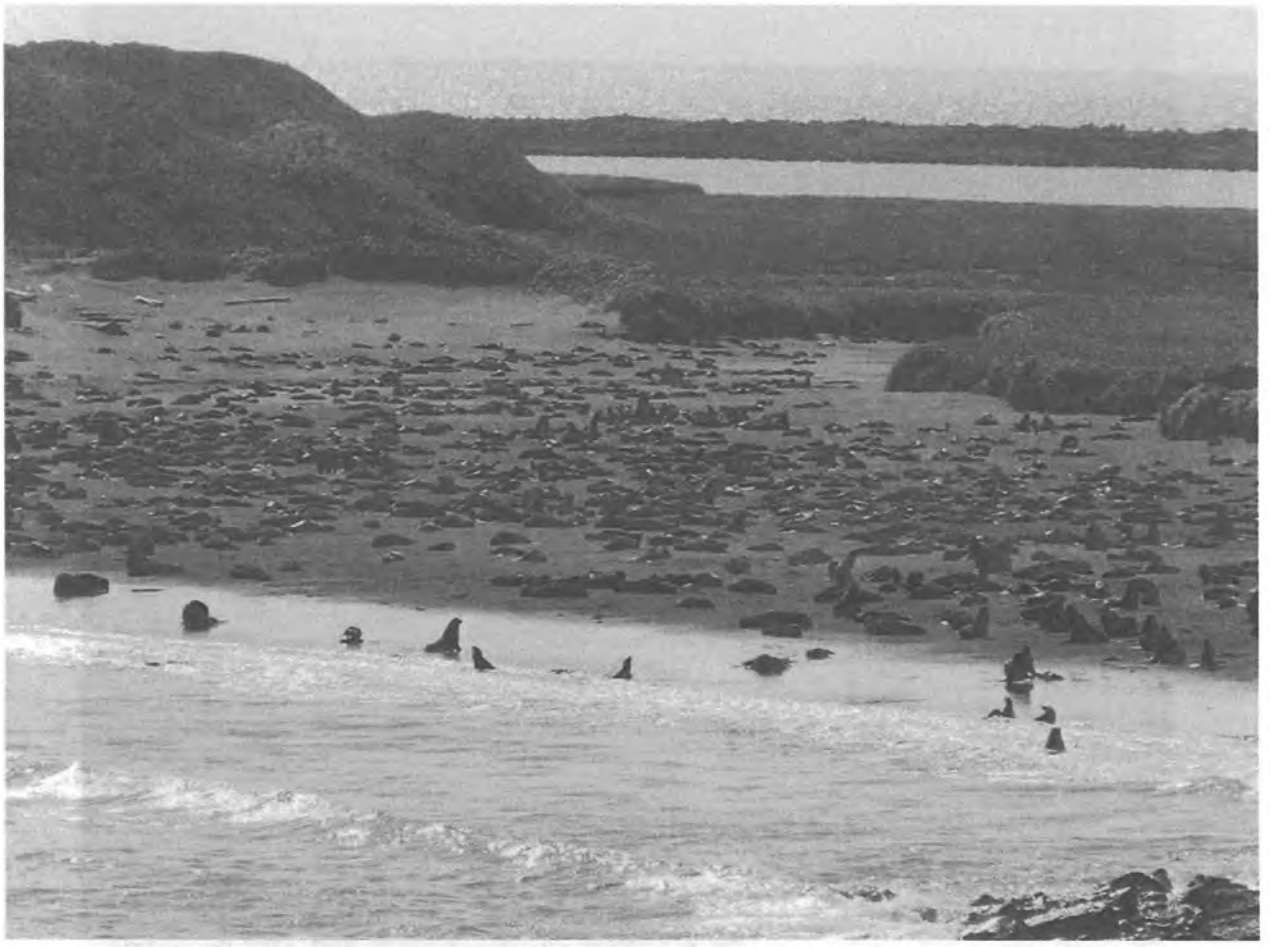
Lace up ankle fitting over boots with heels and drain holes are best for use with immersion suits since they protect the feet and help prevent ankle injuries. Thermal lined "Pac Boots" are best when it is cold and dry. Boot dryers and spare liners are a necessity.

Gloves are another important consideration, the type and design will depend on the temperature, wet or dry environment and the work that needs to be performed. Normally all salvage personnel will require a variety of gloves and spares on any job. Cases of chemical hand warmer packs are something we never leave home without.

Divers will of course need dry suits as a minimum for thermal protection but hot water suit systems will enable better production when there is extensive diving work. The down side of the hot water systems are their bulk and the challenge to keep hoses and heater units from freezing when shut down and the difficulty to thaw them out when they do. For this reason it is sometimes better to keep the equipment simple and make the dives shorter.

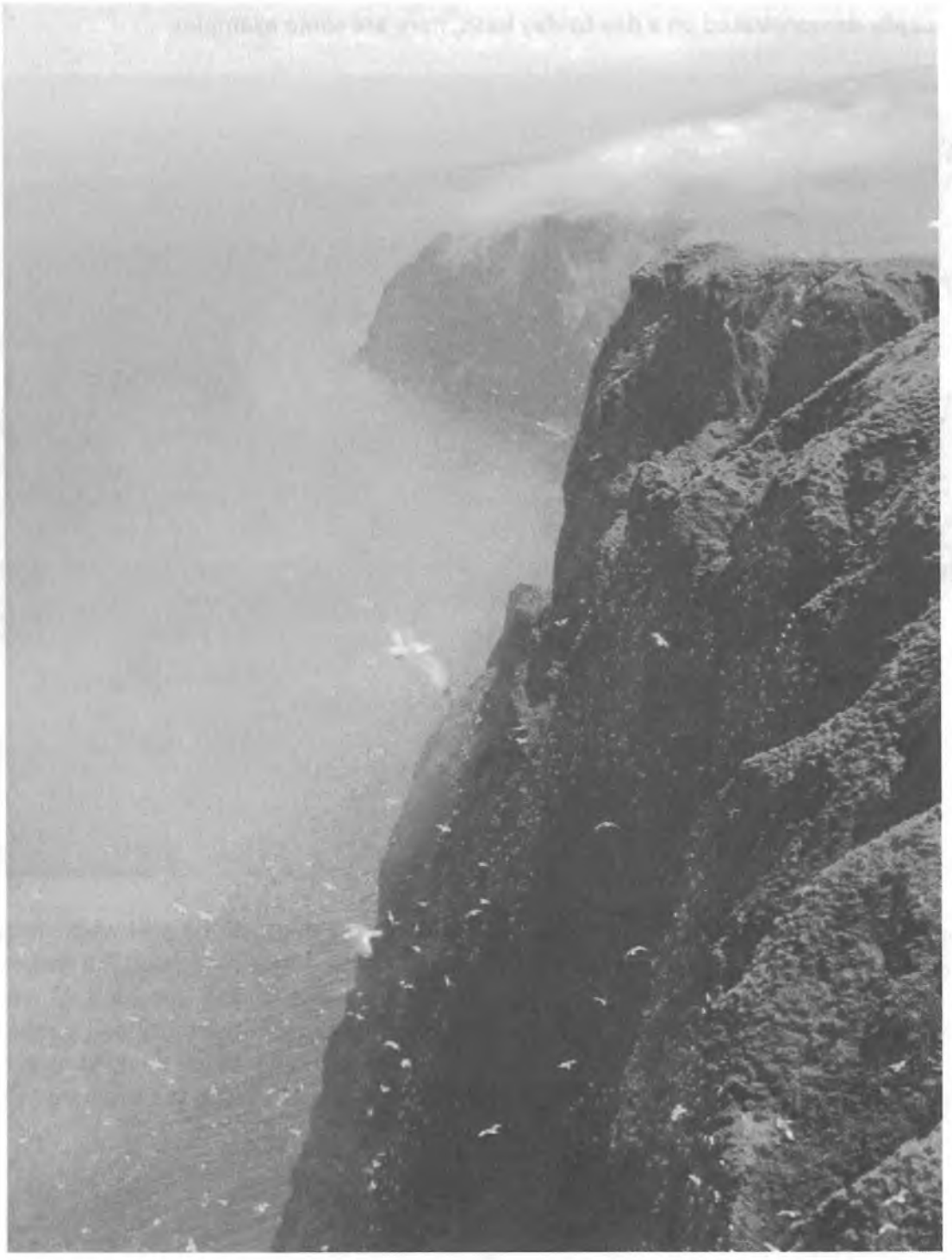
WILDLIFE

One of the rewards to working in the north and Alaska in particular is in observing the beauty of landscapes unaltered by man and the abundant wildlife found therein. As salvers our work is in defense of the environment and the wildlife that depends on the clean water and space they need to survive. There are few places on earth where the reasons for our effort are so dramatically demonstrated on a day-to-day basis, here are some examples.



We once found ourselves working a grounded trawler in the midst of the gray whale migration, with dozens of whales around us while scores of seals and sea lions consumed the thousands of fresh codfish we threw over to lighten the vessel. If the media had got wind of what was happening around us the hue and cry from the environmental community and public would have been a huge distraction considering we were already doing all we could to prevent the 130' vessel from breaking up in the next gale. Since we were successful the drama was kept to ourselves.

We performed an explosive demolition of a sunken factory trawler 15 miles south of Round Island one of the largest walrus haul outs in the world. Another time our task was to remove a 160' oil field supply boat with its bottom torn out and back broke in the middle of a 2 million strong seabird colony while they were nesting. By working with refuge managers and biologists operations like these are sometimes possible without causing undue stress to the wildlife.



Often though and especially in recent years it is getting harder and harder to find a consensus among the concerned parties that allows an operationally practical (at least cost effective) approach. So whether it is reasonable or not we are forced to do our work during the winter or early spring before breakup or moderating weather.

On the one hand we have the wildlife that is such a blessing to observe and our responsibility to protect and on the other the challenges of face-to-face encounters. From near misses with whales to the biggest bears in the world tearing up our gear and running us off the beach, a bull sea lion grabbing a diver on the ladder and throwing him through the air to tame arctic foxes that love to steal or just chew up your gear but in the summer the worst can be the mosquitoes.

So for all these kind of reasons wildlife issues are going to be an important part of any arctic salvage operational planning as well as crew training. For example vessel operators should be aware that their lights attract birds at night and to avoid mass bird strikes they may need to shut down all but essential navigational lighting. Beach crew personnel need a plan to keep food supplies bear proof and resist the temptation to feed the animals.

EMERGENCY MANAGEMENT

With the advent of OPA 90 and the Incident Command System that followed an efficient protocol has been established to manage emergency maritime incidents. The strength of this system is the organization it brings to the complex issues that arise when responding to a large vessel incident. This system does not in itself create sound, timely decision-making on scene and can if it is overly burdensome, even obstruct on scene operations.

There is no substitute for having an experienced salvage master on scene who has the authority to implement an appropriate response to the given situation and circumstances. A classic example of the failure to listen to the salvage master was the capsizing of the French liner Normandie at pier 88 in New York harbor.

Although there are many examples of things going well we tend to learn some of our most important lessons when things get out of control. Here are three examples of situations in my own experience that show the result of a lack in on scene leadership and control.

The M/V Swallow a 307' refrigerated cargo ship had run aground on Ulakta Head, a tug was dispatched to pull it free as an onshore gale was developing, a marine surveyor had come aboard and instructed the vessels master not to take the tow line since he was afraid of damage to the ships propeller if it struck a rock during the pulling operation. The result of the delay in making up the tow was the constructive total loss of the ship and a destructive heavy oil spill for the area.

The 378' "Reefer Ship" M/V Kuroshima was swept by huge wave while hauling in their anchors that killed two of their officers and injured a third. The ship was subsequently driven aground by the storm force winds. At dusk one of my men and I reached the ship by inflatable boat to

help the captain and assess the situation. One of the USCG 378' cutters was in port at the time with a helicopter and a large crew but with darkness falling, 20' seas, hurricane force winds, with driving snow and drops of heavy oil driving through the air, there was not much the coast guard equipment could do. So the cutter crew along with the local USCG Marine Safety Detachment and response teams from the police and port department converged on the scene using the local road system.

With hundreds of response personnel on the beach it was decided that the ship's crew could evacuate in the port lifeboat with a line to the beach and a line to the ship to keep it in the lee of the ship. The two deceased and one injured officer were placed in the lifeboat with 17 other crewmembers and the boat was lowered to just above the wave tops. I unsuccessfully argued that the line attached from the lifeboats bow be drawn in by the men on the beach and instead it was connected to a loader on the road that we could not see. The loader operator was supposedly given a radio to communicate with us on the ship but instead they just started pulling and never responded to our calls to stop. The result was that the lifeboat was pulled away from the ships side until the line broke just as the boat touched a wave top and the crew cut loose the falls. With the line gone on the bow the lifeboat was immediately sucked out with the wave behind the ship and into the huge breaking surf. The lifeboat was eventually recovered and pulled up onshore but what should have been a safe and simple operation became for a time a terrifying and life-threatening situation for the lack of a strong designated leader.

Another four-hold tramper the M/V Hekifu was driven upon an extensive shoal by hurricane force winds while being moved by a marine pilot. Bottom plating was being set in by the ship working on boulders, especially under the engine room where breached shell plate and flooding was imminent. In heavy horizontal snow causing periods of zero visibility and sustained winds at times above 100 knots our salvage vessel was able to drop anchors, back in and connect a towline. Using our bow anchors we pulled back into deep water and a tractor tug made up alongside to add pulling power. There was a small harbor tug on scene that was acting as the pilot boat and our captain wanted it secured to our starboard bow to help hold our heading once the anchors were brought up. The pilot on the tramper wanted his pilot boat to stand by the ship and the tractor tug captain said he would be able to hold our heading, but our captain insisted it was needed. So to make peace I compromised by saying we would keep the small tug at our starboard bow but not put a line on it and once the ship was free the pilot could have it back. With a dropping off of the wind we were able to start moving the ship as soon as we began to pull. As the pilot began to feel some motion with his ship he called for his pilot boat that immediately left station at our bow. The moment he was gone the ship came aground again along with more 100-knot winds. Our vessel and the tractor tug began swinging to starboard and there was nothing we could do about it. Locked in irons we swung like a pendulum as the tug alongside threw their lines and we dropped our anchors. By the time we fetched up on our anchors we had rocks on both sides but did not hit one. By the time we pulled out to safety we had lost the tide, so the ship had to spend the night aground however, since it was off the rock pile and the winds came down it suffered no further damage. That was another lesson to show the salvage master must take charge of the assets at hand or there can be more in peril than just the casualty.

ARCTIC SALVAGE OPERATIONAL DIFFERENCES

Probably the most obvious difference dealing with the arctic compared to anywhere else in the world is ice. Sea ice can limit or curtail vessel operations; it can carry off buoys and disrupt or break ground tackle or towing cables.

Ice can affect the casualty in a number of ways for example:

Surface ice can block access to open water and large individual ice floes driven by wind or current can ground alongside a casualty thwarting towing or ground tackle operations.

Structural damage can result when sea ice presses against a grounded vessel and heavy ice with big seas can reduce any vessel to scrap metal.

Freezing spray can build up on a drifting vessel to the point of its capsize and over time freezing spray can build up on a vessel aground encasing machinery, covering access hatches, fuel manifolds, vents and etc. Freezing spray will also add considerably to the ground effect due to its weight.

Because of these ramifications decisions must be made at the outset how to avoid the ice or work with it, since working against it is never much of an option, for example:

Compromises may have to be worked out with agencies, refuge managers and biologists who would prefer we worked in the winter when most wildlife is gone. When they realize that the alternative may be a much less desirable outcome for everyone if the hull breaks up in the meantime. Sometimes prep work can be done in the winter to minimize the window needed at

that crucial time when the ice breaks up and just before most of the birds and mammals show up.

One example of using ice to our advantage was in Nome when the 225' triple screw AHTS "Aquamarine" was handling the 558' "Bima", the world's largest bucket dredge. During a fall gale at the end of the season the Bima drug the Aquamarine over the tailings pile under full power damaging all three 8' props and bending two propeller shafts and the starboard rudder. With the Aquamarine out of commission and no tugs for thousands of miles capable of towing the Bima south the decision was made to move both vessels alongside the rock jetty that protects Nome's harbor and then to build an ice dam to protect the two vessels from the sea ice that was beginning to form. This was done by spraying seawater though monitors placed around the dredge in a semicircle that froze and built up, first floating and then sinking as the weight of the spray ice increased. When the ice reached the bottom the dam was built up until it was 20' or more above sea level and 50' wide. During the winter our company was contracted to repair the Aquamarine behind the ice berm in the water under the ice. In the spring the ice berm successfully protected the vessels from the gale tossed sea ice and both vessels went right to work after breakup.

Early one spring we were tasked with the lightering of fuel and removal of a crabber wrecked on a reef that was soon to be occupied by thousands of fur seals. The wreck was so covered with frozen spray that it resembled an iceberg and there was no way to access the fuel tanks let alone conduct wreck removal operations. We finally settled on a system of boring holes into the ice in which an explosive charge was detonated to fracture the ice sufficiently to allow efficient manual removal. These explosive charges created very little air blast and caused no damage to the casualty. Frozen spray with its entrapped tiny air bubbles is one of the toughest forms of ice, unless you have wacked this stuff with a sledge hammer it would be hard to believe how tough it really is.

If a casualty cannot be towed south before freeze up some areas are much safer than others for spending the winter, both in terms of safety for the vessel as well as environmental risk. A Port of Refuge policy for the arctic is something that will need to be fully developed as it has been successfully implemented and utilized in Southwest Alaska and elsewhere.

Urethane Foam

Next to ice, remoteness from conventional resources shapes operational planning and methodology more than anything else. An example of this is our use of Urethane Foam. Expandable urethane foam came on to the salvage scene over 30 years ago but never gained widespread use due to its expense, technical challenges and the mess of dealing with expanded foam in ship spaces in the ship repair or breaking yard.

Despite these disadvantages urethane foam has been a reasonable alternative to us where heavy lift equipment is not available and operational windows are short by rapidly creating non-shifting internal buoyancy.

Explosives

Another tool that can improve operational effectiveness in remote locations is the judicial use of explosives.

The principle uses of explosives in salvage are as follows:

1) Blasting of rocks penetrating or blocking a vessel aground

2) Blasting of bedrock under a vessel to allow access for divers

3) Blasting ice blocking a vessel or frozen spray covering a vessel.

4) Cutting steel above and below the water during demolition operations especially making the last strategic cuts to eliminate risks to topside burners or divers.

5) Scuttling charges for sinking wrecks rapidly in positions agreed to in EPA Ocean Dumping permits

6) Utilizing the heat generated by explosives to ignite the bunkers in a vessel and burn it before it breaks up to prevent a spill.

If there is a stigma associated with the use of explosives in salvage operations it is because almost everyone has heard some story of the misuse or ineffectual use of explosives. For this reason it is important that these types of marine operations be conducted by experienced personnel familiar with the principles appropriate to the applications mentioned above since as difficult as it is to obtain approval for the use of explosives it will only get more difficult if the

public and involved agencies do not see safe, clean, effective use with minimal impact on wildlife.

In the six applications for the use of explosives listed above the first five require the blaster to have expertise in rock blasting and demolition in the marine environment, although specialized, these people are generally available.

The last application, as a component to in-situ burning of bunkers in the vessel involves more than just the knowledge of the use of explosives and it could be difficult or impossible to locate explosive handlers with firsthand experience therefore it's very important for the salvage response contractor to have a thorough understanding of the principles of in-situ burning in order to work up a competent plan of action with his blasting crew.

The fundamentals of in-situ burning of bunkers in the vessel are as follows:

This action is usually only considered when time constraints due to weather and location make it impossible to lighter bunkers before the vessel is expected to break up and the environmental damage from the oil spill is expected to far exceed the air pollution associated with the burning of bunkers.

Explosives are used because it provides a safe way to ignite the oil remotely and the intense heat generated by the explosives can create a conflagration of such heat and magnitude that it will rapidly and efficiently burn the bunkers with a minimum of heavy smoke and air pollution.

The explosives employed are designed to ignite the fuel and not damage the hull since the vessel must contain the fuel while it is being burned. Since flash and heat are essential Class A type high explosives would typically be used with charges connected with high core load detonating cord such as 200 grain.

All explosive materials are a balanced combination of fuel and oxidizer when detonated with fuel oil there is of course a huge imbalance so to be efficient an additional source of oxygen should be provided.

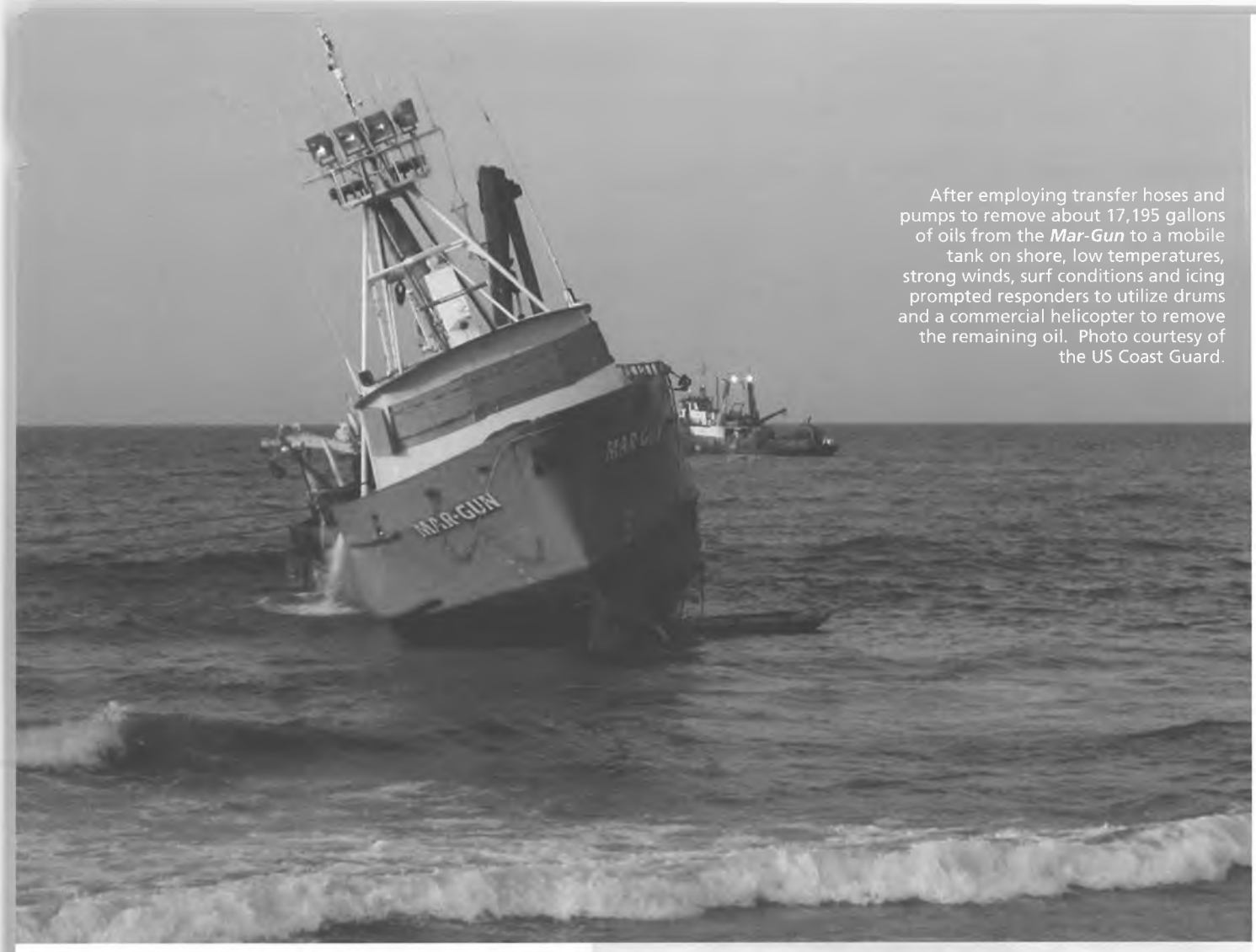
The use of explosives in the arctic and the marine environment in general is mainly limited by its effect on marine life. By working with agency biologists we can make responsible determinations as to the potential risks to marine life and how they may be avoided or minimized by operational timing or technique.

To summarize, men have been working at the edge of the ice for all of history but today's technologies are allowing us to accomplish a great deal in relative comfort and safety as long as we maintain the same respect for these cold waters as the seafarers before us.

Magone Marine Service:
30 Years in Dutch

By Dan Magone

Top: Magone Marine responded in 2006 when the car carrier ***Cougar Ace*** lost stability and developed a 60-degree list to port south of the Aleutian Islands. Magone photo. Above: Some of the company's equipment at the facility in Dutch Harbor, Alaksa. Magone photo. Right: The 112-foot fishing vessel ***Mar-Gun*** was fishing for Pollock earlier this year when she went aground on the rocky shoal off St. George Island. Here she is being atended to by Magone and Coasst Guard personnel. Photo courtesy of the US Coast Guard.



After employing transfer hoses and pumps to remove about 17,195 gallons of oils from the ***Mar-Gun*** to a mobile tank on shore, low temperatures, strong winds, surf conditions and icing prompted responders to utilize drums and a commercial helicopter to remove the remaining oil. Photo courtesy of the US Coast Guard.

Magone Marine Service was founded by Dan Magone in Dutch Harbor, Alaska in 1979. Thirty years later, the company employs 45 men and women. Today, the success of the company depends on the varied talents, experience and teamwork of the whole crew.

I was an entrepreneur since early childhood; everything from selling light bulbs door to door to a firewood and tree trimming business. On leaving high school I opted to start in the trades before going to college to get some sense of direction. I never found time to go back to school. As an avid teenage sport diver, my first career inspiration was to become a commercial deep-sea diver. To this end I completed a six-month course in Wilmington, California and went directly to work in the Gulf of Mexico on oilrigs and pipelines.

After a year and a half in the Gulf and somewhat disillusioned with the lack of glamour and prospects of an oilfield diver, I moved back to California and went to work in a heavy truck shop as a welder, fabricator and mechanic. I simultaneously formed my own company, Welding Specialties, and in 1974 the company was successful enough to allow me to go out on my own.

In spring of 2007 Magone Marine added a 1,000-ton floating drydock, thereby enabling the local fishing fleed to haul their boats out without having to travel thousands of miles for basic hull maintenance and emergency repairs. Magone photo.

As I gradually built up a clientele of fishing vessels on the coast, I began to see a niche for the kind of work I loved to do, including diving, and I renamed the company Magone Marine Service in 1975. I quickly discovered that the worst nightmare a large vessel owner had when operating in northern California or southern Oregon was propulsion machinery damage, since there were no drydocks between San Francisco Bay and Coos Bay. With this in mind, I studied the theory and technique of propeller and shaft removal and repair, babbit bearing repair and engine/shaft alignment. My one-ton service truck was set up with all the tools and equipment to remove, repair, balance and reinstall damaged propellers, while the boat sat in the water tied to the dock, usually within a 24 hour period. It wasn't long before Magone Marine Service gained the title of the "wet drydock" and I serviced a fleet of trawlers and albacore boats that operated from Half Moon Bay, California to Brookings, Oregon.

In 1978 one of my clients was running a king-crabber out of Dutch Harbor and called to say "grab your gear and get up here… my rudder has come adrift".

On arriving in Dutch Harbor I looked out in the bay to see the 'cover girls' of the fishing magazines, the finest boats in the US fleet that I had only read about, and nobody there to fix 'em! After repairing the ***Sea Witch,*** I returned to Bodega Bay, sold everything but my tools to pay my bills and by February of 1979, at the age of 27, I had moved to Dutch Harbor.

In the late '70s, fishing was good, the fishermen were wild and there were no dry-docks for thousands of miles. I set up shop first in a WW II hanger at the airport and later in a warehouse on Standard Oil Hill, and started planning for the shipyard that would take decades to complete.

Soon I was joined by brothers David and Craig, who helped in the business when they were not commercial fishing.

In 1980 Magone Marine Service was incorporated in the state of Alaska with me as president, operations manager and principle stockholder. Two years later I married Susan Carney, and as my family will agree, I sure needed a good woman in my life!

Dan Magone straightens a propeller at the company's facility in Dutch Harbor. Magone photo.

1982 was also the year the company entered into a joint venture with the regional native corporation to rebuild the area's old military marine railways and run a shipyard operation. Although this was a busy time, the business relationship did not work, out so after the first year Magone Marine moved out on its own again and continued performing below waterline repairs with divers.

Magone's departure from the marine

The bulk freighter ***Selendang Ayu*** broke in half after running aground off the coast of Unalaska, spilling oil and its cargo of soybeans. Photos courtesy of the US Coast Guard and Magone Marine.

railways facility coincided with the dramatic decline in the crab fisheries, and since the US trawl fisheries had not yet been developed the ship repair business looked bleak. What saved the company was the price of oil. With oil up to $33 a gallon the geophysical ships were headed to the Bering Sea, and they needed support for their vessels in Dutch Harbor.

Within a few years the exploratory drilling rigs moved in with all their support vessels and provided us with the work we needed to not only survive, but provide valuable experience for my crew of young divers and shipwrights.

By the mid '80s the price of oil dropped, and with it went the oil field supply boats, but by then the Pollack and Cod trawl fisheries where in full swing and the company's services were once again important to the fishermen.

Having the only diving crew around, the company was of course called to the aid of vessels in distress following accidents and groundings, to perform emergency hull repairs and assist in refloating. We even completed salvage jobs on vessels that wrecked in Unalaska Bay. In the meantime I came to know eminent west coast salvage master Mick Leitz, who would call

on Magone Marine to assist in fishing vessel salvage operations in the vicinity and for support for his operations further north with the salvage vessel ***Salvage Chief***.

He was a mentor to me. These were in the days before the current wreck removal laws so you only took on a salvage job if you could save them money on the value of the hull and machinery.

Leitz showed me the need to assess the cost of the entire salvage, tow and repair. If your client hires you to salvage a vessel and later finds out it cannot be cost effectively repaired, then somebody has a big problem on his hands. You'll wish you had never gotten involved.

In 1989, while the country's attention was focused on the ***Exxon Valdez***, Magone Marine Services had developed into a serious marine salvage company and was busy with other projects including raising the seiner ***Northern Dawn*** and the trawler ***Rosella*** and refloating the crabber ***American Beauty***. The company also performed the wreck removal of the Japanese refrigerated cargo ship ***Swallow*** from Ulakta Head.

By 1990 the company had grown to 50 employees with gross earnings for the year of $6.2 million, the majority of which was general ship repair, but marine salvage was becoming a significant part of our overall operations. At the time Magone was operating from a warehouse in Captains Bay, but our landlord wanted it for other purposes, so with no more WWII warehouses left to move to, we bought a WWII vintage troop transport barge from Western Pioneer, had it converted to a machine shop/office/bunkhouse/crane barge at Marine Industries Northwest in Tacoma, and had Crowley tow it to Dutch Harbor.

We moved in to our new facility, such as it was, in November of 1990. By then the company had added another 260-foot by 48-foot "APL" that we had salvaged, and with the two barges moored to shore with drive on ramps, the Magone Marine facility in Dutch Harbor was born.

In 1991 an overcapitalized fishing fleet was restricted from fishing year round and there began an abrupt and steady decline in the vessels using Dutch Harbor that is only now stabilizing. To cover the company's now increased overhead amid plummeting revenues, the company diversified into dock repair and maintenance. I also set the company up as the local oil spill response contractor, and in 1993 became a "BOA" oil spill response contractor with the USCG. In 1991 we began rebuilding an old Yard Freighter hull and converting it to a salvage tug, hoping to glean more work from a larger area.

Times were hard for the next 10 years but with our tug ***Redeemer*** which came online in late 1992, besides salvage work we were able to haul anything for anybody to anyplace nobody else would. We hauled cattle, horses, drilling rigs,

Magone was called to salvage the stern of the *Selendang Ayu*. Magone photo.

construction equipment and materials… you name it. Combined with the new wreck removal laws we once again found enough work to get by.

With a few exceptions Magone Marine has handled all the significant salvage or wreck removal work from Kodiak westward and the Bering Sea since that time. We are typically subcontractors to the big international salvage companies when responding to the largest ship casualties, but these appear to take place only every 5 or 10 years in our neighborhood.

Since the company's remote shipyard had focused on emergency repairs and unplanned vessel maintenance problems, work was always cyclical with the fishing seasons, and over the course of the year ship repair was only marginally profitable. However the shipyard acted as a base for our salvage vessels, and kept a core crew at hand for the big emergencies when they happened. Examples include such high-profile cases as the ***Kuroshima***, ***Selendang Ayu*** and ***Cougar Ace***. These projects generated considerable revenue through vessel day rates, equipment and labor, and the profit was put back into the business to strengthen and upgrade the services the company has always offered, and to upgrade the facility to provide more of a year round operation.

In 1989 Magone Marine Services developed into a "serious marine salvage company."

In 2005 we expanded our dock facility with the addition of a 300-foot by 90-foot floating dock on which was installed a smooth concrete deck to facilitate equipment operating and cargo handling. Heavy ramps at each end accommodate trucks, large load-

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ers and cranes. With the new dock, the Magone facility now covers 1,200 feet of the waterfront in Dutch Harbor between the Coast Guard dock and the new Dutch Harbor Ports facility.

In the spring of 2007, my longtime dream of having my own drydock came true with the acquisition of a 1,000-ton-capacity floating dry-dock from Foss Shipyard in Seattle. Foss had purchased the dry-docks from the former Marco shipyard when that yard closed, and sold this one to make room at their facility. The new drydock has proved to be a blessing for Magone Marine as well as the local fleet, as they are no longer forced to travel thousands of miles for basic hull maintenance and emergency repairs. It has acted to stabilize the Magone Marine Services workflow and allowed the company to hire and retain more skilled shipyard personnel. The drydock is also allowing us to catch up on maintenance and upgrades to our own fleet, that now includes three salvage vessels, one landing craft and three mobile barges. The Magone dock facility is made up of 4 permanently moored barges.

> "It is gratifying to see the company coming together and interesting to look at the future of our area in these changing times." DAN MAGONE

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In 2006 Magone Marine became a member of the American Salvage Association, and in July of that year the company participated in a joint effort with ASA members Titan, Crowley and Foss in the salvage of the capsized car carrier ***CougarAce***. The ***CougarAce*** job was a good example of ASA members working together. Through the Incident Command system, the Port of Refuge issue was handled efficiently with all the regulatory agencies and concerned parties, which enabled the salvors to bring the ship into protected waters where it could be safely righted.

Although we certainly have a ways to go in terms of upgrading our facility and organization the vision I have had for Magone Marine in Unalaska/Dutch Harbor is finally coming together. In the last few years I have received some big help to the organizational end of things.

Mark Stahl joined the company in February of 2006 as Controller/office manager. Mark had previously spent two years in Afghanistan with his wife and family, working as Finance Manager for PACTEC. After two years in Kabul, his wife decided Unalaska Island in the Aleutians didn't sound too bad.

Mark has done a great job raising the level of professionalism and ef-

Dan Magone is seen here directing winch operators for the purchase tackle on the ***Mar-Gun*** salvage. Magone photo.

ficiency in our office that was needed to support our current operational workload and the financial issues that are involved.

John Adams joined the company in October of 2007 as Shipyard Superintendent, coming from a navy background as a nuclear engineering officer on the ***USS Carl Vinson***, ***USS Nimitz*** and ***USS California***. Later in his Navy career he worked as Project Manager, Production Manager, Project and Planning Engineer and Assistant Superintendent on various nuclear submarine and surface combatant overhaul and repair projects.

After retiring from the Navy, John was working as an owner's representative and consultant on yacht construction projects out of Tuzla, a small suburb of Istanbul, Turkey, when he responded to an ad for a Shipyard Superintendent position in the Aleutians. His organizational skills have been put to the test, but it looks like he's winning.

We've seen some good men come and go over the years, and a great many colorful characters, but many of the old guard remain, including Jeff Whited, who is in charge of the machine shop and outside machinist duties including the company's engine and shaft alignment work.

Dave Magone, Butch Aus and Ted Sherebernikoff, as salvage vessel operators, have over the years done much to build the company's reputation in trying circumstances with limited resources and with not one significant casualty to vessels or crew on any salvage job to date.

Finding good talent for our small company in the remote location has always been challenging, but I am encouraged by the quality of our new hire captains, divers and engineers this last year. It seems the slowdown in the offshore oil industry has been to our advantage.

There is still a lot of work to do to get the company ship shape, But it takes time when you put your customers' jobs first, which is how it needs to be.

It is gratifying to see the company coming together and interesting to look at the future of our area in these changing times. As I look out from the company's Dutch Harbor base over the vast ocean to the North, South, East and West, I ask myself, will the fisheries remain healthy? Is Arctic oil development just around the corner? How rapidly will we be seeing an increase in Arctic marine transportation? I don't know the answers, but I expect our talented crew will continue to be around to offer service and support as long as there's a need. PMM

Thank you to our customers, marine surveyors, insurers, suppliers, bankers and lawyers – as well as the maritime community of the Pacific Northwest.

We are blessed to have so many friends.

Magone Marine Service Inc.

Phone (907) 581-1400 Fax (907) 581-1495 dmagone@arctic.net
www.magonemarine.com

December 31, 2009

Salvage capabilities in Alaska's North,

As we see interest increasing for oil and gas development, transportation and tourism in the Alaskan Arctic the question arises, what about emergency response and salvage? The short answer is there is not much here yet but that's about to change. For a better understanding of what to expect let's take a look at what's been going on in Alaska and how that will effect coming operations in the arctic.

A brief history of modern marine salvage in the Alaskan arctic and subarctic would start with development at the North Slope of Alaska when in 1975 Crowley Maritime operated their "Sea Train" of tugs and barges to haul the modules, equipment and supplies north each summer for the oil companies. As there was no salvage support anywhere north of Puget Sound their underwriters required that a salvage vessel sail with them. Fred Devine's "Salvage Chief" was chosen and sailed with the fleet in 1975 and '76. The next year Crowley brought the "Arctic Salvor" online, an offshore supply type vessel set up with an extensive salvage spread including multiple heavy winches for ground tackle and towing operations similar to the Salvage Chief. The Arctic Salvor took over the Sea Train duties in 1977.

I started operations in Dutch Harbor on Unalaska Island in the eastern Aleutians as Magone Marine Service in 1978 and used vessels of opportunity for Salvage operations until 1993 when we completed conversion of a Navy "Yard Freighter" to our salvage tug "Redeemer". Since that time we have handled almost all the marine salvage work in Western Alaska, largely composed of fishing or coastal transportation. The exceptions are the few very large salvage operations in which we have typically been subcontractors to the big salvage operators from the "Lower 48".

Following the grounding of the Exxon Valdez in 1989 and the OPA 90 Act that resulted we saw the formation of oil pollution contractors, co-ops and regional response organizations such as CISPERI (Cook Inlet Spill Prevention & Response Inc.) covering the Cook Inlet oil and gas operations, and Alyeska Pipeline Service Company with their SERVS (Ship Escort/Response Vessel System) which covers the entire trans-Alaska pipeline, the oil terminal in Valdez and Prince William Sound out to where the tankers enter the Gulf of Alaska. Both CISPERI and SERVS have emergency response/towing vessels especially SERVS with 5 Crowley owned assist tugs of over 10,000 HP but these vessels are committed to serving in relatively small geographical areas in support of ongoing operations.

So to date Alaska does not have much to brag about in terms of marine salvage resources but we do have a good record for pulling together when the need arises, here are a few good examples:

During a gale in October of 2002 a zinc ore lightering barge broke tow and grounded in 20' seas and 60 knot winds off the village of Kivalina located at 67° 44 N and 164° 33 W, approximately 82 miles north of the Arctic Circle on the Chukchi Sea and not too far from where Shell would like to do some exploratory drilling this summer. As Divine Salvage had the response contract with the gale subsiding Mick Lietz arrived on scene with a plane load of equipment and divers he rounded up in Anchorage. What he found was a 300' barge with a massive aft superstructure supporting an ore offloading boom and conveyors system that had drifted in over the outlying shoals and was now sunk on the bottom save for the buoyancy in the bow rake tanks. It would make a great story how Mick and company got the wreck to float and out of there before the next gale, towing it to shelter behind one island and then another before making it to the Magone Marine facility in Dutch Harbor. The barge was floating on a "bubble" and there was bottom plate missing from a large area of the stern with plate hanging 30' below the bottom. The starboard chine was crushed up 6' to 8' and all below deck spaces were holed or common with each other except the bow rake tanks. Any other time a barge damaged to this extent would be scuttled in deep water but the ore handling equipment mounted on the deck could not be removed and it represented 50% of the production capacity of the largest zinc mine in the world therefore it had to be saved. The project to make this wreck "seaworthy" for a winter tow from Dutch to Seattle would be another good story to tell, and they did make it there in time for Christmas.

When the car carrier Cougar Ace rolled over to a 60° list to starboard, 230 miles south of the Aleutians in the summer of 2006 we had a classic example of how Alaskans and the salvage community at large were able to pull together. Magone provided two salvage vessels to transport a Titan response team to the ship while Foss released a tug from its barge in Adak to assist the casualty and Crowley dispatched two big tugs from Puget Sound over 2,000 miles away. So you have four ASA members working together to save the ship and prevent the pollution its demise would cause, but that wasn't enough. Without the help of the USCG Morgenthau and its H65 helicopter the salvage team could not have boarded to inspect, stabilize and rig the ship for tow. When initial efforts to right the ship at sea looked doubtful we began working through the Unified Command with the State of Alaska, on a "Port of Refuge" and through the cooperation and input of the various agencies and concerned parties a plan was put into place in a timely manner that led to a successful outcome of the incident without loss of ship or pollution. A formal Port of Refuge plan for the Alaskan Arctic is still in its infancy and will take some time to implement but the State of Alaska and the USCG are familiar enough with the principles to manage an incident responsibly in the meantime.

When the Selendang Ayu grounded and broke in half in December of 2004 Magone supported Smit's operation in removing the remaining heavy oil in the stern section while Magone later performed a partial wreck removal of the stern section. This incident caused the worst oil spill in Alaska since the Exxon Valdez with the expected outcry from the public as to what can be done to prevent another such incident. With funds from the Selendang settlement the Aleutian Islands Risk Assessment (AIRA) was formed to push for shipping safety in the Aleutians and in particular the stationing of a large rescue tug in the area: You can see what they are doing by going to their web site at http://aleutianriskassessment.com/.

Of course the heavy hitters in the marine response community are looking for a financially viable way to provide this response vessel but it hasn't happened yet.

I am seeing a lot more interest in my neighborhood in the last year or so with Shell Oil and their contractors stirring around in Dutch, while Global Diving and Salvage has set up shop in Anchorage and Bisso has staged response equipment with CISPRI. But for now in the Bering Sea and north it's still more up to Alaskan ingenuity than impressive equipment when it comes to dealing with a marine emergency response.

The American Salvage Association has added "Arctic Salvage Operations" to their list of training modules which provide the information that state and federal agencies and other interested parties need to better understand and work with the salvage community when called upon. For information on the ASA training modules and conferences go to their web site at http://americansalvage.org/.

At your service,

Dan Magone, President
Magone Marine Service, Inc.

5
Law of the Sea Convention

1982 Law of the Sea Convention (LOS Convention)

Why becoming a party benefits the United States

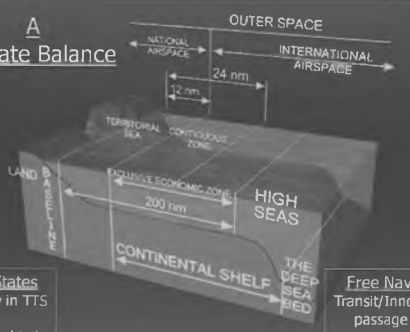
Rear Admiral Fred Kenney
U.S. Coast Guard
The Judge Advocate General

CGJAG

U.S. COAST GUARD

Law of the Sea

A Delicate Balance



Coastal States
Sovereignty in TTS

Resource Rights in EEZ

Free Navigation
Transit/Innocent/ASL passage in TTS

FON in EEZ

U.S. COAST GUARD

Background on Law of the Sea

Customary International Law

- "General practice accepted as law" (ICJ Statute Art. 38(1))
- Primary source for the creation of universal international law
- Subject to change

Territorial Sea (TTS) Limit:

Cannon ball-shot
3 nm
12 nm

1958 Law of the Sea (lacked balance)

- TTS – CZ – CS – HS/Fishing (The 4 not linked)
- Nations could pick and choose
- No agreement on TTS limit
- Didn't adequately account for advances in tech

U.S. COAST GUARD

Background on Law of the Sea

1982 Law of the Sea

- Strikes balance between coastal states and freedom of navigation interests
- Tech advances in such things as refrigeration and seabed drilling drive inclusion of EEZ provisions and extended continental shelf provisions

1982 Law of the Sea Crystallizes:

- TTS at 12nm
- Right of innocent passage through foreign TTS
- Traditional high seas freedoms of navigation (FON) and overflight seaward of TTS
- Transit passage through international straits and archipelagic sea lanes

U.S. COAST GUARD

Background on Law of the Sea

1982 Law of the Sea

New Convention concluded in 1982 but U.S. and other developed nations did not join because of following objections to the Part IX deep seabed provisions:

- Governance of the International Seabed Authority
- Forced technology sharing
- Production limits and fees

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U.S. COAST GUARD

Background on Law of the Sea

President Reagan declared that the United States will abide by all provisions of the 1982 Convention except Part XI

Part XI fixed by 1994 Implementing Agreement

1982 Convention, as modified by the Part XI agreement, submitted to the Senate in 1994 by President Clinton

Every Administration, both Democratic and Republican, since 1994 has supported the LOS Convention

Twice favorably voted out of the Senate Foreign Relations Committee but not brought to the floor for a vote

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U.S. COAST GUARD

Background on Law of the Sea

Law of the Sea Convention entered into force in 1994

161 nations, and the European Union, have joined the Law of the Sea Convention

The United States is the only major maritime power that is not a party to the Convention

All Arctic nations, except the United States, are party to the Convention

Accession to the Convention is supported by the U.S. military, and national security, business, & environmental interests

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U.S. COAST GUARD

Myths About the LOS Convention

The LOS Convention:

- Does not create a United Nations navy
- Does not create a United Nations body that governs the world's oceans
- Does not require mandatory technology transfer
- Does not subject military activities to dispute resolution
- Does not restrict U.S. intelligence activities
- Does not require the U.S. to litigate disputes before an international court of justice
- Does not erode U.S. sovereignty

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U.S. COAST GUARD

U.S. Accession Promotes National Security

Becoming a party to the Convention advances our security interests by allowing us to:

- Leverage the Convention's provisions to push back extended territorial claims, such as in the South China Sea
- Improve international maritime cooperation
- Exercise the right of approach and visit
- Secure our territorial sea and assert authority in the contiguous zone
- Be on the "inside" in interpreting and further developing the Convention

Joining the Convention promotes our long-term strategic interests

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U.S. COAST GUARD

U.S. Accession Benefits Our Economic Interests

The Law of the Sea Convention will help American business by securing rights to ocean and seabed resources; ensuring open sea lanes for maritime commerce; and promoting access to lay submarine cables and pipelines:

- U.S. Exclusive Economic Zone is third largest in the world
- Permits U.S. to perfect rights to resources over one of the world's largest continental shelf
- Provides mechanisms to secure rights to mine the deep seabed
- Ensures an efficient global marine transportation system
- Accession supported by business, shipping, offshore industry, and fisheries interests

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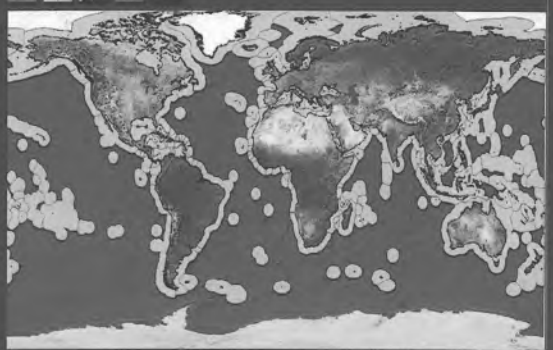
U.S. COAST GUARD

Exclusive Economic Zone (EEZ)



U.S. COAST GUARD

Extended Continental Shelf (ECS)

U.S. COAST GUARD

Benefits to the U.S. Coast Guard

Successive Commandants of the Coast Guard have strongly supported joining the Convention because:

- The freedom of navigation provisions assure our ability to project global Coast Guard presence
- The legal certainty and clarity of a treaty improves mobility to get on-scene for mission execution
- Improves our standing and credibility to achieve desired national outcomes in maritime agreements, especially at IMO and for counterdrug cooperation
- Gains leverage to hold other nations accountable for ensuring safety, security, and environmental protection
- Enhances our ability to advance U.S. interests in the new frontier of the Arctic

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U.S. COAST GUARD

Why the U.S. Needs to Become a Party Now

The U.S. should join the Convention now because we need to:

- "Lock in" the favorable rights under the Convention as a matter of treaty law before they get eroded
- Take advantage of the economic benefits afforded by the Convention
- Get a "seat at the table" to shape the law of the sea and related policy in other international forums
- Improve our strategic position, especially regarding deep seabed mining and Arctic rights

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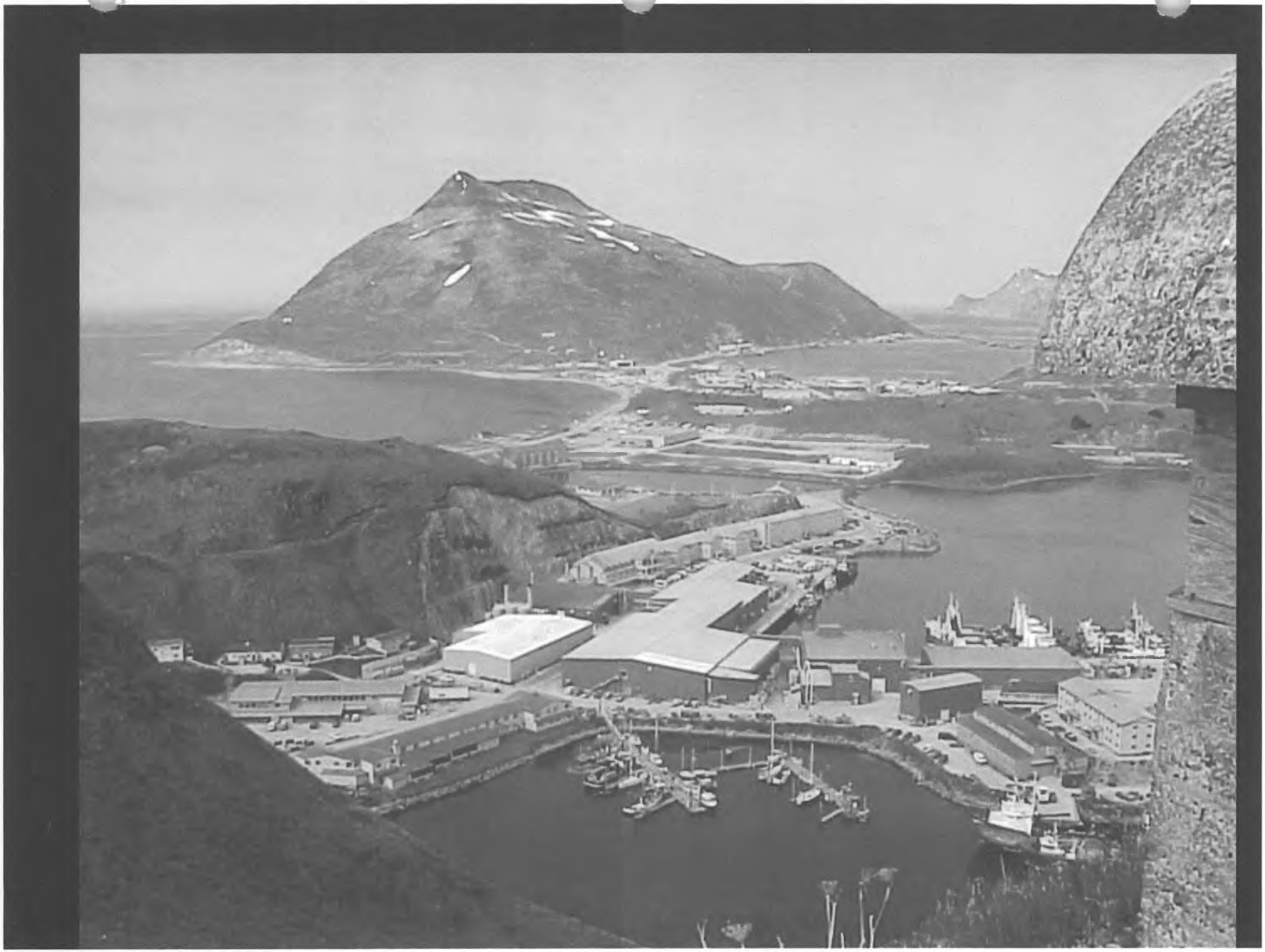
U.S. COAST GUARD

6
Bering Sea Fisheries Overview

Bering Sea Fisheries Overview

August 24, 2011

Frank Kelty
City of Unalaska



AMERICAN SEAFOODS COMPANY

Sea
Wolf
UNALASKA

BERING PROWLER

Commercial Fishery Landings by Major Ports Nation-Wide

Top Five Commercial Fishery Landings at Major U.S. Ports 2008-2009
Figures in Millions of Pounds

Port	2008	2009
Dutch Harbor-Unalaska, AK	612.7	506.3
Empire-Venice, LA	353.2	411.8
Reedville, VA	354.2	349.4
Kodiak, AK	250.9	282.9
Intercoastal, LA	254.6	244.7

missing Alaska!

Top Five Commercial Fishery Values at Major U.S. Ports 2008-2009
Figures in Millions of Dollars

Port	2008	2009
New Bedford, Mass	241.3	249.2
Dutch Harbor-Unalaska, AK	195.0	159.7
Kodiak, AK	98.7	103.8
Naknek- King Salmon, AK	65.3	76.1
Cape May- Wildwood, NJ	73.7	73.4

National Marine Fisheries Service Fish Landings – Nation Wide

- Year: 2009
- Species : ALL Species Combined
- State : All States
- Pounds: 7.8 billion lbs.
- Value: $3.9 billion dollars

STATE OF ALASKA
FISHERY LANDING & VALUE

- Year: 2009
- Species: All species combined
- Pounds 4.06 billion lbs.
- Value: $1.3 billion dollars
- 52% of the nation's fishery landings for 2009 came from the State of Alaska, and 12.4% of that amount landed in Unalaska.

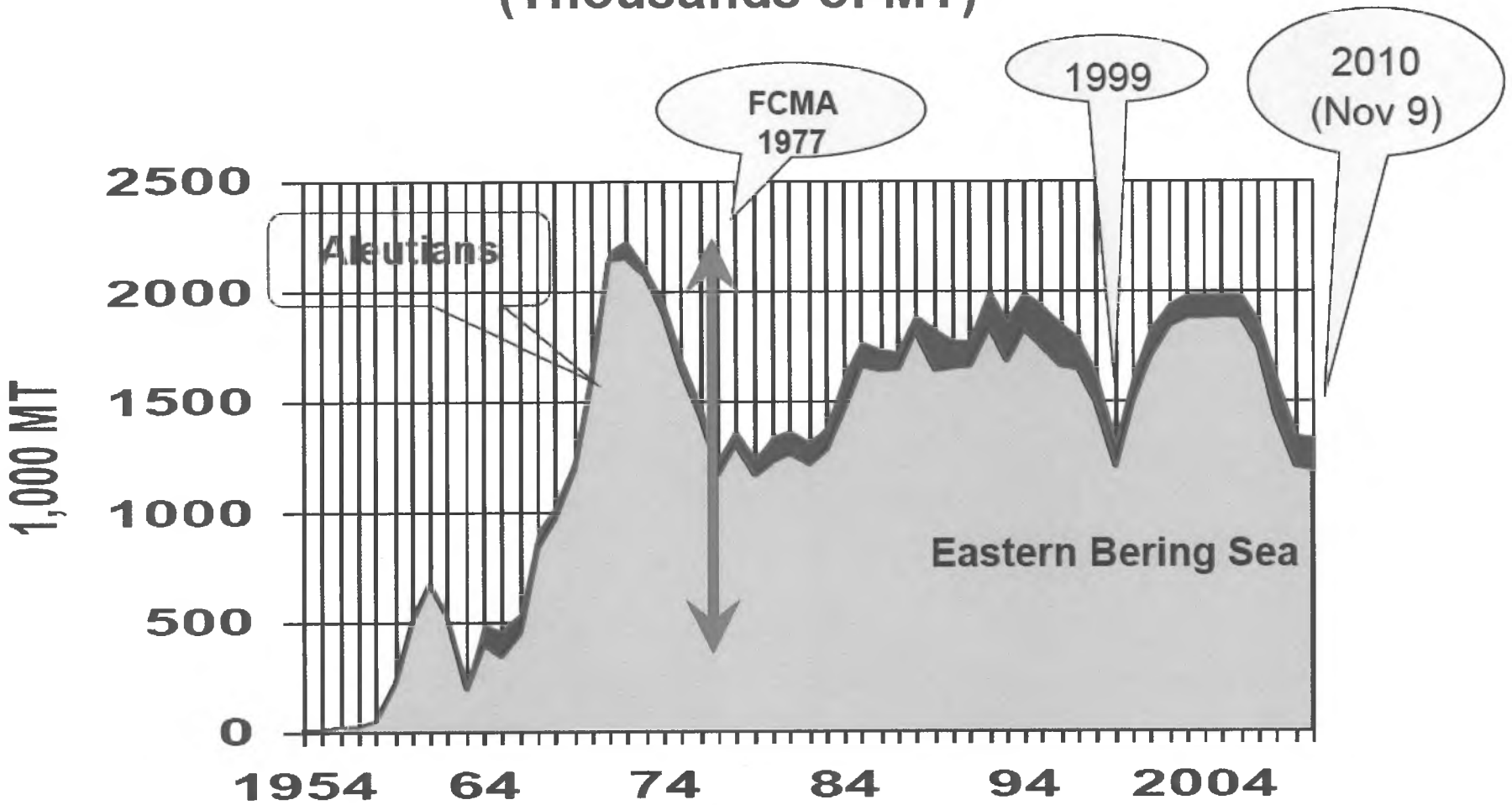
Growth of Pollock in Alaska

- 1980 2.2 million lbs.
- Ex Vessel Value $148,558 dollars
- 2009 Pounds 1.8 billion lbs.
- Ex-Vessel Value $270.5 million dollars

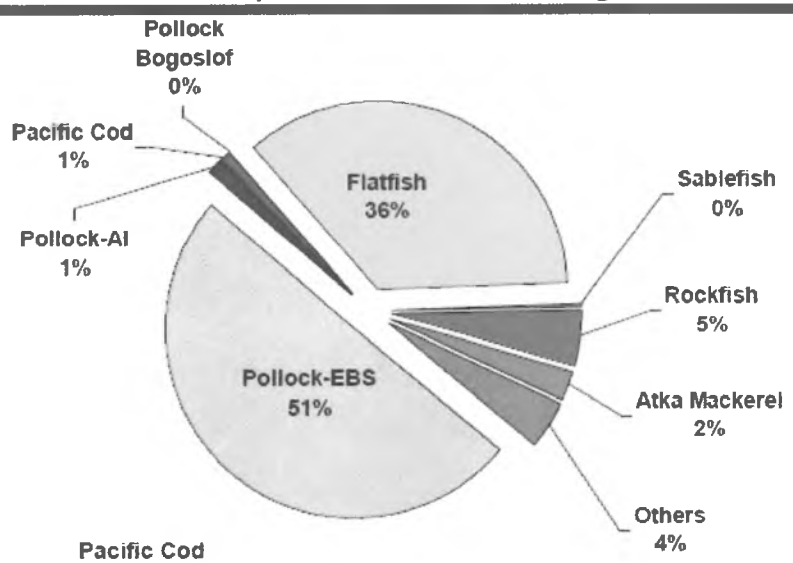
- Total Pounds since 1980 54.9 billion lbs
- Total Value since 1980 $4.6 billion dollars

Bering Sea Groundfish Stocks

Catch History of Total BSAI Groundfish 1954-2010 (Thousands of MT)

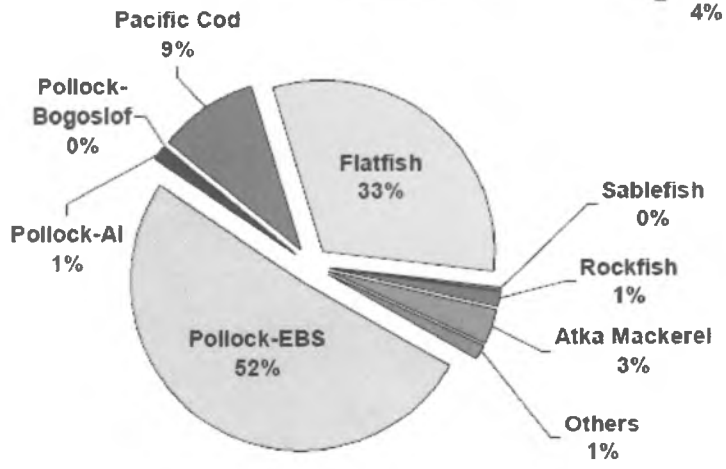


Summary Result of Dec 2010
BSAI Assessment
Exploitable Biomass versus ABCs
(Percent Change from 2010-2011)



Biomass = 20.6 mmt

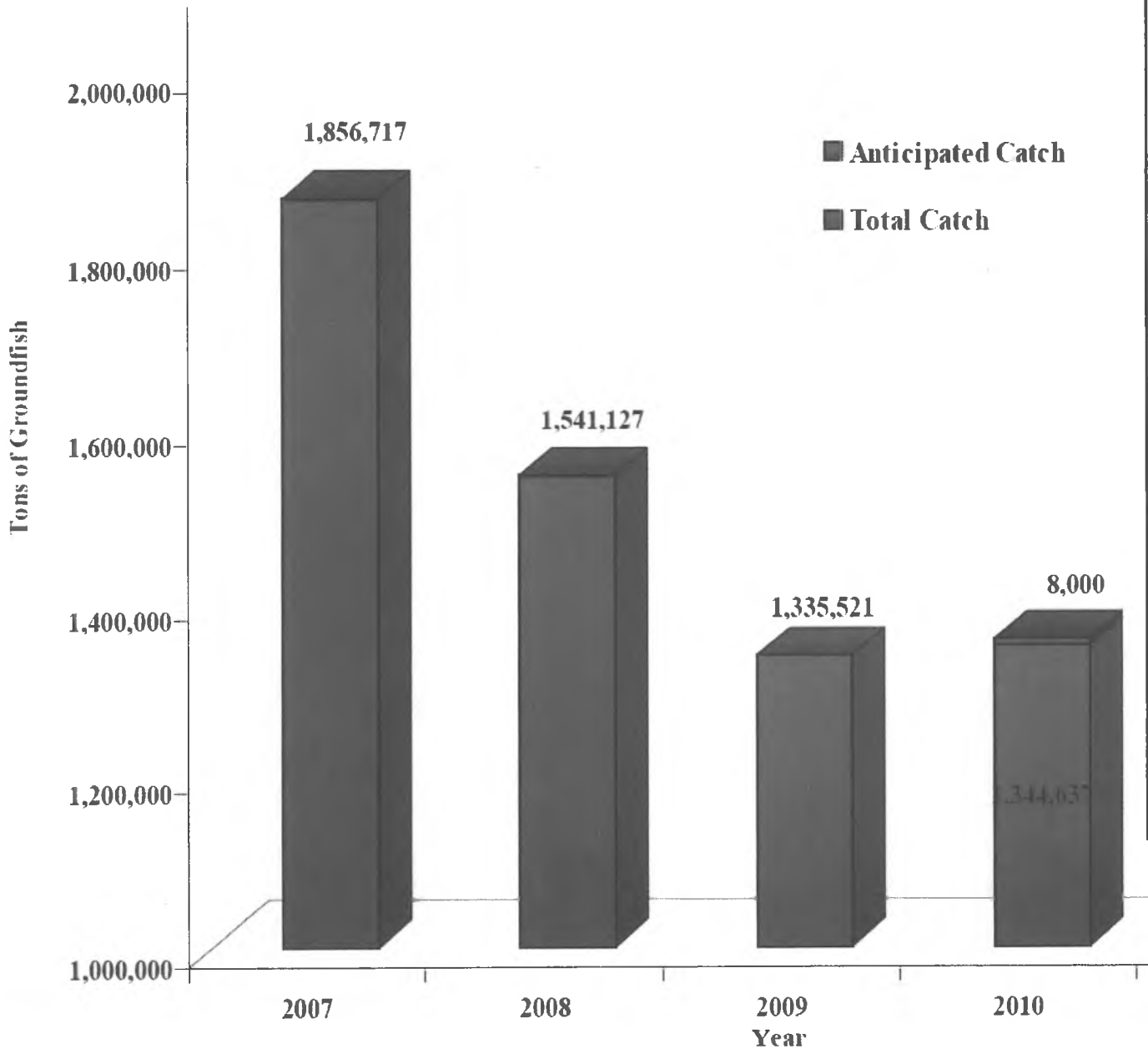
Up 27%



ABC = 2.53 mmt

Up 19%

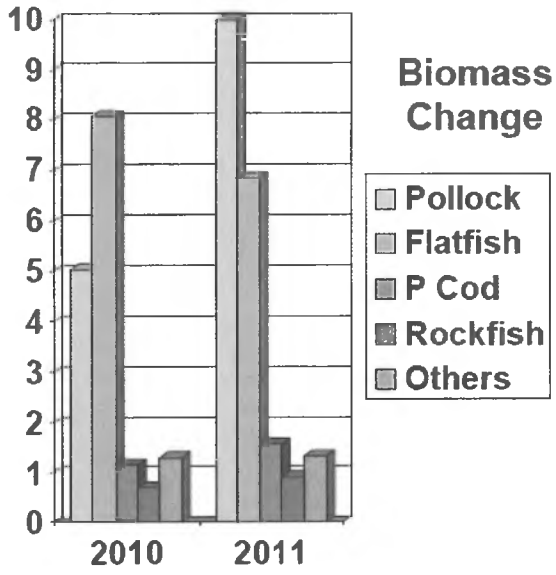
2007 - 2010 BSAI Total Catch

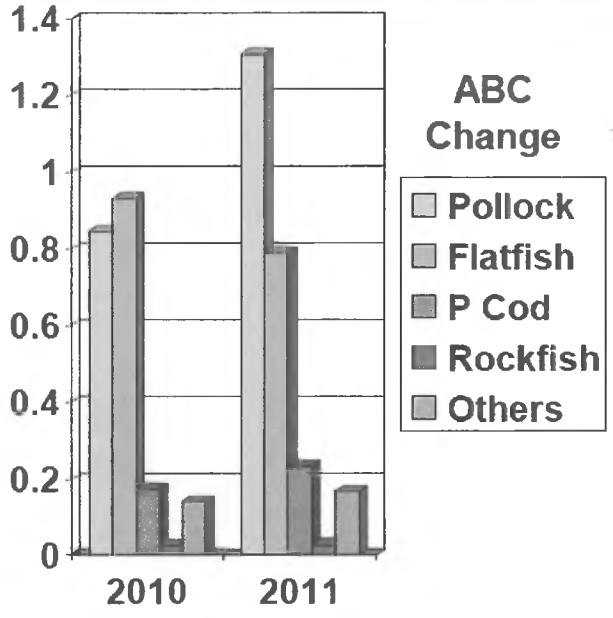


2007 TAC	1,969,270
Total Catch	**1,856,717**
TAC Left	112,553
2008 TAC	1,815,038
Total Catch	**1,541,127**
TAC Left	297,735
2009 TAC	1,659,440
Total Catch	**1,335,521**
TAC Left	323,919
2010 TAC	1,655,356
Total Catch	*1,344,637*
Anticipated Catch	*8,000*
Total Catch with Anticipated catch	**1,352,637**
TAC Left	302,719

BSAI Percent Changes by Major Groups
Changes from 2010-2011

Groups	Biomass	ABC
Gadids	+ 87	+ 51
Flatfish	- 15	- 15
Rockfish	+ 31	+ 26
All Others	+ 3	+ 19
Total	+ 27	+ 19

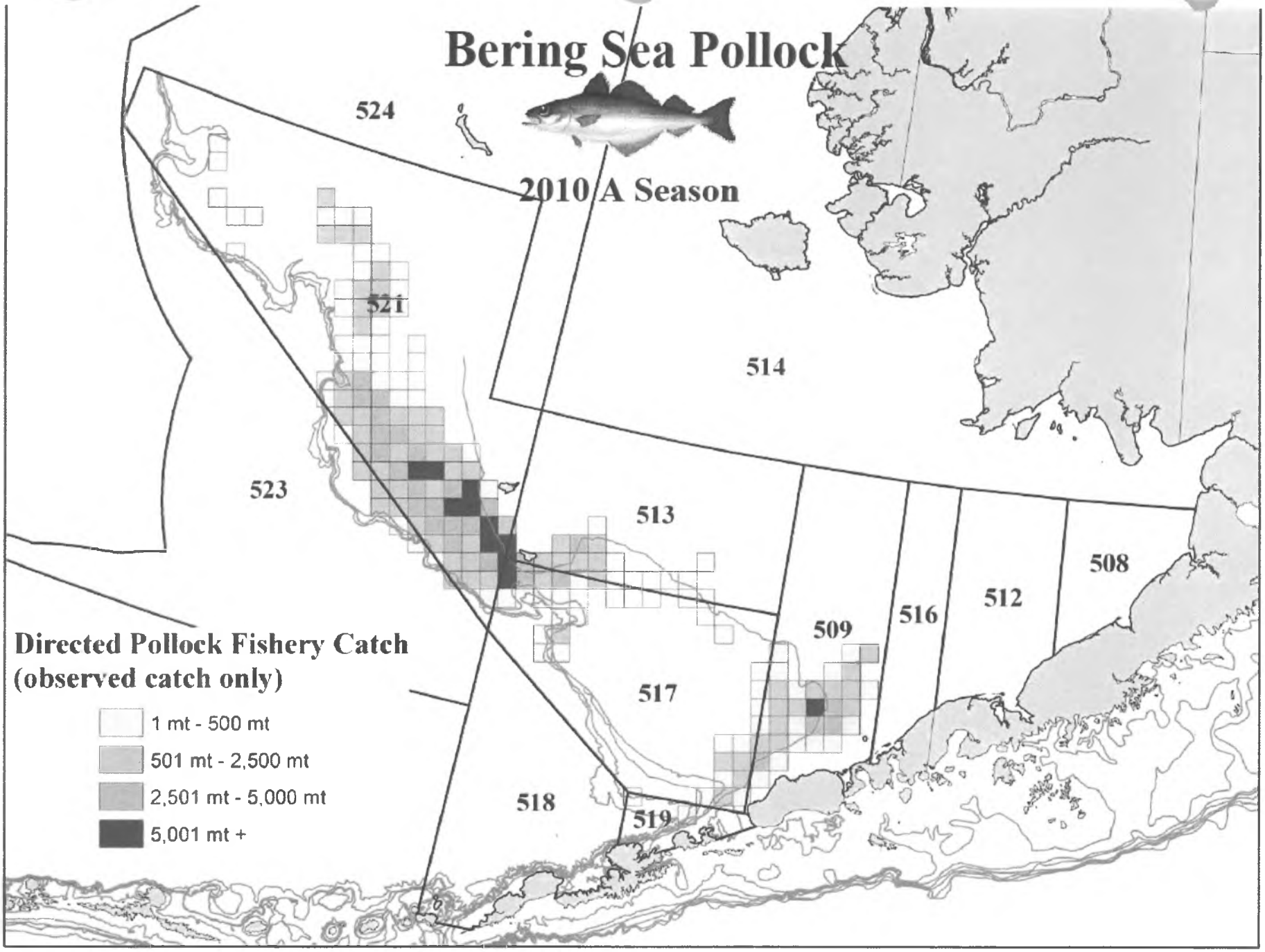


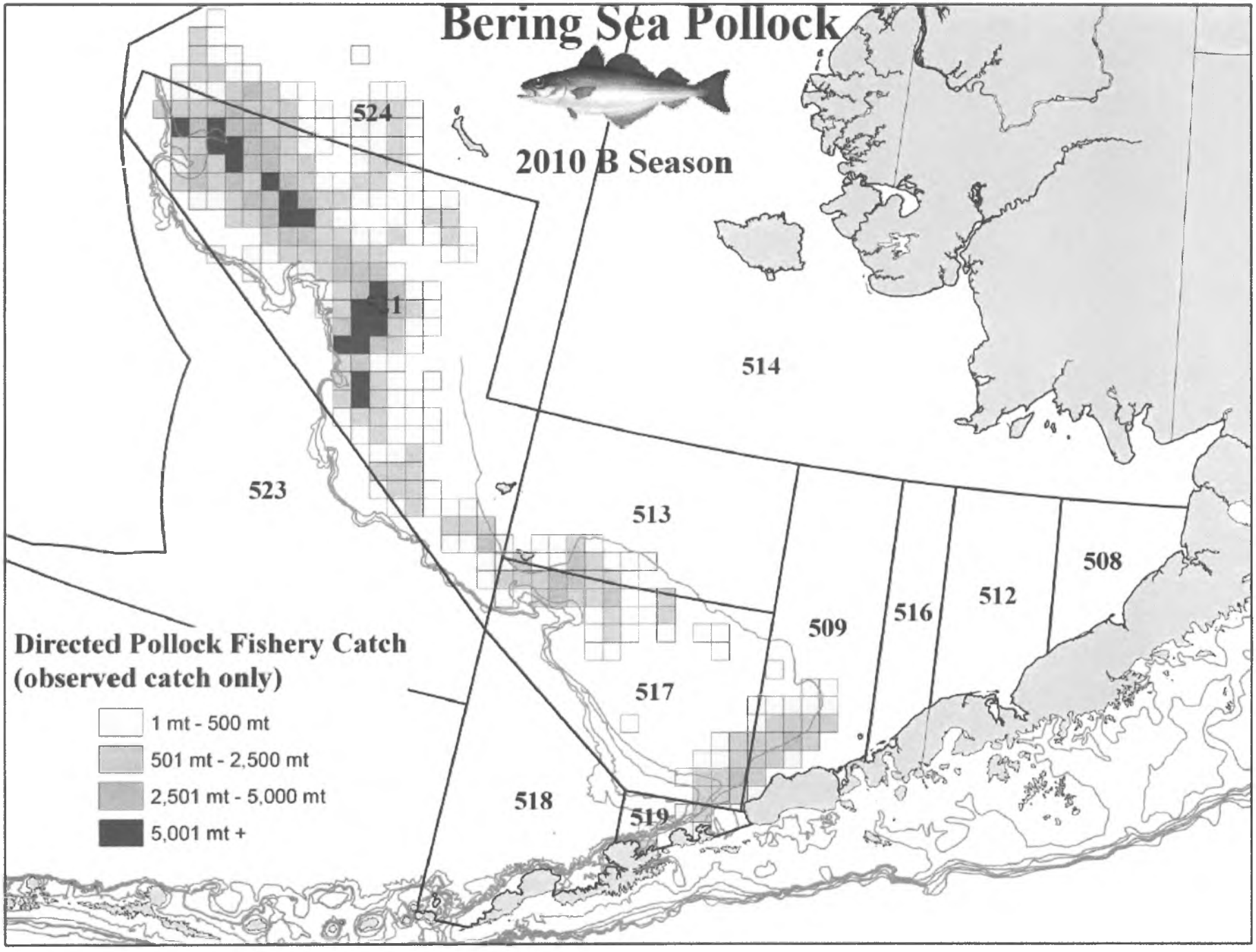


Summary (Pollock)

(From Table 5,Team Summary Appendix A)

Stock	ABC 2010 (mt)	ABC 2011 (mt)	ABC Change from 2010
Pollock, EBS	813,000	1,270,000	Up 56%
Pollock, AI	33,100	36,700	Up 11%
Pollock, Bogoslof	156	156	No change


Bering Sea Pollock
2010 A Season
524
521
514
523
513
508
512
516
509
517
518
519
Directed Pollock Fishery Catch
(observed catch only)
1 mt - 500 mt
501 mt - 2,500 mt
2,501 mt - 5,000 mt
5,001 mt +


Bering Sea Pollock
2010 B Season
524
521
514
523
513
508
516
512
509
517
518
519
Directed Pollock Fishery Catch
(observed catch only)
1 mt - 500 mt
501 mt - 2,500 mt
2,501 mt - 5,000 mt
5,001 mt +

Summary (Cod and Sablefish)

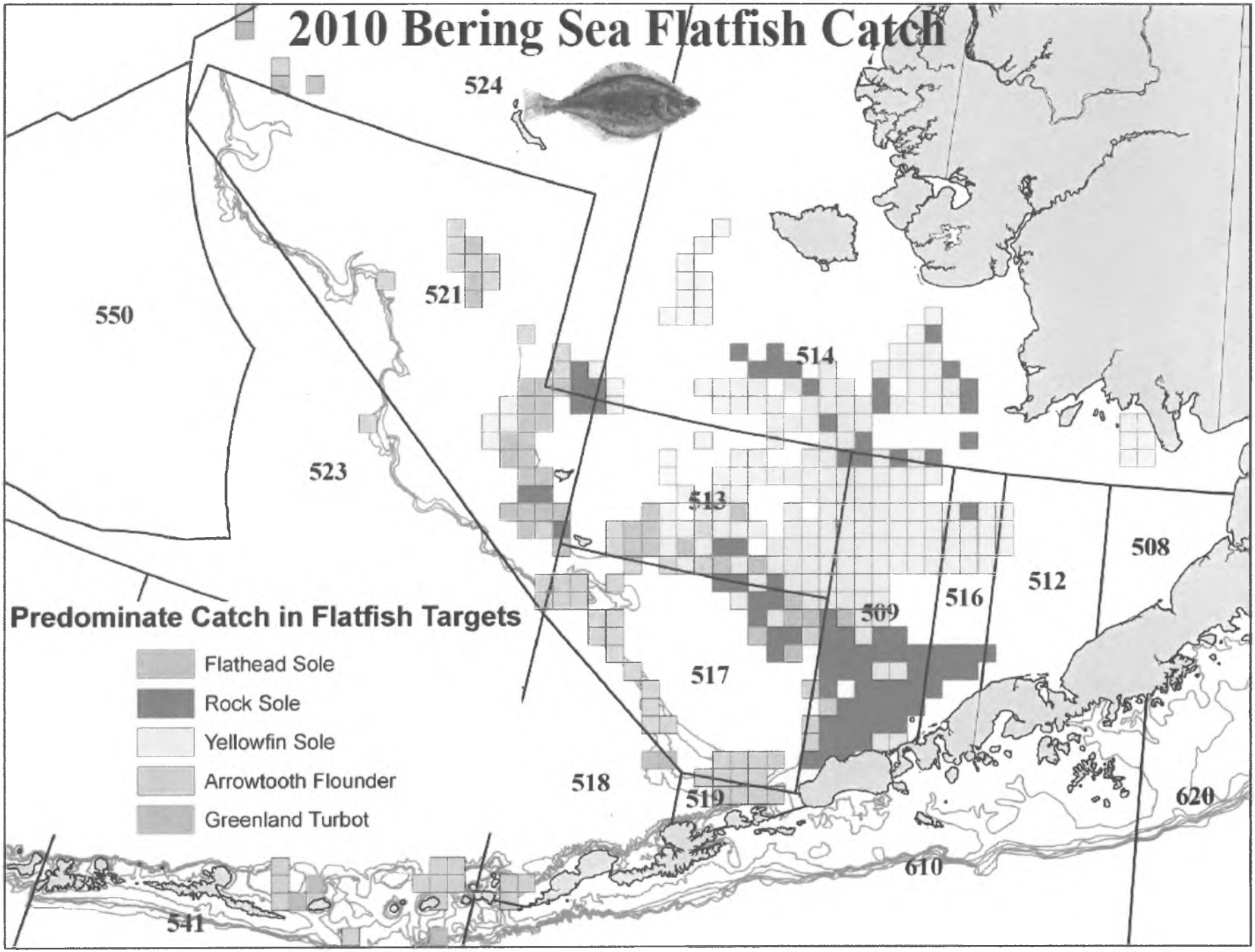
(From Table 5,Team Summary Appendix A)

Stock	ABC 2010 (mt)	ABC 2011 (mt)	ABC Change From 2010
Pacific Cod, BSAI	174,000	235,000	Up 35%
Sablefish, EBS	2,790	2,850	Up 2%
Sablefish, AI	2,070	1,900	Down 9%

Summary (Flatfishes)

(From Table 5,Team Summary Appendix A)

Stock	ABC 2010 (mt)	ABC 2011 (mt)	ABC Cha from 20
YellFn. Sole	219,000	239,000	Up 9%
Grn. Turbot	6,120	6,140	Up ?
Arrow. Fl.	156,000	153,000	Down 2%
N.RockSole	240,000	224,000	Down 6
Flathead S	69,200	69,300	No Chan
Alaska Plaice	224,000	64,100	Down ??
Other Flats	17,300	14,500	Down 16


2010 Bering Sea Flatfish Catch
524
550
521
514
523
513
508
512
516
509
517
518
519
620
610
541
Predominate Catch in Flatfish Targets
Flathead Sole
Rock Sole
Yellowfin Sole
Arrowtooth Flounder
Greenland Turbot

Summary (Rockfishes)

(From Table 5,Team Summary Appendix A)

Stock	ABC 2008 (mt)	ABC 2009 (mt)	ABC Change From 2009
POP, BSAI	18,860	24,700	Up 30%
Northern R	7,240	8,670	Up 20%
ShortRaker	387	393	Up 1%
Other Rockfish	1,040	1,280	Up 23%

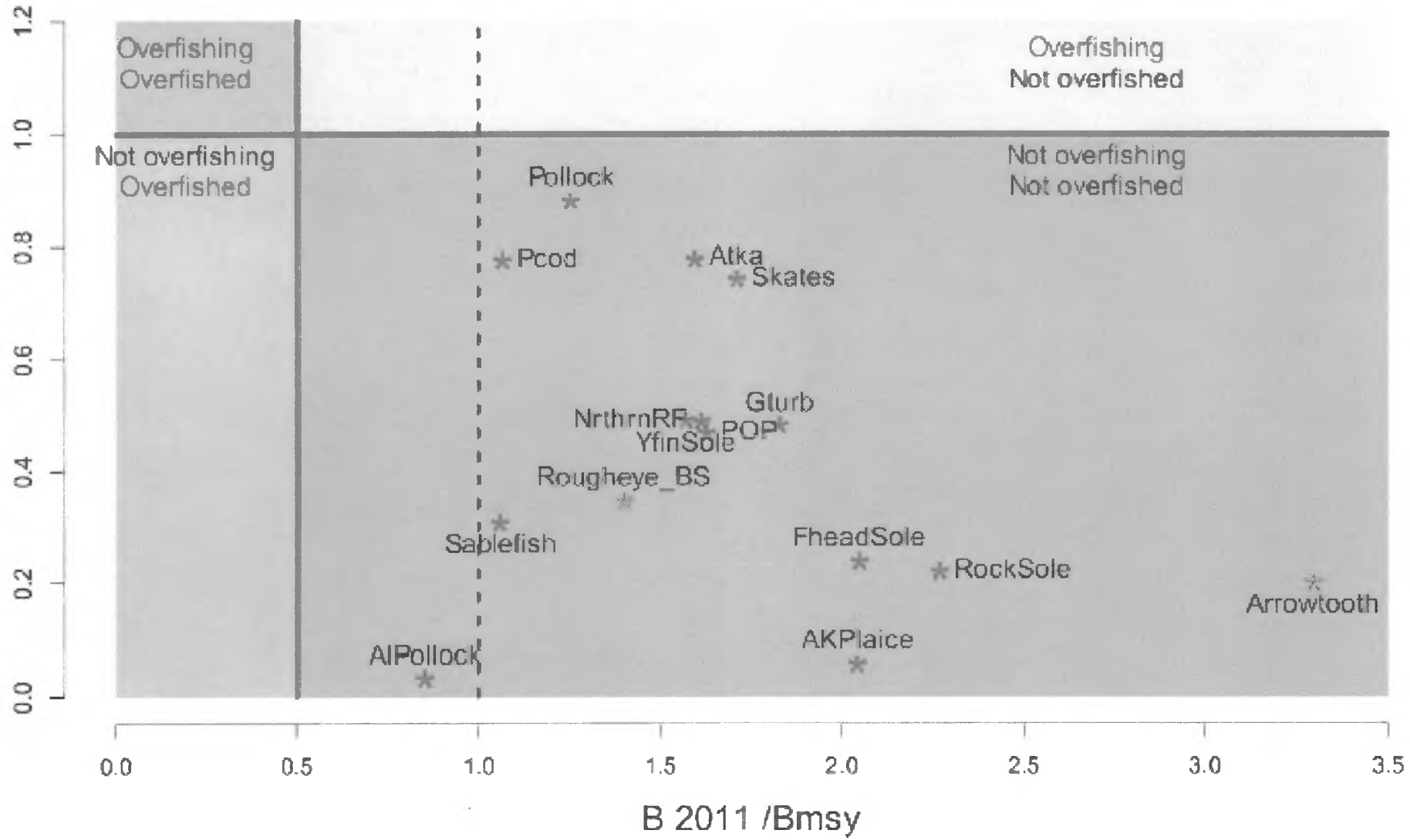
Summary (Atka Mackerel & Other Species)

(From Table 5,Team Summary Appendix A)

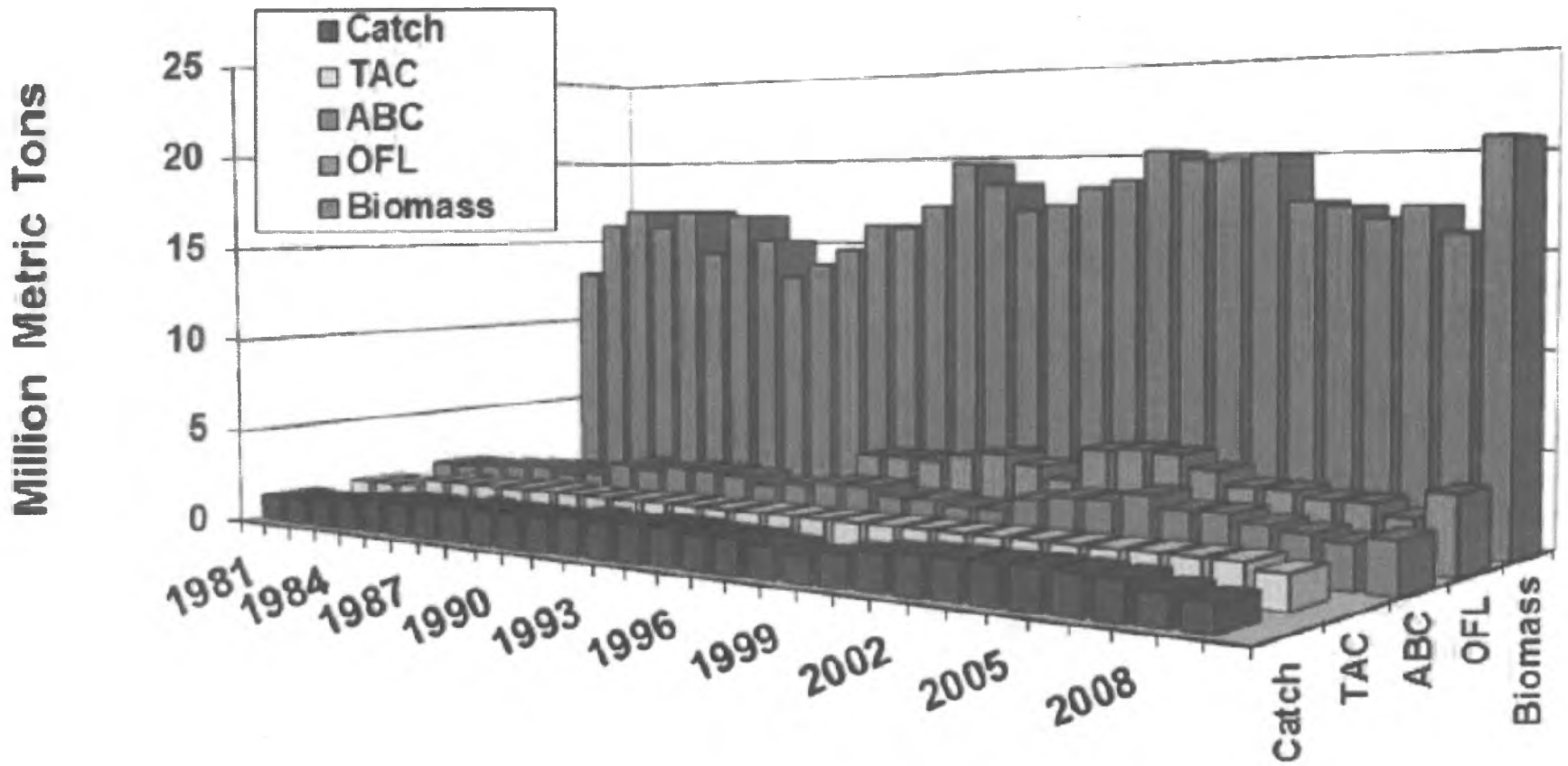
Stock	ABC 2010 (mt)	ABC 2011 (mt)	ABC Change From 2010
Atka Mackerel	74,000	84,300	Up 14%
Squid	1,970	1,970	No Change
Other Species	61,100	76,616	Up 25%

Report Card on Status of Stocks 2011

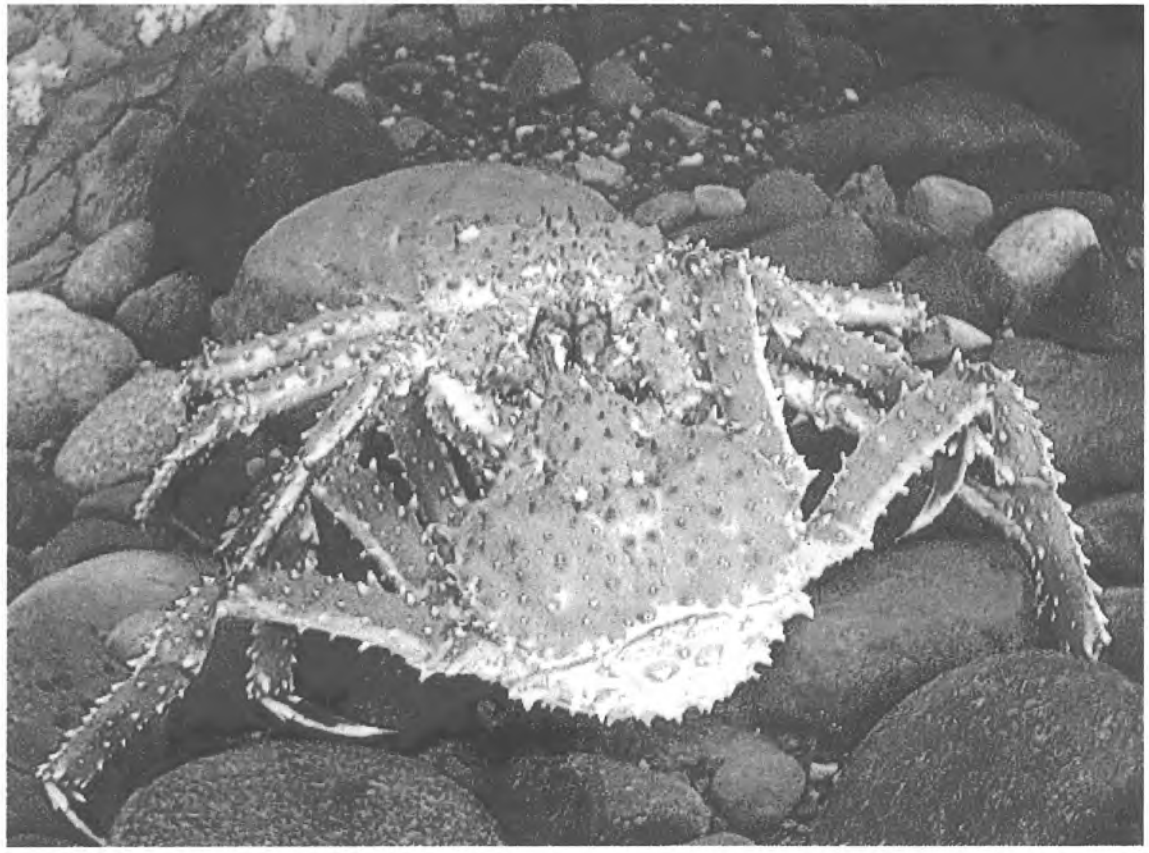
Bering Sea and Aleutian Islands



Bering Sea & Aleutian Islands Groundfish Catch Limits 1981-2010



Bering Sea Crab Fisheries



BSAI 2010/11 Crab Harvests

Species	Allocation Poundage (Millions)	Total Catch Poundage (Millions)	Ex-Vessel Value (Millions)
BB Red King	14.6	14.6	$91.2
Snow Crab	53.68	53.5	$120.1
Brown King	5.9	5.9	$20.1
Blue King	1.4	1.0	$4.5
Dungeness	N/A	795,392	$1.4
NS Red King	375,000lbs	400,000lbs	$1.27

Table 2-2.–Bristol Bay commercial red king crab general/ IFQ fishery economic data. 1980–2009/10.

	Value		Season length	
Season	Exvessel[a]	Total[b]	Days	Dates
1980	$0.90	$115.3	40	09/10-10/20
1981	$1.50	$49.3	91	09/10-12/15
1982	$3.05	$8.9	30	09/10-10/10
1983	FC	FC	FC	FC
1984	$2.60	$10.8	15	10/01-10/16
1985	$2.90	$12.1	8	09/25-10/02
1986	$4.05	$45.0	13	09/25-10/07
1987	$4.00	$48.7	12	09/25-10/06
1988	$5.10	$37.6	8	09/25-10/02
1989	$5.00	$50.9	12	09/25-10/06
1990	$5.00	$101.2	12	11/01-11/13
1991	$3.00	$51.2	7	11/01-11-08
1992	$5.00	$40.2	7	11/01-11/08
1993	$3.80	$55.1	9	11/01-11/10
1994	FC	FC	FC	FC
1995	FC	FC	FC	FC
1996	$4.01	$33.6	4	11/01-11/05
1997	$3.26	$28.5	4	11/01-11/05
1998	$2.64	$37.4	5	11/01-11/06
1999	$6.26	$69.1	5	10/15-10/20
2000[c]	$4.81	$36.0	4	10/16-10/20
2001	$4.81	$37.5	3	10/15-10/18
2002	$6.14	$54.2	3	10/15-10/18
2003	$5.08	$72.7	5	10/15-10/20
2004	$4.71	$65.7	3	10/15-10/18
2005/06	$4.24	$69.5	93	10/15-01/15
2006/07	$3.48	$48.0	93	10/15-01/15
2007/08	$4.19	$76.2	93	10/15-01/15
2008/09	$4.98	$90.3	93	10/15-01/15
2009/10	$4.44	$63.1	93	10/15-01/15

Note: FC = fishery closed

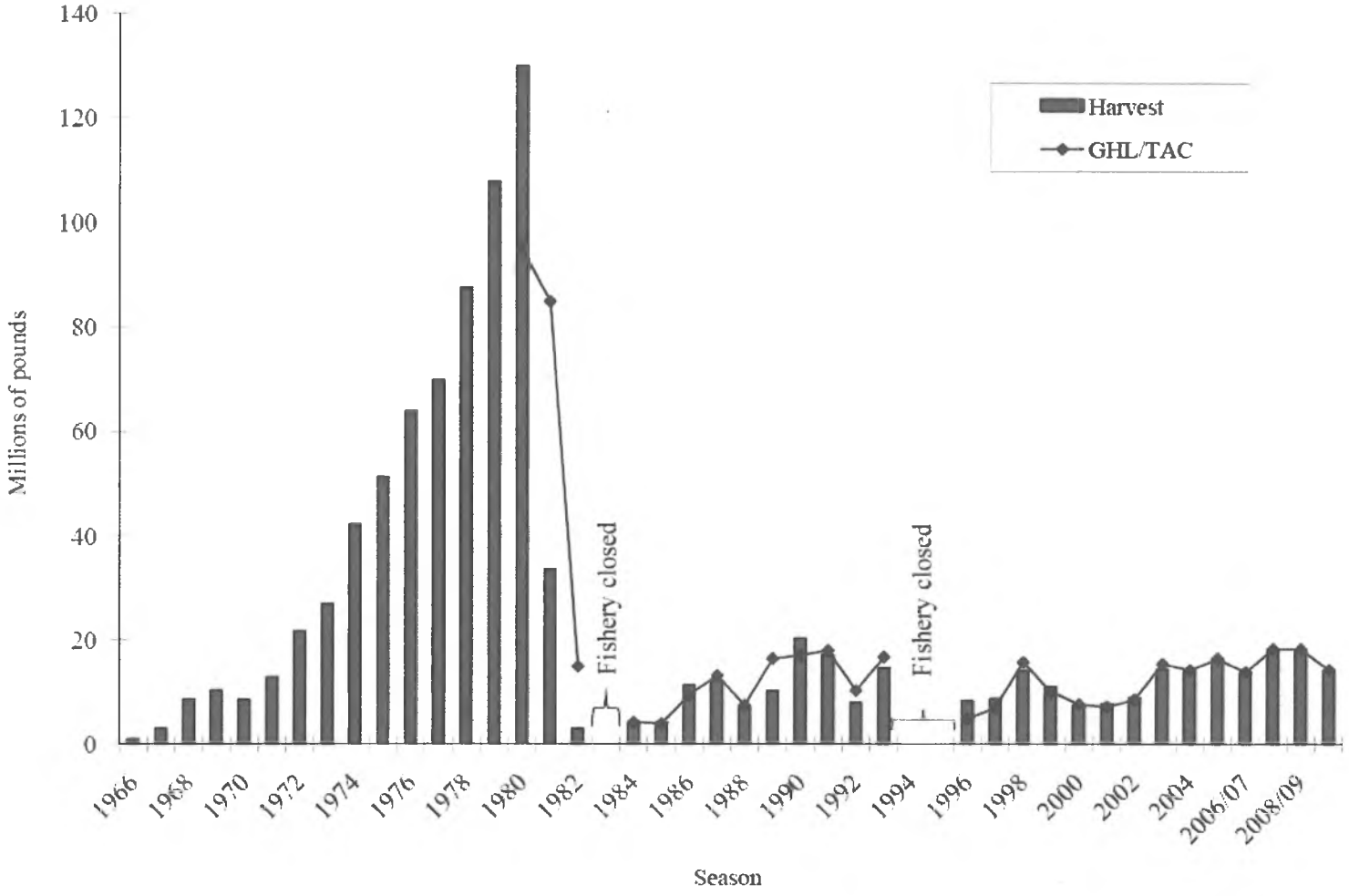


Figure 2-2.–Bristol Bay commercial red king crab general/IFQ fishery harvest and GHL/TAC, 1966–2009/10.

Table 2-28.–Bering Sea District commercial IFQ snow crab fishery economic data 1979/80–2009/10.

Season	Value		Registered pots[c]	Season length[d]
	Exvessel[a]	Total[b]		
1979/80	$0.21	$82.50	35,503	307
1981	$0.26	$13.10	39,789	229
1982	$0.73	$20.70	35,522	167
1983[e]	$0.35	$8.70	15,396	120
1984[e]	$0.30	$7.80	12,493	320
1985[e]	$0.30	$19.50	15,325	333
1986[e]	$0.60	$60.00	13,750	252
1987[e]	$0.75	$75.70	19,386	158
1988[e]	$0.77	$100.70	38,765	120
1989[e]	$0.75	$110.70	43,607	112
1990[e]	$0.64	$102.30	46,440	148
1991[e]	$0.50	$162.60	76,056	159
1992	$0.50	$156.50	77,858	97
1993	$0.75	$171.90	65,081	59
1994	$1.30	$192.40	54,837	45
1995	$2.43	$180.00	53,707	33
1996	$1.33	$85.60	50,169	45
1997	$0.79	$92.60	47,036	65
1998	$0.56	$134.65	47,909	64
1999	$0.88	$160.78	50,173	66
2000	$1.81	$55.09	43,407	7
2001	$1.53	$32.12	40,379	30
2002	$1.49	$44.20	37,807	24
2003	$1.83	$46.98	20,452	9
2004	$2.05	$44.99	14,444	8
2005	$1.80	$41.47	12,840	6
2005/06[f]	$0.84	$27.66	13,734	229
2006/07	$1.40	$36.85	10,851	229
2007/08	$1.60	$89.96	13,647	229
2008/09	$1.37	$71.49	12,549	229
2009/10	$1.13	$48.27	11,804	229

[a] Average price per pound.

[b] Millions of dollars.

[c] Prior to 1992 includes Tanner crab gear.

[d] In days.

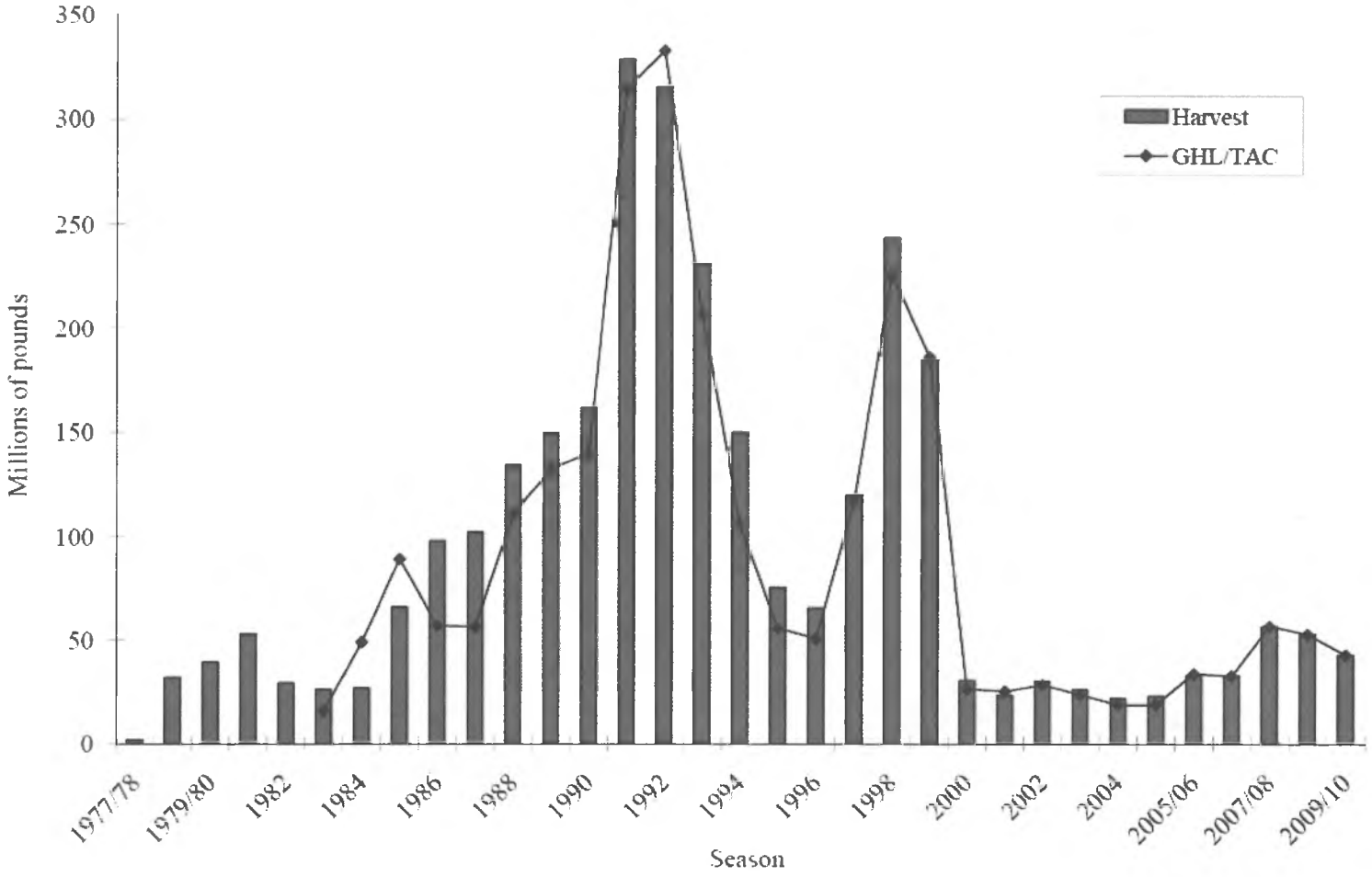
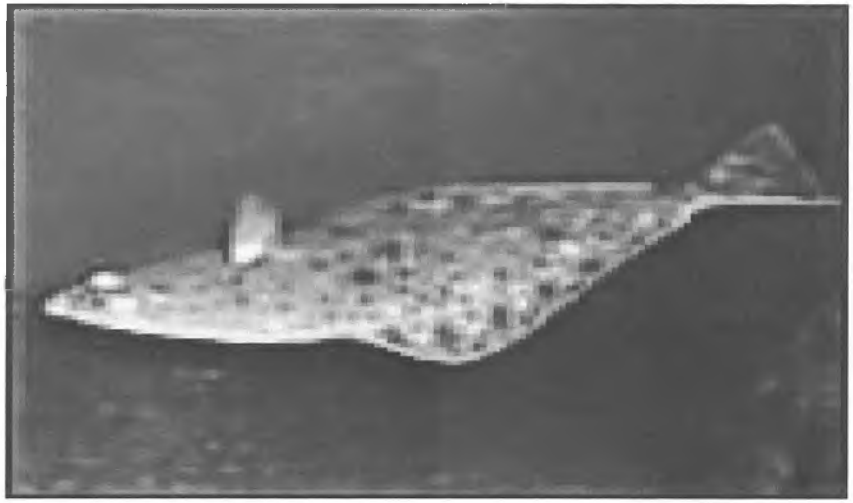


Figure 2-11.–Bering Sea District commercial snow crab general/IFQ fishery harvest and GHL/TAC, 1977/78–2009/10.

Halibut/Sablefish IFQ's



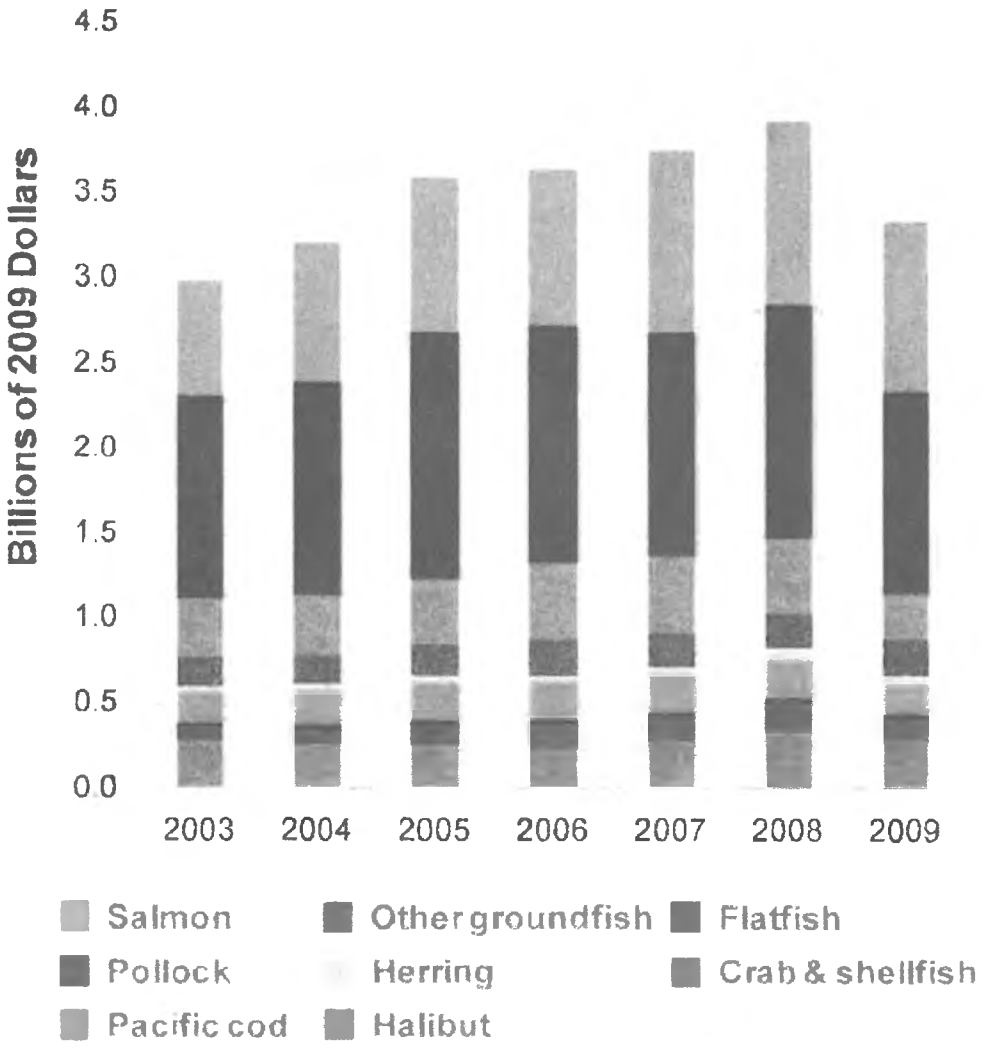
BSAI IFQ Halibut 2010

Areas	IFQ TAC (Millions)	Total Harvest (Millions)	Ex-Vessel Value (Millions)
4-A	4.4	4.35	$20.8
4-B	1.72	1.39	$6.6
4-C	812,000	106,000	$508,000
4-D	1.13	1.7	$8.1
Totals	8.06	7.54	$36.0

BSAI IFQ Sablefish 2010

Areas	IFQ TAC (Millions)	Total Harvest (Millions)	Ex-Vessel Value (Millions)
Bering Sea	2.4	1.08	$6.3
Aleutians	2.7	1.41	$8.3
Totals	5.1	2.49	$14.6

Real Wholesale Value by Species, 2003-2009



Source: Hiatt, 2007 and Hiatt, 2010b

Table 1. Seafood Industry Employment by Region, 2009

Summary of Workers	Harvesting	Processing	Total
Aleutian and Pribilof Islands	5,309	6,276	11,585
Bristol Bay	9,385	4,522	13,907
Kodiak	3,664	2,934	6,598
Northern	627	68	695
Southcentral	8,071	3,491	11,562
Southeast	10,150	4,886	15,036
Yukon Delta	2,986	831	3,817
At-Sea	1,732	5,616	7,348
Total	**41,924**	**28,624**	**70,548**

Source: Northern Economics, Inc. and ADOLWD, 2010.

Table 2. Estimated Seafood Ex-vessel Volume and Value by Region, 2009

Region	Harvest Weight (1,000 MT)	Ex-Vessel Value ($ Millions)
Aleutian and Pribilof Islands	497.2	393.7
Bristol Bay	86.6	119.0
Kodiak	157.2	129.8
Northwest/Arctic/Yukon-Kuskokwim	3.9	6.7
Southcentral	77.8	177.0
Southeast	134.4	209.8
At-Sea	883.0	307.9
Total	**1,840.0**	**1,343.8**

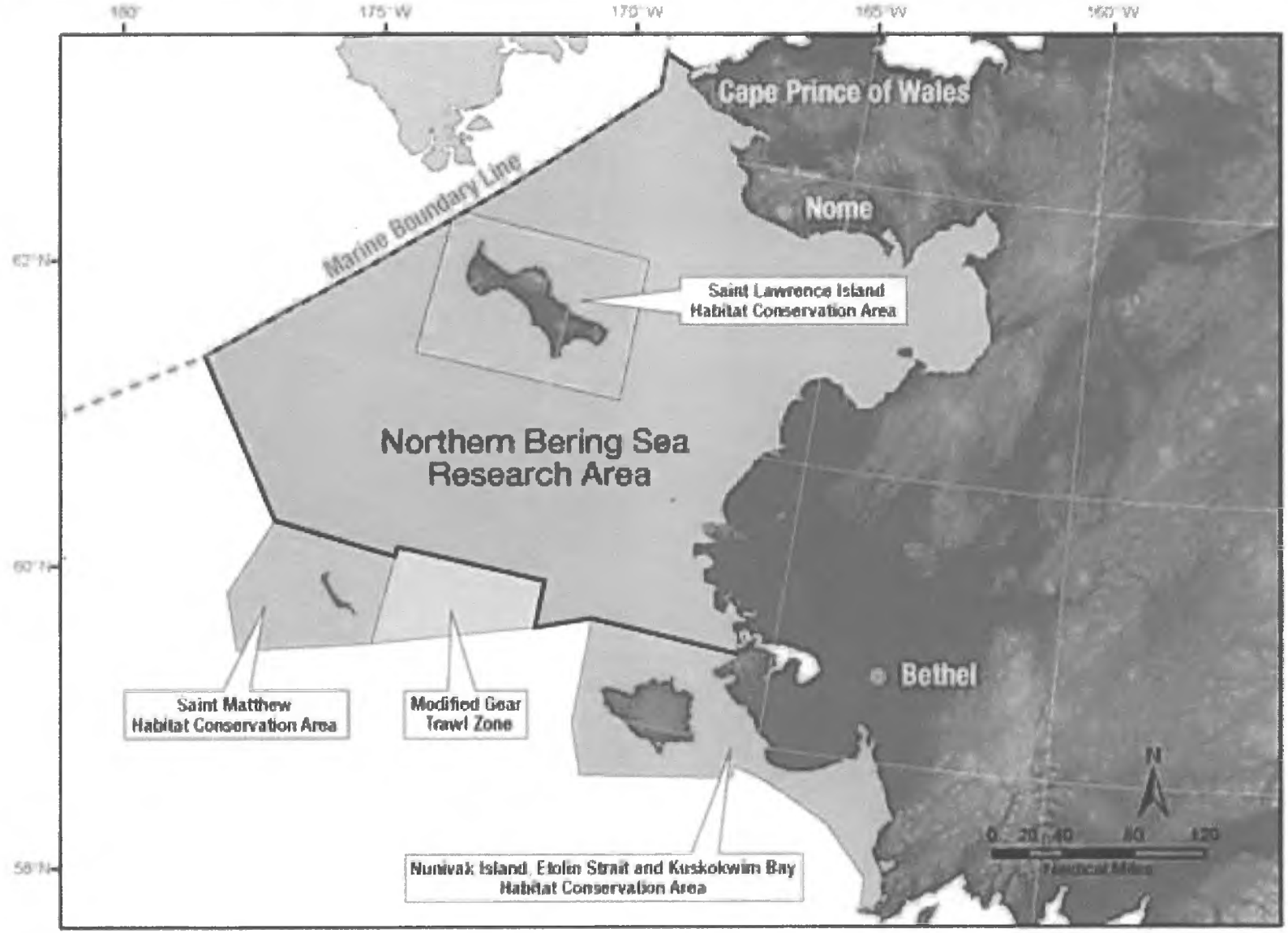
Source: Estimated by Northern Economics using NMFS (2010a), Hiatt (2010a) and Hiatt (2010b)

Table 3. Estimated Seafood Wholesale Volume and Value by Region, 2009

Region	Product Weight (1,000 MT)	Wholesale Value ($ Millions)
Aleutian and Pribilof Islands	180.9	735.8
Bristol Bay	48.6	250.2
Kodiak	72.9	261.1
Northwest/Arctic/Yukon-Kuskokwim	2.3	15.9
Southcentral	45.4	289.3
Southeast	81.1	374.2
At-Sea	457.0	1,396.3
Total	**888.1**	**3,322.9**

Source: Hiatt, 2010b

Northern Bering Sea Research Area



ure 1-1 **Arctic Management Area of the Chukchi and Beaufort Seas (Source: NMFS Alaska Region Analytical Team 2009)**

Table 4-2 Biomass estimates for key species and taxonomic groups in the Beaufort and Chukchi Sea regions

		survey region		
		Chukchi	Beaufort	total
Area (km^2)		98,803	6,280	105,083
Biomass estimates (mt)				
Individual fish species				
Arctic cod	*Boreogadus saida*	27,122	15,217	42,339
saffron cod	*Eleginus gracilis*	4,605	0	4,605
Bering flounder	*Hippoglossoides robustus*	1,761	463	2,224
Pacific herring	*Clupea pallasi*	1,298	0	1,298
warty sculpin	*Myoxocephalus verrucosus*	966	14	980
marbled eelpout	*Lycodes raridens*	963	1,582	2,544
Arctic staghorn sculpin	*Gymnocanthus tricuspis*	843	1	844
Canadian eelpout	*Lycodes polaris*	794	479	1,272
walleye pollock	*Theragra chalcogramma*	187	383	570
Pacific cod	*Gadus macrocephalus*	90	13	102
Alaska plaice	*Pleuronectes quadrituberculatus*	56	0	56
yellowfin sole	*Limanda aspera*	17	0	17
capelin	*Mallotus villosus*	15	0	15
Greenland turbot	*Reinhardtius hippoglossoides*	10	143	153
Fish groups				
snailfishes		252	167	418
pricklebacks		122	11	132
other sculpins		4,980	14	4,994
other eelpouts		478	338	816
miscellaneous fish species		257	8	265
Individual invertebrate species				
snow crab	*Chionoecetes opilio*			
-total biomass		66,491	29,731	96,222
-exploitable biomass		**0**	**6,571**	**6,571**
cucumboreal toad crab	*Hyas coarctatus*	5,206	742	5,949
notched brittlestar	*Ophiura sarsi*	993	115,821	116,814
red king crab	*Paralithodes camtschaticus*	36	0	36
blue king crab	*Paralithodes platypus*	285	8	8
Miscellaneous invertebrate species		636,920	76,178	713,098
Total fish biomass		**44,815**	**18,831**	**63,646**
Total invertebrate biomass		709,931	227,662	937,592
Total biomass		754,746	246,493	1,001,239

Arctic Foreseeable Future Actions

Table 3-1 Past, Present, and Reasonably Foreseeable Future Actions

Oil, gas, and mineral development	• Lease sales, seismic exploration, and exploratory drilling • Chukchi Sea routine exploration • Beaufort Sea routine exploration • Other mineral development • Introduction of invasive species
Transportation and shipping	• Seasonal tug, barge, freight transport supporting local development • New polar shipping routes • Introduction of invasive species
Changing infrastructure demands	• Infrastructure changes in response to melting permafrost, increases in flooding, and coastal erosion
Subsistence and Commercial Harvests	• Subsistence – bowheads, beluga, seals, fish, birds • Past commercial whaling
Scientific research	• Icebreakers • Seasonal surveys • Marine mammal research
Actions by other federal, state, and international agencies	• US Coast Guard activities • Expansion and construction of boat harbors • Tourism

Issues of Concern facing Bering Sea/ Aleutian Island Fisheries

- Endangered Species Act
- Marine Spatial Planning
- Bycatch Management
- Catch Share Legislation
- Marine Protected Areas
- MSA Reauthorization

Video of drone aircraft with a video camera to improve SSL counts

- This program is being worked on by Cascade Fishing Company, North Pacific Fisheries Foundation and University of Alaska Fairbanks. Cascade Fishing is heavily involved in the Aleutian Island Mackerel and Pacific Cod fisheries, that have been impacted by the latest SSL Bi-Op restrictions.

Questions?

7
Arctic Fishery Management

9/26 10/9 Fishie meeting

Development and Implementation of an Arctic Fishery Management Plan

Steve A. MacLean
North Pacific Fishery Management Council
Northern Waters Task Force Meeting
Unalaska, Alaska
24 August, 2011

1

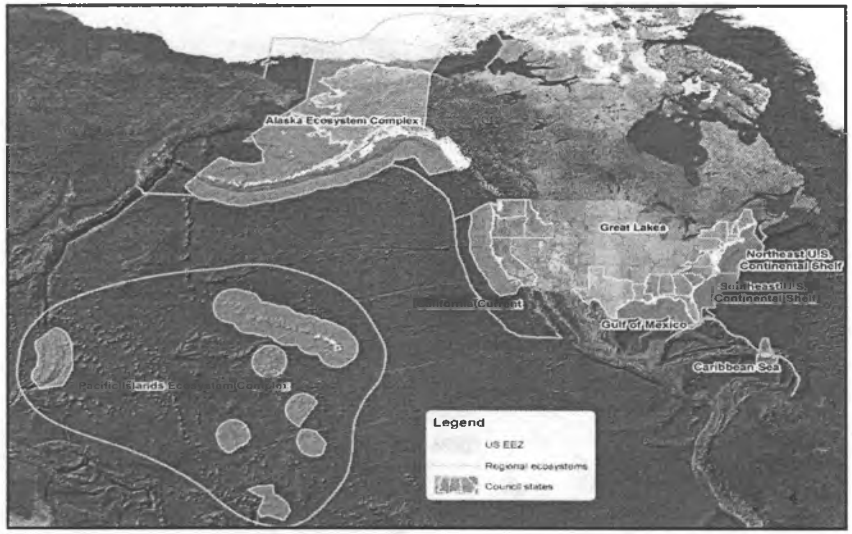
Who is the North Pacific Fishery Management Council?

What is an Arctic Fishery Management Plan?

What do we do with an Arctic Fishery Management Plan?

2

Membership of the North Pacific Fishery Management Council



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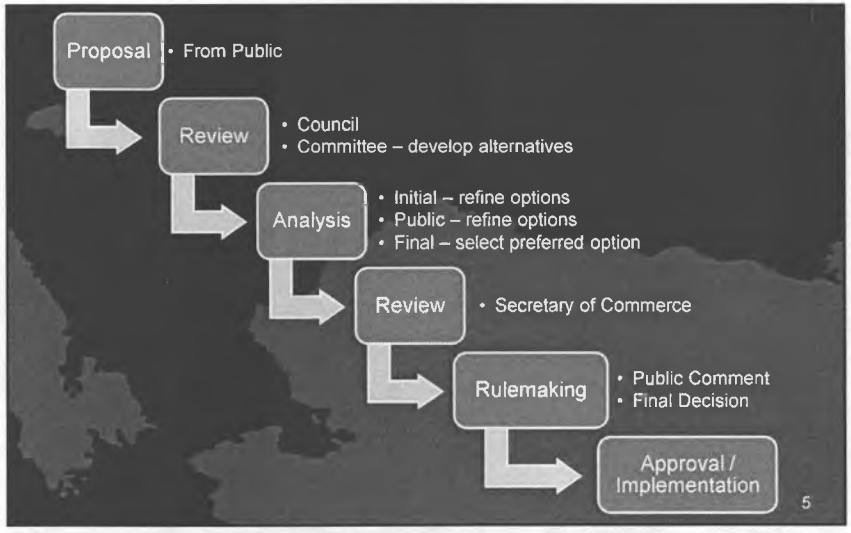


Who is the North Pacific Fishery Management Council?

What is an Arctic Fishery Management Plan?

What do we do with an Arctic Fishery Management Plan?

6

Fishery Management Plans (FMPs)

- Policy guidance for fishery management
- Informs the public
- Establishes expectations
- Content:
  - Conservation and management measures necessary to prevent overfishing and to promote long-term health and stability of the fishery

7

National Standards

1. Prevent Overfishing
2. Use Best Scientific Information
3. Manage Stocks as Discrete Units
4. No Discrimination Between Residents of Different States
5. Promote Efficiency in Fishery Resource Utilization
6. Variations in Fisheries, Fish Stocks and Catches
7. Minimize Costs and Avoid Duplication
8. Include Fishing Communities
9. Minimize Bycatch and Bycatch Mortality
10. Promote Safety

8

Fishery Regulations

- Catch Quotas
- Gear Types
- Seasons
- Bycatch Limits
- PSC Limits
- Protected Resources
- Habitat
- Entry Control
- Community Considerations

9

Existing Fishery Management Plans

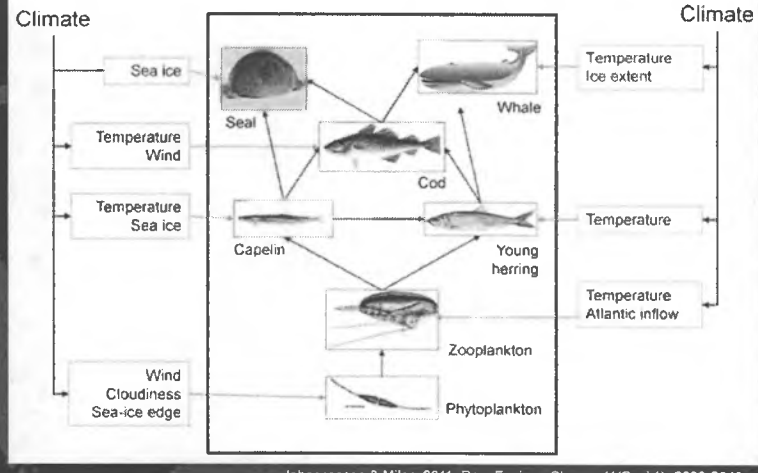
- GOA Groundfish
- BSAI Groundfish
  - Aleutian Islands Fishery Ecosystem Plan
- BSAI King and Tanner Crab
- Alaska Scallop
- Salmon
- Arctic

10

Heightened Interest in Arctic

- Alaska ecosystem management initiatives
- Ecosystem-based fishery management
- Public comment
- Proactively address future issues in the Arctic
- Orderly Arctic fishery development

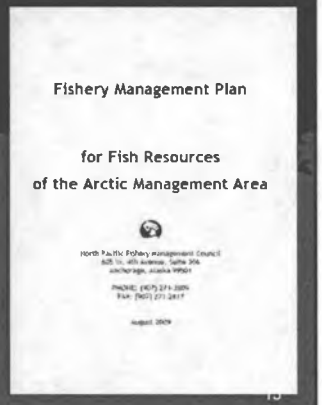
11



Johannessen & Miles. 2011. Reg. Environ. Change 11(Supl 1): S239-S248

Arctic Fishery Management Plan

- Available at NPFMC website
  - www.fakr.noaa.gov/npfmc/
- 7 Chapters
  - Introduction
  - Management Policy & Objectives
  - Conservation & Management Measures
  - Habitat, Fisheries, Ecosystem
  - Applicable Law and Other Fisheries
  - Fishery Impact Statement
  - References


Fishery Management Plan

for Fish Resources
of the Arctic Management Area

13

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Chapter 2: Management Policy & Objectives

Ecosystem-based management policy that proactively applies judicious and responsible fisheries management practices, based on sound scientific research and analysis, to ensure the sustainability of fishery resources, to prevent unregulated or poorly regulated commercial fishing, and to protect associated ecosystems for the benefit of current users and future generations.

1. Biological Conservation
2. Economic and Social
3. Gear Conflict
4. Habitat
5. Vessel Safety
6. Due Process
7. Research and Management
8. Alaska Native Consultation
9. Enforceability
10. Marine Mammal and Seabird

15

Chapter 3: Conservation and Management Measures

- Assessment of biological resources of Management Area
- Best available scientific information
- Establish Fisheries Management criteria
  - Maximum Sustainable Yield
  - Optimum Yield
  - Methods
  - Overfishing Limits
  - Finfish Tiers
  - Acceptable Biological Catch
  - Total Allowable Catch
- Restrictions
  - Gear, Time & Area, Catch, Bycatch,
- Monitoring
- Management & Enforcement

16

Summarize Existing Data

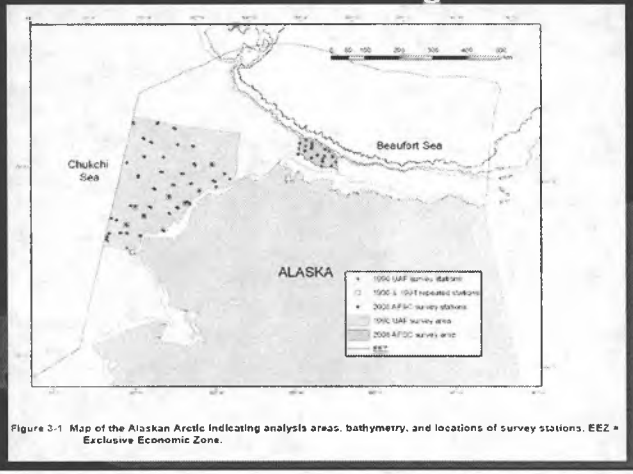
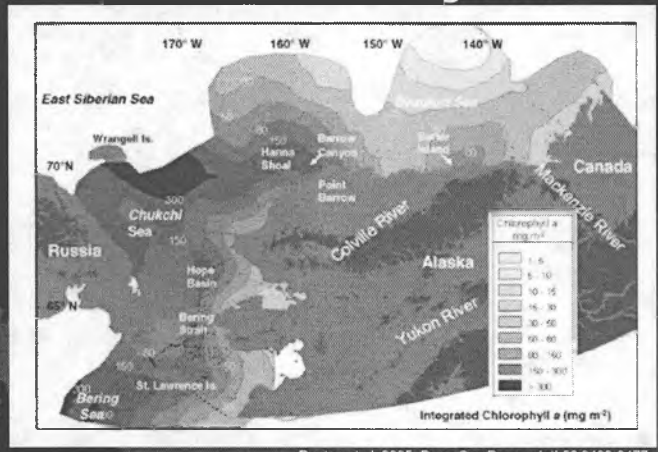


Figure 3-1 Map of the Alaskan Arctic indicating analysis areas, bathymetry, and locations of survey stations. EEZ = Exclusive Economic Zone.

17

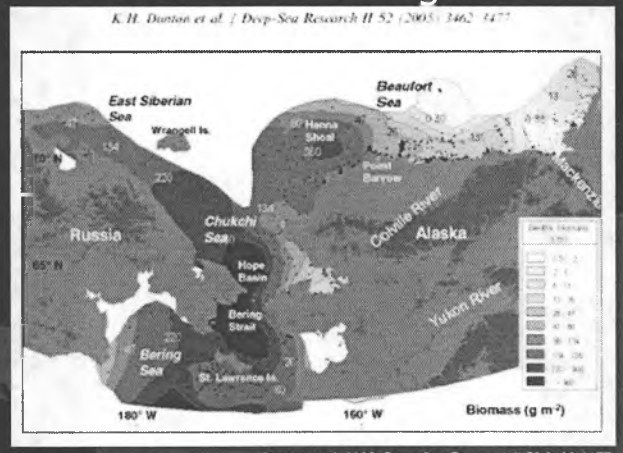
Summarize Existing Data



Dunton et al. 2005. Deep-Sea Research II 52:3462-3477

18

Summarize Existing Data



Dunton et al. 2005. Deep-Sea Research II 52:3462-3477

19

		Survey Region	
		Chukchi	Beaufort
Species		Biomass estimate (mt)	
Arctic Cod	*Boreogadis saida*	27,122	15,127
Saffron Cod	*Eleginus gracilis*	4,605	0
Bering Flounder	*Hippoglossoides robustus*	1,761	436
Pacific herring	*Clupea pallasi*	1,298	0
Warty sculpin	*Myoxocephalus verrucosus*	966	14
Snow crab	*Chionoecetes opilio*	66,491	29,731

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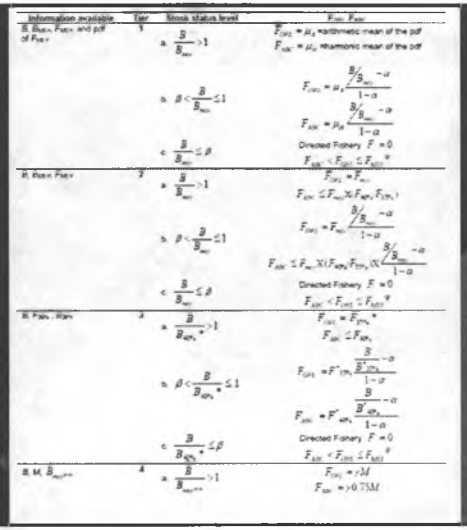

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Fishery Criteria

- Maximum Sustainable Yield
  - Arctic Cod – 5,758 mt
  - Saffron Cod – 589 mt
  - Snow Crab – 453 mt
- Optimum Yield
  - Reductions from Socio-economic, ecological factors
  - Arctic Cod – 100%
  - Saffron Cod – 100%
  - Snow Crab – 100%

No commercial fishing for any FMP managed fishery is currently authorized in the Arctic management area

22

application of products of science

Research

- Council research priorities
- Activities most important for conservation and management of fisheries
- Recommended by Council
- Conducted by
  - NOAA
  - ADFG
  - Universities
  - NGOs
- Funded by NSF, NPRB, etc.

I. Fisheries
II. Fisheries Interactions
III. Habitat
IV. Other Needs

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Chapter 4: Fishery Impact Statement

Because the Arctic FMP does not [currently] *authorize any commercial fishing and no commercial fishing occurred… no fishery impact is expected.*

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Who is the North Pacific Fishery Management Council?

What is an Arctic Fishery Management Plan?

What do we do with an Arctic Fishery Management Plan?

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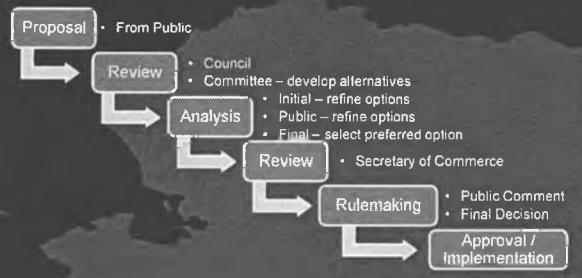
Review and Implementation

- Arctic Fisheries Prohibited
- Continue Research to Understand Arctic Ecosystem
- Evaluate Populations for Potential Commercial Fisheries



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Thank You

Contact:

North Pacific Fishery Management Council
605 West 4th Ave, Suite 306
Anchorage, AK 99501
907-271-2809
907-271-2817 (fax)
Steve MacLean
steve.maclean@noaa.gov
www.fakr.noaa.gov/npfmc

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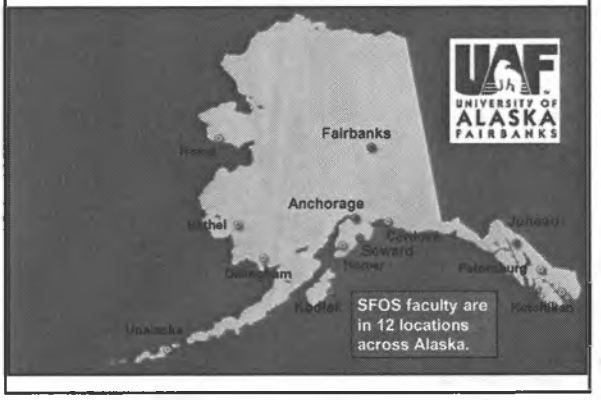
8
Arctic Fisheries Research

Arctic Fisheries Research

Dr. Gordon H. Kruse
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks

UAF School of Fisheries and Ocean Sciences



UAF Fishery Research Locations

Southeast

Gulf of Alaska

Bering Sea

Aleutians

Arctic

UAF School of Fisheries & Ocean Sciences

Headquartered in Fairbanks

Fisheries Division	Fishery Industrial Technology Center	Seward Marine Center	Alaska Sea Grant	Marine Advisory Program	Institute of Marine Science
Juneau & Fairbanks	*Kodiak*	*Seward*	*Fairbanks*	*Anchorage + 10 coastal communities*	*Fairbanks*

SFOS Fisheries Division for AY10-11

SFOS Combined:

- $18.2 million in research grants/contracts
- Breakdown: 67% federal, 28% corporate/private, and 5% state/local

Fisheries Division:

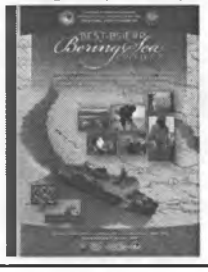
- 13.5 fisheries faculty (5.5 in Fairbanks and 8 in Juneau)
- 71 fisheries undergraduates (59 B.S. and 12 B.A.)
- 80 graduate students (51 M.S. and 29 Ph.D.)

Recent SFOS Fishery Research Topics

- **Freshwater fisheries**
  - Ecology, population dynamics and fisheries for whitefishes, inconnu, lampreys, northern pike, rainbow trout, Arctic char, burbot, etc.
- **Anadromous fisheries**
  - Salmon genetics, ecology, diseases, survival, population dynamics, and fishery management
- **Marine Fisheries**
  - Genetics, ecology, population dynamics, fishery oceanography, economics, seafood science, and management of Pacific halibut, rockfishes, sablefish, pollock, cod, herring, crabs, shrimps, octopus, etc.

Integrated Ecosystem Research in the Bering Sea

Bering Ecosystem Study (BEST)
+
Bering Sea Integrated Ecosystem Research Program (BSIERP)



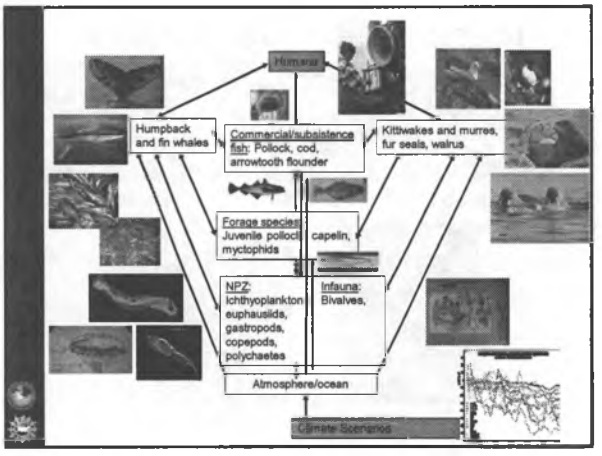
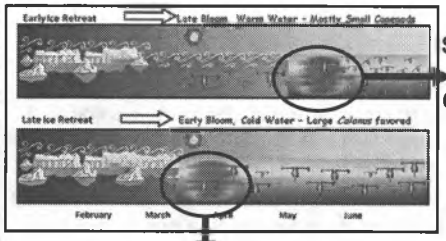


Illustration of Timing of Ice Retreat and Spring Bloom



Stays in Water Column

to Bottom

Retrospective Analysis of Trends in Fish, Seabird, and Mammal Populations in the Eastern Bering Sea

UAF PIs: Franz Mueter, Gordon Kruse

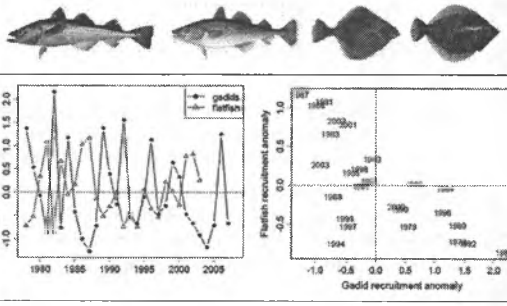
Collaborators: USFWS

Project Status: Ongoing

Project Goals: (1) Examine similarities/differences in trends in abundance, productivity, and diets among fish, seabirds, and marine mammals; (2) estimate relationships with environmental variability.

Motivation: Understanding trends and possible drivers will allow better predictions of the future effects of climate variability.

Results: Environmental variability appears to have some common and opposite effects on different species. Hence, there will be some 'winners' and 'losers' under climate change.



Biomass Dynamic Model for the Eastern Bering Sea

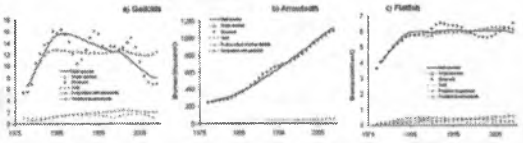
UAF PIs: Gordon Kruse, Franz Mueter

Project Status: Ongoing

Project Goals: (1) Develop a relatively simple simulation model describing the ecological interactions of pollock, cod, arrowtooth flounder, and other flatfishes; (2) determine whether this simple model can perform as well or better than complex ecosystem models for forecasting.

Motivation: Large ecosystem models are very expensive, complex, and tend not to be useful for fishery management purposes.

Results:



- Loss of cod biomass owing to competition/predation by arrowtooth flounder exceeded commercial catches of cod since 1986
- Negative effects of arrowtooth flounder will intensify with continued increases in their abundance

Shifts in Spatial Distribution of Fish and Shellfish on the Eastern Bering Sea Shelf

UAF PI: Franz Mueter

Co-PI: Blue World Research

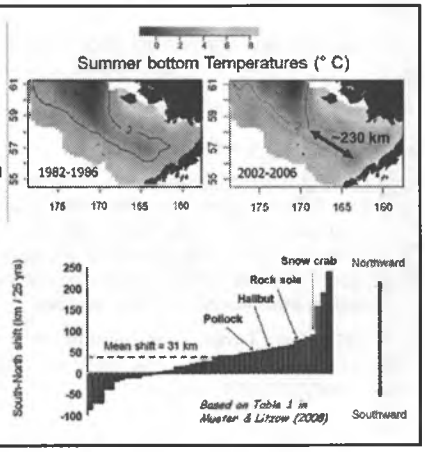
Project Status: Ongoing

Project Goal: Understand shifts in the spatial distribution of fish and invertebrates in the eastern Bering Sea

Motivation: Shifts in the distribution of commercial species in the eastern Bering Sea may affect their availability to the fishery, as well as their predator-prey interactions with other species

Results:

Northward shifts in distribution of many species and changes in species composition and diversity are associated with warming trends



Forecasting Changes in Eastern Bering Sea Walleye Pollock under Climate Change

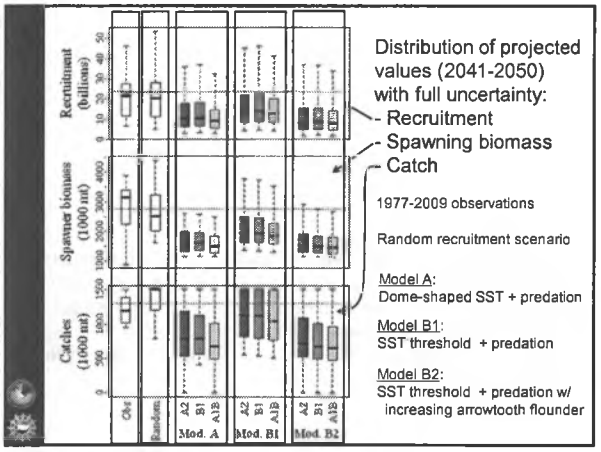
UAF PI: Franz Mueter

Collaborators: NOAA, University of Washington

Project Status: Completed

Project Goals: Forecast likely catch levels, recruitment, and biomass of EBS walleye pollock under different climate scenarios and harvest strategies through 2050.

Motivation: Walleye pollock in the eastern Bering Sea support the largest commercial fishery in Alaska. Long-term forecasts can help managers and industry prepare for possible effects of climate change.



Distribution of projected values (2041-2050) with full uncertainty:
- Recruitment
- Spawning biomass
- Catch

1977-2009 observations

Random recruitment scenario

Model A:
Dome-shaped SST + predation

Model B1:
SST threshold + predation

Model B2:
SST threshold + predation w/ increasing arrowtooth flounder

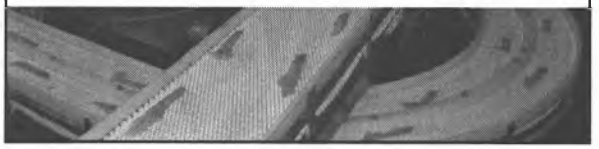
A Historical and Economic Analysis of the Bering Sea Pollock Fishery

UAF PIs: Keith Criddle

Project Status: completed

Funding Source: NMFS

Project Goal: Document the development and evolution of the eastern Bering Sea pollock fishery and to develop statistical model of domestic and international markets for pollock fillets, surimi, and roe.



Results:

- The Western Alaska CDQ program entities receive about $60 million/yr in royalties from pollock leases and about $120 million/yr from investments from royalties.
- Because fuel costs are likely to continue to rise and pollock are increasingly likely to be found at long distances from processing plants in Unalaska and Akutan, losses to the State, CDQs, and the pollock fishery are likely.
- In fall 2007, the inshore sector left 37,991 mt worth $8 million of the B-season (July-October) pollock allocation unharvested due to high fuel prices and long distances to productive pollock fishing grounds northwest of the Pribilofs.

Cooperative and Non-cooperative Strategies for Management of Bering Sea Pollock

UAF PIs: Keith Criddle, Terrance Quinn II

Project Status: in progress

Funding Source: NPRB

Project Goal: Derive management strategies for eastern Bering Sea pollock that better account for Russian catches in the Navarin Basin

Motivation: Under warm conditions, a portion of the EBS pollock stock shifts into Russian waters. Russian catches are not considered in current management. As warming continues, failure to account for Russian catches could jeopardize sustainability of EBS pollock.

Characterization of the Salmon Bycatch in the Bering Sea and Aleutian Islands (BSAI) Pollock Fisheries and its Effects

UAF PIs: Milo Adkison, Keith Criddle

Project Status: in progress

Funding Source: NPRB

Project Goal: Determine the impact of bycatch in Bering Sea groundfish trawl fisheries on Western Alaska salmon returns

Motivation: Although salmon bycatch is a small (<0.1%) percentage of the target catch, the magnitude of groundfish harvests from the BSAI trawl fisheries is so great that total bycatch of Chinook and other salmon can be substantial.

Dispersal and Behavior of Pacific Halibut in the Bering Sea and Aleutian Islands

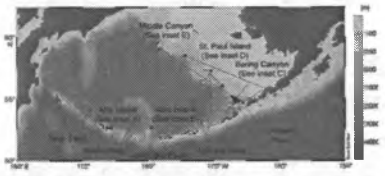
UAF PIs: Andy Seitz and Brenda Norcross

Collaborating organization(s): IPHS USGS

Funding source: IPHC, USGS, NPRB

Project Status: Ongoing

Project Goal: To investigate the degree to which halibut, found in the BSAI during summer, remain there to spawn in winter. A better understanding of spawning stock structure may yield insight into why halibut abundance is increasing in the Bering Sea and western GOA and decreasing in the eastern GOA and Southeast AK.



Results:

- The BSAI region contains a separate spawning group of adult halibut
- There is evidence for geographically localized groups of halibut along the Aleutian Islands; their movements may be impeded by tidal currents in island passes.
- Mid-winter aggregation areas of halibut are assumed to be spawning grounds, extending the species' presumed spawning range

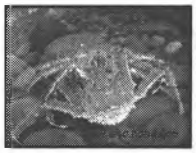
Other Related Projects

- The molecular genetics of chum salmon for conservation, management, and evolutionary studies – Tony Gharrett (UAF) and NMFS and ADF&G colleagues.

- Molecular evolution of the poachers (Agonidae) – Andres Lopez (UAF)

- Evolution of reproductive biology in sculpins (Cottidae) – Andres Lopez

Effects of Climate and Gadid Predation on Red King Crab



UAF PI: Gordon Kruse

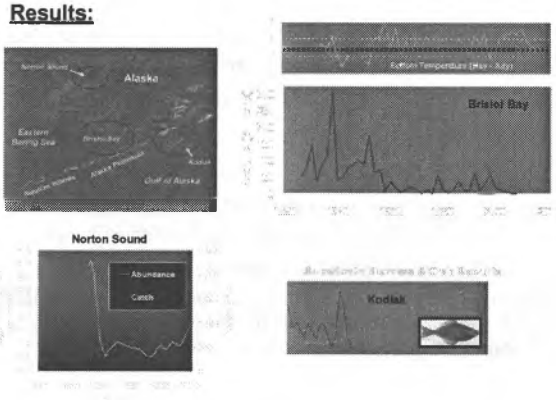
Co-Pis: ADF&G, Bechtol Research

Project Status: Ongoing

Project Goal: Develop an understanding of king crab stock successes and failures by comparative analysis

Motivation: Most red king crab fisheries collapsed in the early 1980s. Few recovered and many remain severely depressed.

Results:



Recruitment Mechanisms for Tanner crabs in the Eastern Bering Sea

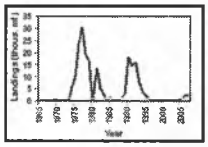
UAF PIs: Gordon Kruse

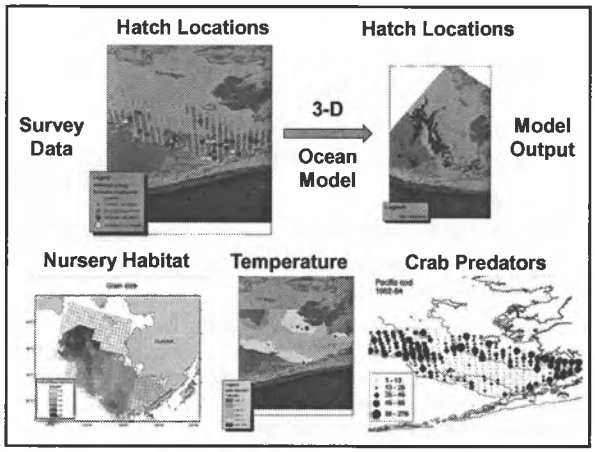
Co-PIs: NOAA, Rutgers

Project Status: Ongoing

Project Goal: Investigate processes that regulate the productivity of Tanner crab fisheries in the eastern Bering Sea

Motivation:





Development of Biological References Points for Bering Sea Snow Crab

UAF PIs: Ginny Eckert, Gordon Kruse

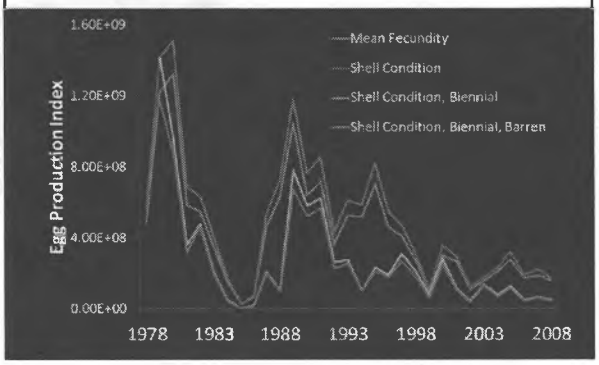
Funding: NPRB

Project Status: Ongoing

Project Goal: To improve understanding of factors influencing variability in female reproductive potential

Motivation: Snow crabs support the largest crab fishery in Alaska. The fishery has suffered wide booms and busts, including declared "overfished". Current management reference points are problematic.

Alternative Egg Production Indices



Analysis of the Minimum Size Limit for Eastern Bering Sea Tanner Crab Fisheries

UAF PIs: Gordon Kruse, Josh Greenberg

Co-PI: Bechtol Research (consulting)

Funding: BSFRF

Project Status: Completed

Project Goal: Analyze merits of reduced minimum size limits for Tanner crab fisheries

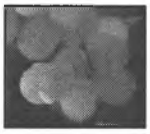
Motivation: Mean size of crab maturity has been declining since the mid 1970s. Many crabs no longer grow to legal size leading to high sorting & handling mortality rates, failure to achieve TACs, and poor economic viability of the fishery.

Results: Reductions in size limit: (1) increases legal male abundance, (2) increases legal male CPUE, (3) reduces fishing effort needed to achieve the TAC, (4) reduces discard mortality rates, and (5) likely increased market share and prices.

Outcome: In March 2011, the Alaska Board of Fisheries reduced the size limit from 5.5" carapace width to 4.4" for the Pribilof area and 4.8" for the Bristol Bay area. Reduced costs and increased landings should accrue to $ millions annually.

Other Related Projects

- Reproductive indices of male snow crab in the eastern Bering Sea – Sherry Tamone (UAS)
- Reproductive biology of snow crabs – Sherry Tamone (UAS), Ginny Eckert (UAF), Tom Shirley (Texas A&M)
- Molting biology of male snow crabs – Sherry Tamone (UAS)



Arctic Integrated Ecosystem Survey

UAF PI: Franz Mueter

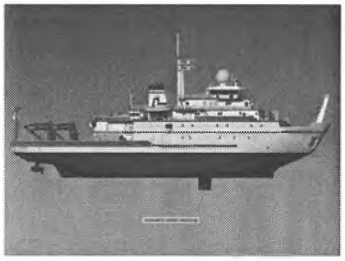
Co-PIs: Trent Sutton, Brenda Norcross, Megan McPhee (UAF). Ed Farley (NOAA).

Project Status: Getting underway

Project Goals: Provide baseline oceanographic and fisheries data for the northern Bering Sea and Chukchi Sea to help resource managers better predict effects of climate and human impacts on ocean productivity and on the ecology of marine and anadromous fishes.

Motivation: The Arctic FMP has closed Arctic waters off Alaska to commercial fishing because of rapid changes occurring in the Arctic. Adequate baseline information is currently missing and is needed to assess if or when sustainable fishing may be possible.

R/V Sikuliaq



- 261 foot vessel accommodates 26 scientists and students to conduct multi-disciplinary research
- Launch in mid 2012; ready for full operation 2014

9

U.S. Customs and Border Protection Alaska

U.S. CUSTOMS AND BORDER PROTECTION ALASKA

OVER VIEW

120 CBPO and 7 CBPAS

10 seaports

3 land border ports

6 Airports

2 seasonal ports

1 pre clearance port

MISSION

We are the guardians of our Nation's borders.
We are America's frontline.

We safeguard the American homeland
at and beyond our borders.

We protect the American public against terrorists
and the instruments of terror.

We steadfastly enforce the laws of the United States
while fostering our Nation's economic security
through lawful international trade and travel.

We serve the American public with
vigilance, integrity and professionalism.

We Facilitate Trillions of Dollars Per Year In Global Trade With The U.S.

In Just One Typical Day Last Year…

Travelers processed	989,689
Containers and vehicles processed	329,039
Undeclared/illegal currency seized, in dollars	300,582
Pounds of drugs seized	14,645
People apprehended for illegal entry	2,139
People refused entrance to the U.S. at ports of entry	616
Agricultural pests caught	454
Criminals arrested at ports of entry	107
False documents intercepted	72
Individuals matched with names in terrorism database	14

CBP SEA PORT EFFORTS

- 100% of cargo and passengers are screened pre arrival
- High risk vessels are met by enforcement boarding teams
- Partnership with federal, as well as state and local authorities
- Outreach and education
- Technologies
- Partnership to address northern passage

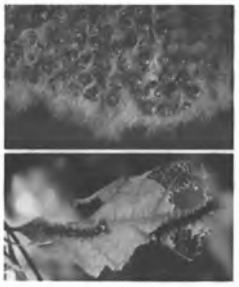
TARGETS

- Terrorist and implements of terror
- Narcotics
- Immigrants (Undocumented)
- IPR and Consumer Safety
- Tech
- Child Porn
- Invasive Species
- Weapons

U.S. Customs and Border Protection August 2011 Field Operations

Invasive Species

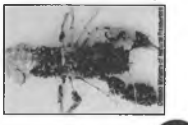
- Can be described as any foreign plant pests, weeds, and/or diseases.
- Introduction will harm the economy, the environment, and/or human health



U.S. Customs and Border Protection August 2011 Field Operations

Why Important?

- Scientists estimate the economic impact to exceed $1 Billion annually.
- Push out native species
- Close foreign markets (trade in certain affected commodities)
- Reduce biological diversity
- Place other species to/nearer extinction Kill Forest trees
- Kill Forest trees
- Alter wildfire intensity and frequency
- Damage crop yields



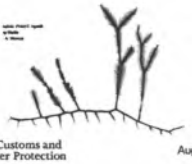
U.S. Customs and Border Protection August 2011 Field Operations

Arrival Mechanisms

- Almost always result from human activity
- Some intentionally brought into new region and released
- Unintentionally introduced as a byproduct of cultivation, commerce, tourism, and/or travel.

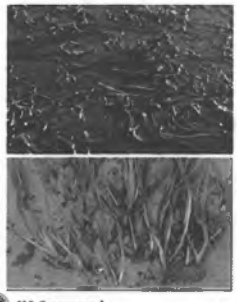
Seaweed

- Can be spread by Tanker ballast water, seaweed mariculture, shellfish farming, live seafood packing, or even the aquarium trade.



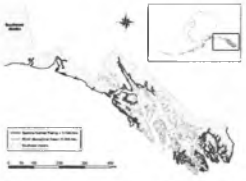
- "Killer Seaweed" (***Caulerpa taxifolia)*** - Invaded Mediterranean at a rate of 50km/year and displaced 30,000 acres of seagrass meadows.
- California eradication successful at a cost of $7 million over a 6 year period.

Dwarf Eelgrass (*Zostera japonica)*



- Seagrass4-14" long and 1.5mm wide, annual or short-lived perennial, SP-P, mid intertidal, sandy and muddy shores, salt or brackish waters; 6-7 month life cycle.
- Native to Asia, Russia, Sakhalin Is.
- Decreases water flow/increases sedimentation rates. Long term possibility of raising elevation of mudflats causing eventual disruption of ocean currents.
- First Collected in American in 1957. Is known to be in Washington, Oregon, and British Columbia.
- Warming waters could further speed spread northward.

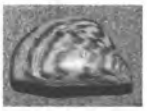
Chord Grass
(*Spartina* spp.)



- perennial grass, 1-1.5m tall, SP-P, on mud flats, estuaries, salt marshes, sand or cobble beaches.
- Native to the Atlantic Ocean
- Currently found In Pacific Northewest.
- Aggressive, forming dense, monospecific stands, converting mudflats into marsh, and altering patterns of circulation and drainage.
- 4 Species considered noxious from CA to WA.
- On Map red indicates areas with a rating of 3 (most positive based on 0-3 scale) where chord grass would find optimal growing conditions.

U.S. Customs and Border Protection August 2011 Field Operations

Zebra Mussel
(Dreissena polymorpha)



- Believed to have come from ballast tanks of a transoceanic ship
- Native to Caspian and Black Seas
- First found in the great lakes in 1988
- Freshwater mussel now found throughout the great lakes,19 states, and all large navigable rivers in the eastern US
- 1 adult female can produce 30,000 young each season and has up to two seasons per calendar year.
- Attach to virtually anything in mass numbers from pipes to sea creatures. Major impact on factories and water treatment facilities as well as biological hosts whom are ultimately unable to perform life functions with the attached mussels.
- In Lake St. Claire in 2 years after known introduction ALL hard-shelled native species were encrusted by Zebra mussels.
- Sheer numbers reduce biomass to a level that also significantly reduces/removes native species

U.S. Customs and Border Protection August 2011 Field Operations

Asian Gypsy Moth
(*Lymantria dispar*) "AGM

- 1869 French naturalist imported gypsy moths to try to breed with silkworms.
- The lineage of these moths now infest at least 15 states and defoliate hardwood forests…prefer oak but will also target willow, birch and aspen.
- 1993 Vessel at Wilmington NC opened cargo hold to release dozens of Asian Gypsy Moths (AGM)…more threatening relatives of the European gypsy moths already here.
- AGM eat the foliage of both conifers and hardwoods (600 different species vs 250 species in the European gypsy moth)
- Unlike European gypsy moths AGM females can fly and rapidly expand infestation area.

U.S. Customs and Border Protection August 2011 Field Operations

AGM Reference Map

U.S. Customs and Border Protection August 2011 Field Operations

Egg Masses

Egg masses are usually velvety in texture. They are generally 1.5 inches long and .75 inches wide, but can be as small as a dime. Their color ranges from light tan to dark brown. 500-1500 eggs typical per egg mass

U.S. Customs and Border Protection August 2011 Field Operations

AGM Larvae

- Larvae sizes range from 2mm long at hatching to 3 inches long in the mature stage.
- Dispersing larvae may be seen blowing on silk strands.
- Once hatched move to vertical structures and rapidly climb

U.S. Customs and Border Protection August 2011 Field Operations

Adult AGM

- Adult gypsy moths are typically active July-September.
- Female moths (left) can have wingspans of over 3.5 inches wide. Male moths (right) tend to be smaller with wingspans near 1.5 inches wide.

U.S. Customs and Border Protection August 2011 Field Operations

AGM Infestation

- AGM ports in Russia and Japan are becoming infested.
- Trapping records indicate very large populations of AGM in Far East Russian

U.S. Customs and Border Protection August 2011 Field Operations

AGM Vessel Inspection

The entire superstructure of the vessel must be inspected.

Egg masses are normally deposited in sheltered locations such as in crevices or cavities, under tarps and behind walls and doors.

Female moths tend to oviposit near light sources

U.S. Customs and Border Protection August 2011 Field Operations

SUCCESS

- IPR Linked to terrorist organizations
- Multiple heroin seizures.
- Breeder documents
- AGM and Zebra Muscles
- 300% increase in Ag intercepts
- WHTI, CTPAT, ACAS, NII and TECH
- 13 Million addition revenue collected

U.S. Customs and Border Protection

August 2011

Field Operations

10
Seafood Industry in Alaska's Economy

MARINE CONSERVATION ALLIANCE

SEA FACTS

THE SEAFOOD INDUSTRY IN ALASKA'S ECONOMY

As a major player in global markets, Alaska's seafood industry is an economic engine for both the state and the nation. This publication updates "The Seafood Industry in Alaska's Economy," first published in 2009. It shows that the seafood industry continues to be the largest private sector employer in the state.

Photo courtesy of ASMI

2011 Executive Summary Update

- Alaska led all states in terms of both volume and ex-vessel value of commercial fisheries landings in 2009, with a total of 1.84 million metric tons (MT) worth 1.3 billion dollars (NMFS 2010a).

- National harvest volume in 2009 was 3,568,599 MT (NMFS 2010a).

- In the list of top 50 U.S. ports based on volume for 2009, Alaska had 11 including Dutch Harbor-Unalaska (1st); Kodiak (4th); Naknek-King Salmon (11th); Sitka (14th); Ketchikan (15th); Petersburg (18th); Cordova (21st); Seward (26th); Homer (36); Juneau (41st); Kenai (50th) (NMFS 2010a).

- In the list of top 50 U.S. ports based on ex-vessel value for 2009, Alaska had 10; 8 of them were in the top 20. These ports include Dutch Harbor-Unalaska (2nd); Kodiak (3rd); Naknek-King Salmon (4th); Sitka (9th); Homer (12th); Seward (17th); Ketchikan (18th); Cordova (19th) (NMFS 2010a). Three other Alaska ports, Akutan, King Cove and Sand Point, would also make the top 20 were it not for confidentiality requirements that prevent release of data for ports with fewer than three processors.

- In 2009, Dutch Harbor-Unalaska was the leading U.S. port in quantity of commercial fishery landings, and the second U.S. port in value of commercial fishery landings (NMFS 2010a)

- Dutch Harbor-Unalaska ranked second (after New Bedford, MA) with a harvest value of $159.7 million dollars; Kodiak was ranked third at $103.8 million, and Naknek-King Salmon ranked fourth at $76.1 million dollars (NMFS 2010a).

- The seafood industry, through direct, indirect and induced effects, contributed a total of $4.6 billion to Alaska's economic output in 2009.

Prepared by Northern Economics

Importance of Alaska to the Global Seafood Market

- If Alaska were a nation it would have placed 14th among seafood producing countries in 2008 (NMFS 2010b and FAO 2010).

- Alaska landings of global groundfish species groups (including cod and pollock) and flatfish accounted for 18 percent of the world harvest of these species groups in 2008 (Hiatt, et al. 2010 and FAO 2010).

- In 2008 about 35 percent of the world capture production of salmon occurred in Alaskan waters (Hiatt, et al. 2010 and FAO 2010).

- Alaska accounted for 95 percent of total U.S. pacific salmon landings in 2009 (NMFS 2010a).

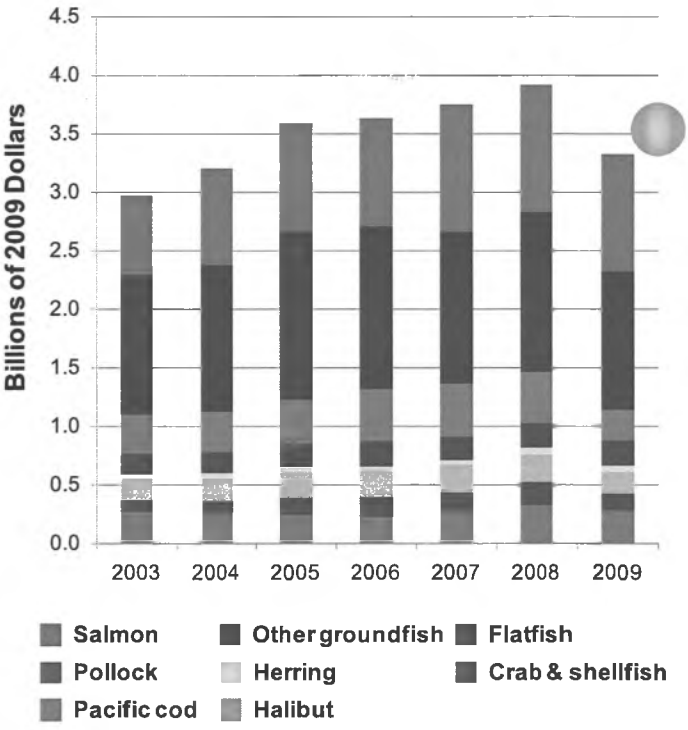
- The 2010 salmon season was one of the best on record with almost 170 million fish harvested in Alaska, the 11th highest number since statehood. Preliminary 2010 estimates show that the salmon harvest generated $533.9 million, the highest ex-vessel value in eighteen years (since 1992) (ADF&G 2010).

- In 2009, $1.6 billion dollars worth of seafood was exported directly from Alaska to destinations such as Japan, China, South Korea, Canada, and Europe (Office of the Governor of the State of Alaska 2009, NOAA 2010a).

- In 2009 Japan was the leading direct importer of Alaska fish and fisheries products (by value) followed by China, South Korea, Germany, the Netherlands and Canada (NOAA 2010a).

Photo Courtesy of PSPA

Real Wholesale Value by Species, 2003-2009



Source: Hiatt, 2007 and Hiatt, 2010b

Importance of Alaska Seafood to the U.S.

- In 2009, Alaska accounted for over 52 percent of the volume of the commercial seafood harvested in the United States (NMFS 2010a).

- Alaska as a single state led all other multi-state regions in the U.S. in terms of ex-vessel value with over 34 percent of the U.S. total (NMFS 2010a).

- The five New England States combined for a distant second with 20 percent, followed by the five states on the Gulf of Mexico with 16 percent (NMFS 2010a).

- Alaska's pollock fishery is the largest in the U.S., accounting for 24 percent of total U.S. fisheries landings (NMFS 2010a).

- In 2009, 26 percent of total U.S. crab catches were king and snow (tanner) crab, and they accounted for 35 percent of total U.S. crab value (NMFS 2010a). King and snow crab come entirely from Alaska.

- Dutch Harbor-Unalaska holds the record for catch volume with 911.3 million pounds landed in 2006 (NMFS 2010a).

- Alaska landings of Pacific Sea Herring accounted for 98 percent of the Pacific coast with 87 million pounds valued at over $29.3 million (NMFS 2010a).

Importance of Alaska Seafood to Alaska

- In 2009 total estimated ex-vessel value of Alaska's commercial harvest was $1.3 billion (NMFS 2010a).

- The additional value added by Alaska's seafood processing sector brought the first wholesale value of Alaska's commercial seafood industry to over $3.3 billion in 2009 (Hiatt et al. 2010).

- It is estimated that the seafood industry's $3.3 billion in wholesale value generated an additional $1.3 billion in indirect and induced economic output for a total contribution of $4.6 billion to Alaska's economic output (NEI using Hiatt 2010b, NOAA 2010b, Mothership Fleet Cooperative 2010 and IMPLAN 2009 data).

- The seafood industry also generated more than 80,800 direct, indirect, and induced jobs and $1.45 billion in direct, indirect and induced payments to labor and income (NEI using Hiatt 2010b, NOAA 2010b, Mothership Fleet Cooperative 2010 and IMPLAN 2009 data).

- In 2009 the wholesale value generated by the seafood industry represented over 10 percent of the $34 billion basic sector activity in Alaska's economy (Hiatt 2010b, Office of the Governor of the State of Alaska 2009, U.S. Census Bureau 2010 & 2011, ADOR 2011, McDowell 2010, and Szumigala 2010). The basic sector, because it brings money into the state from outside, is the driving force behind all economic activity in the state.

- The seafood industry ranks third in importance behind the North Slope oil and gas industry and federal government in terms of generating basic economic activity in Alaska (NEI using ADOLWD 2010 and ADOLWD 2011a).

- Alaska's seafood industry generated about $79 million in state taxes and fees, in addition to local fish taxes in fiscal year 2009 (ADOR 2009; ADCCED 2011).

- Seafood was Alaska's leading export in 2009 and accounted for 50 percent of total direct exports—nearly double the value of the second highest export sector (minerals at 26 percent), (U.S. Census Bureau 2010). Total Alaskan seafood exports were even greater; a large portion of Alaskan seafood is exported internationally from packaging and storage facilities in Washington.

- In 2009, seafood processing accounted for about 95 percent of all food manufacturing jobs in Alaska, and 71 percent of total manufacturing jobs (ADOLWD 2010 and ADOLWD 2011b).

Photo courtesy of Ron Clarke

- With 70,548 estimated direct jobs in seafood harvesting and processing, the seafood industry employs more workers than any other non-government industry sector in Alaska, including oil and gas and mining combined. (ADOLWD 2010, ADOLWD 2011a and Warren 2010).

- With the concentration of major fishing ports in the Aleutian and Pribilof Islands region, seafood processing accounted for 58 percent of all private sector payments to labor in the Aleutian West Census Area in 2009 (ADOLWD 2011b).

- The seafood processing industry is estimated to have accounted for 35 percent of private-sector payments to labor in Kodiak in 2009 (ADOLWD 2011b).

- The Western Alaska Community Development Quota (CDQ) program, which allocates a portion of the Bering Sea catch for coastal communities to invest in economic development, generates millions of dollars each year. In 2008, the CDQ entities collectively generated more than $180 million in revenue (WACDA 2008).

- The CDQ Program augments the important role of the seafood industry in Western Alaska. Sixty-five Bering Sea communities participate in the CDQ program (WACDA 2008).

- From 1992 through 2008 the CDQ Program generated over $240 million in wages, payments to fishers, and scholarships and training benefits (WACDA 2008).

- In 2008 CDQ entities provided wage and salary jobs to more than 1,600 individuals, and the combined payroll for the year exceeded $22.3 million (WACDA 2008).

- The value of the six CDQ groups' assets increased from about $13.3 million in 1992 to over $559 million in 2009 (WACDA 2008).

Table 1. Seafood Industry Employment by Region, 2009

Summary of Workers	Harvesting	Processing	Total
Aleutian and Pribilof Islands	5,309	6,276	11,585
Bristol Bay	9,385	4,522	13,907
Kodiak	3,664	2,934	6,598
Northern	627	68	695
Southcentral	8,071	3,491	11,562
Southeast	10,150	4,886	15,036
Yukon Delta	2,986	831	3,817
At-Sea	1,732	5,616	7,348
Regional Total (Total Seafood Jobs)	**41,924**	**28,624**	**70,548**

Source: Northern Economics, Inc. and ADOLWD, 2010.
Note: On-shore regional worker counts do not sum to the statewide workforce total as a single worker may be active in more than one region. NEI uses the sum of the regions as an estimate of total seafood jobs.

Table 2. Estimated Seafood Ex-vessel Volume and Value by Region, 2009

Region	Harvest Weight (1,000 MT)	Ex-Vessel Value ($ Millions)
Aleutian and Pribilof Islands	497.2	393.7
Bristol Bay	86.6	119.0
Kodiak	157.2	129.8
Northwest/Arctic/Yukon-Kuskokwim	3.9	6.7
Southcentral	77.8	177.0
Southeast	134.4	209.8
At-Sea	883.0	307.9
Total	**1,840.0**	1,343.8

Source: Estimated by Northern Economics using NMFS (2010a), Hiatt (2010a) and Hiatt (2010b).

Table 3. Estimated Seafood Wholesale Volume and Value by Region, 2009

Region	Product Weight (1,000 MT)	Wholesale Value ($ Millions)
Aleutian and Pribilof Islands	180.9	735.8
Bristol Bay	48.6	250.2
Kodiak	72.9	261.1
Northwest/Arctic/Yukon-Kuskokwim	2.3	15.9
Southcentral	45.4	289.3
Southeast	81.1	374.2
At-Sea	457.0	1,396.3
Total	**888.1**	**3,322.9**

Source: Hiatt, 2010b

2011 report sponsored by the Marine Conservation Alliance

March, 2011

This is a 2011 update of the Executive Summary from the 2009 report "The Seafood Industry in Alaska's Economy". This report, as well as the 2011 update with full references is available at www.marineconservationalliance.org.

Also follow '**SeaAlliance**' on:

431 N. Franklin St. Ste 305 Juneau, AK 99801 | phone 907. 523.0731 | www.marineconservationalliance.org

Bethel Meeting, Oct. 10, 2011

<TARGET><BILL></BILL><SUBJECT>Bethel Meeting, October 10, 2011</SUBJECT><COMM>ANW27</COMM></TARGET>

NWTF Meeting

Bethel

Oct. 10th, 2011

1 Northern Water Task Force
Bethel Agenda

2 US Arctic Research
US Arctic Research Commission – Mary Pete

3 Impact of Climate Change on AK Transportation Infrastructure
AKDOT&PF – Mike Coffey

4 Important Subsistence issues in the ACVP Region
ACVP – Tim Andrew

5 Shoreline & Coastal Erosion; A Crisis for Historic Preservation
ACVP – Steve Street

6 The Bering Sea Datapoint Project
– Mark Edward Springer

7 Submitted Written Testimony

8 Draft NWTF Recommendation

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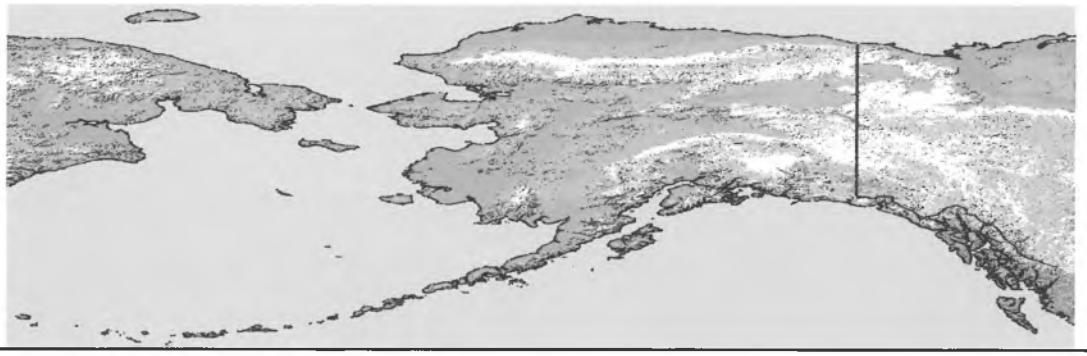
1
Agenda



Alaska Northern Waters Task Force

October 10, 2011 (Monday)
Bethel, AK – Yup'iit Piciryarait Cultural Center

- Arctic Research
- Climate Change & Erosion

Monday, October 10	**Alaska Northern Waters Task Force**
8:12am	**FYI: AKAIR #41 Arrives from Anchorage**
8:45 – 9:45am	**Breakfast – ANWTF Members (Breakfast at YKHC Board Room – 10 AM reconvenes at Cultural CTR)**
10:00 – 10:05am	**Introduction from ANWTF Chair Reggie Joule**
10:05 – 10:20am	**Mary Pete, USARC**
10:20 – 11:00am	**Mike Coffey, DOT, Maintenance and Operations Chief** Climate Change and Alaska's Public Infrastructure
11:00 – 11:10am	**BREAK**
11:10 – 11:50am	**Mike Brubaker, ANTHC, Director, Community Environmental Health** Climate Change: Challenges to existing community infrastructure and design for future sustainability
11:50 – 12:00pm	**BREAK**
12:00 – 1:15pm	**Local Knowledge Elders Panel:** William Alstrom, St. Mary's; Robert Nick, Nunapitchuk; Elias Venes, Bethel; Kenneth Laraux, Bethel; Stanley Tom, Newtok; Howard Amos, Mekoryuk
1:15 – 1:45pm	**Pizza Lunch Provided**
1:45 – 2:30pm	**Tim Andrew, AVCP, Natural Resource Manager**
2:30 – 3:15pm	**Steve Street, AVCP, Director of Cultural & Environmental Sciences** Shoreline Erosion: A Crisis for Historic Preservation
3:15 – 3:30pm	**BREAK**

3:30 – 5:00pm	**Public Testimony (Any topic related to the ANWTF)**
5:00pm	**Meeting Adjourned**
5:30pm-7:00pm	**VFW Reception** VFW Post Bethel
8:39pm	**FYI: AKAIR #46 Leaves for Anchorage**

2
U.S. Arctic Research

US ARCTIC RESEARCH COMMISSION

ABOUT

The US Arctic Research Commission (USARC) is an independent federal government agency created by the Arctic Research and Policy Act of 1984. The Commissioners are appointed by the President of the United States.

USARC is responsible to both the President and the Congress. Every two years, the Commission develops goals and objectives for the nation's Arctic research program, which has a budget of approximately $400 million per year, and is conducted by approximately 15 US federal agencies and state agencies, local governments, university partners, and private-sector collaborators. The Commission's goals are adopted by an Interagency Arctic Research Policy Committee (IARPC) that develops the national five-year Arctic Research Plan. The Commission is also explicitly tasked with making recommendations on the means for developing international scientific cooperation in the Arctic.

DUTIES

- Develop and recommend a national Arctic research policy
- Assist IARPC in establishing a national Arctic research program plan to implement the policy
- Facilitate cooperation in Arctic research among federal, state, and local governments, and international partners
- Review federal Arctic research programs and recommend coordination improvements
- Recommend improvements in Arctic research logistics
- Recommend improved methods for data sharing among research entities

CONTACT

Washington, DC, Office
4350 N. Fairfax Drive, Suite 510
Arlington, VA 22203
Phone | 703.525.0111

Alaska Office
420 L Street, Suite 315
Anchorage, AK 99501
Phone | 907.271.4577

info@arctic.gov | www.arctic.gov

COMMISSIONERS

FRAN ULMER
Chair
US Arctic Research Commission
Anchorage, Alaska

MICHELE LONGO EDER
Attorney at Law
Author
Newport, OR

MARY C. PETE
Director, Kuskokwim Campus
University of Alaska Fairbanks
Bethel, Alaska

HELVI K. SANDVIK
President, NANA Development Corporation
Anchorage, Alaska

CHARLES J. VÖRÖSMARTY, PhD
Director, City University of New York
Environmental Cross-Roads Initiative
Distinguished Scientist, NOAA-CREST
The City College of New York
New York, New York

WARREN M. ZAPOL, MD
Director, Anesthesia Center for
Critical Care Research
Massachusetts General Hospital
Boston, Massachusetts

SUBRA SURESH, PhD
Ex-Officio Member
Director, National Science Foundation
Arlington, Virginia

THE US ARCTIC RESEARCH COMMISSION ENCOURAGES RESEARCH IN FIVE GENERAL AREAS

Environmental Change of the Arctic Ocean and Bering Sea

The Arctic is a clear priority for marine scientific research because the combination of climate change, technological advances, and economic forces make this region increasingly accessible for resource development, transportation, tourism, sovereignty, and security. USARC calls for coordinated research in the Chukchi and Beaufort Seas akin to what was accomplished by the Bering Sea Ecosystem Study. The Study of Environmental Arctic Change (SEARCH), an enduring, interagency effort to understand the nature, extent, and evolution of Arctic environmental change, has grown by the addition of the Arctic Observing Network (AON). The emerging Distributed Biological Observatory (DBO) initiative shows great promise for the Pacific Arctic sector. USARC recommends:

- Increased support for, and broader participation in, AON, DBO, and SEARCH
- Greater integration of Arctic marine research, and support for the strategic action plans being developed by the National Ocean Council

Arctic Human Health

A distinctive approach is required to address health issues of indigenous peoples and to effectively overcome the region's health disparities. US Arctic residents are susceptible to a broad range of physical and behavioral health issues that result in lower life expectancies and higher infant mortality rates than found elsewhere. While the transition from a traditional subsistence lifestyle has brought positive change, it has also increased the prevalence of chronic diseases such as diabetes, hypertension, obesity, and cardiovascular and mental illnesses. Study has just begun on the impact of environmental pollutants and climate change on food safety and health consequences. USARC recommends:

- Developing and implementing an interagency Arctic human health research plan
- A focus on mental and behavioral health issues
- Greater focus on research that would improve access to clean water and improved sanitation systems in rural Alaska

Civil Infrastructure Research

Climate change is impacting civil infrastructure (e.g., roads, buildings, pipelines, ports). Thawing permafrost, increasing coastal erosion, and generally warmer conditions are all contributors. The implications for the Arctic's transportation, communication, energy, and community infrastructure networks are considerable, largely because long-held engineering standards assumed a perpetually stable thermal/permafrost regime. Research is needed to develop new and climate-change-adaptive standards for design, construction, and maintenance. Research and innovative engineering solutions are needed to create new infrastructure to address the demands of an increasingly accessible Arctic, whether by land, sea, or air.

Natural Resource Assessment and Earth Science

As has been clear since the building of the Trans-Alaska Pipeline System, the US Arctic is rich with natural resources from oil and gas, minerals (including rare earth elements), fisheries, lumber, and wildlife ecosystems. Further assessments of living and nonliving resources are needed in the Arctic. Specifically, the US Geological Survey should implement its "Resource Assessment Program" (AMRAP) required by law. Earth science initiatives should continue to incorporate fundamental geophysical and geological research (especially in the Arctic Ocean) so that as a nation, we understand our land, its value, and the extent of our offshore sovereignty beyond the current Exclusive Economic Zone. Emphasis should also be placed on oil-spill prevention and response in the Arctic and sub-Arctic, better Arctic mapping, gas hydrate research, studies of contaminant fluxes and impacts, and long-term funding for the North Slope Science Initiative.

Indigenous Language, Identity, and Culture

Language defines the cultural diversity of our planet, and allows us to separate one population from another. Although critical, language is one of the most vulnerable elements of our cultural heritage. Of the thousands of known languages, fewer than 10 are used by nearly 60 percent of the global population and more than 500 are extinct. In the Arctic, language vulnerability is especially acute, where loss stems from separation of indigenous people from their cultural past. Without a research plan to address Arctic language preservation, the path to language extinction is likely to shorten. This plan should incorporate:

- Regular, permanent census processes to understand the diversity of languages spoken by Arctic people, and the viability of those languages
- Documented procedures to ensure that languages and place names spoken and given by Arctic people are recorded and preserved
- Defined policy options and processes for language preservation that have succeeded in the Arctic, and elsewhere, and are made available to Arctic policymakers and residents

U.S. ARCTIC RESEARCH COMMISSION

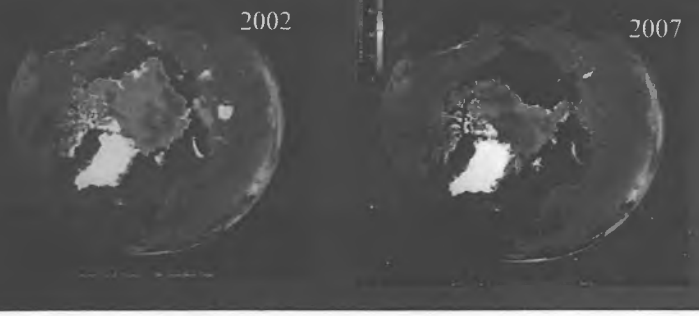
Mary C. Pete
Commissioner
Bethel, Alaska

Kuskokwim Campus – University of Alaska Fairbanks

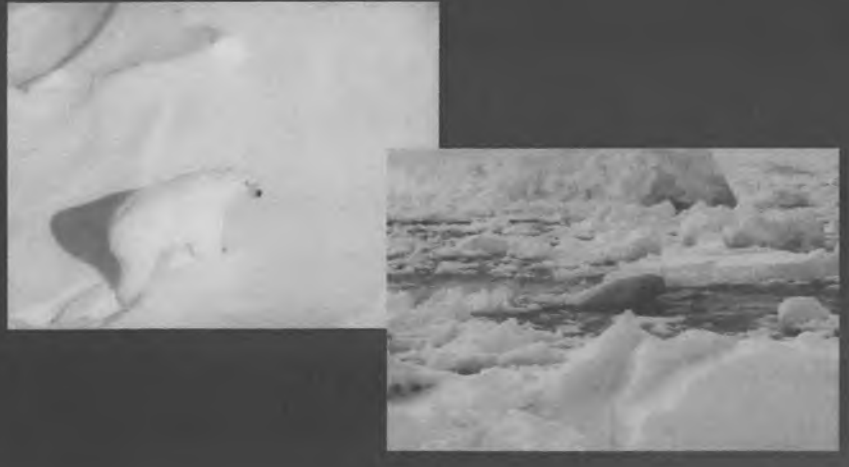
- One of 5 two-year UAF rural campuses
- 13 member advisor council representing 6 school districts in service area and major partners – AVCP, YKHC, AVCP Housing Authority, ONC, alumni, and students
- Sackett Hall: 38-bed dormitory
- Committed to addressing educational needs of a changing environment

Arctic Overview

- Many Arctic related issues in the news today
- Climate change
- Resource development



- Species listings
- Subsistence concerns



- Increased shipping activity
- Territorial disputes
- Contaminant deposition

US Arctic Research

~$400M/yr across >15 federal agencies

...cooperating with over a dozen nations

...using research infrastructure worth billions

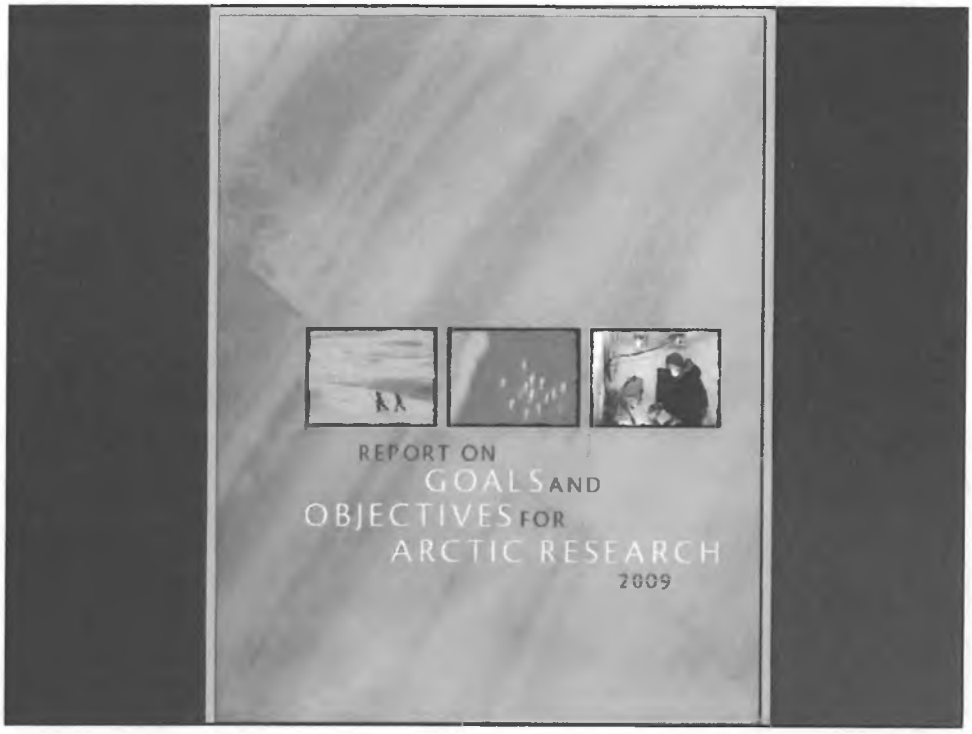
[USARC's budget is ~$1.5M]

What is the USARC?

- Independent US federal government agency that advises Congress a of the President
- Established by the Arctic Research and Policy Act of 1984
- 7 presidentially appointed commissioners, and 4 staff in DC & Anch
- By law, works directly with both Congressional and Executive branc
- Develops and recommends an integrated national Arctic research p
- Helps establish a national Arctic research program plan to impleme
- Facilitates cooperation among many groups

Duties of the Commission:

- Develop, recommend and assist in implementation of an integrated national Arctic research policy
- Facilitate cooperation in Arctic research between Federal, State and local governments
- Review federal Arctic research programs and recommend improvements
- Recommend improved methods for **data sharing** among all Arctic research entities
- Cooperate with the Governor of Alaska in the formulation of Arctic research policy
- Recommend methods for improving international scientific cooperation in the Arctic



Goals Report research themes

- Environmental Change
- Arctic Human Health
- Civil Infrastructure
- Natural Resource Assessment & Earth Science
- Indigenous Languages, Identities, Cultures

What does this mean to Arctic residents?

•USARC listens and responds to the voices of all Americans, including rural Alaskans.

•USARC priorities and initiatives that support Arctic human health research and recommendations that address Arctic languages, cultures, and identities, are examples of this.

•USARC is committed to including Arctic residents in the process to develop Arctic scientific research recommendations and Arctic research policy, and we recognize the value of traditional knowledge with respect to the scientific method.

What does this mean to Arctic researchers?

USARC:
•obtains the broadest possible view of Arctic research needs
•promotes Arctic research
•recommends policy

Our recommendations to the President and Congress that reflect the advice of the scientific community, and the needs of the country.

We recommend research priorities and work with other entities to turn these into an integrated and coordinated national Arctic research plan of funded programs.

Recent USARC activities…

- Ongoing promotion of 5 Research Priorities (climate/environmental change, civil infrastructure, indigenous languages, cultures and identities, Arctic health, resource assessment)
- Helped initiate & participated in drafting of newly released Arctic Policy
- Provided various support for the production of new US icebreakers
- Co-sponsor of many Arctic research meetings
- "Arctic Marine Shipping Assessment"
- Promoting ARRV, IOOS, BARC, etc., and work with Alaskan delegation & Governor's Office, as well as many other interagency initiatives

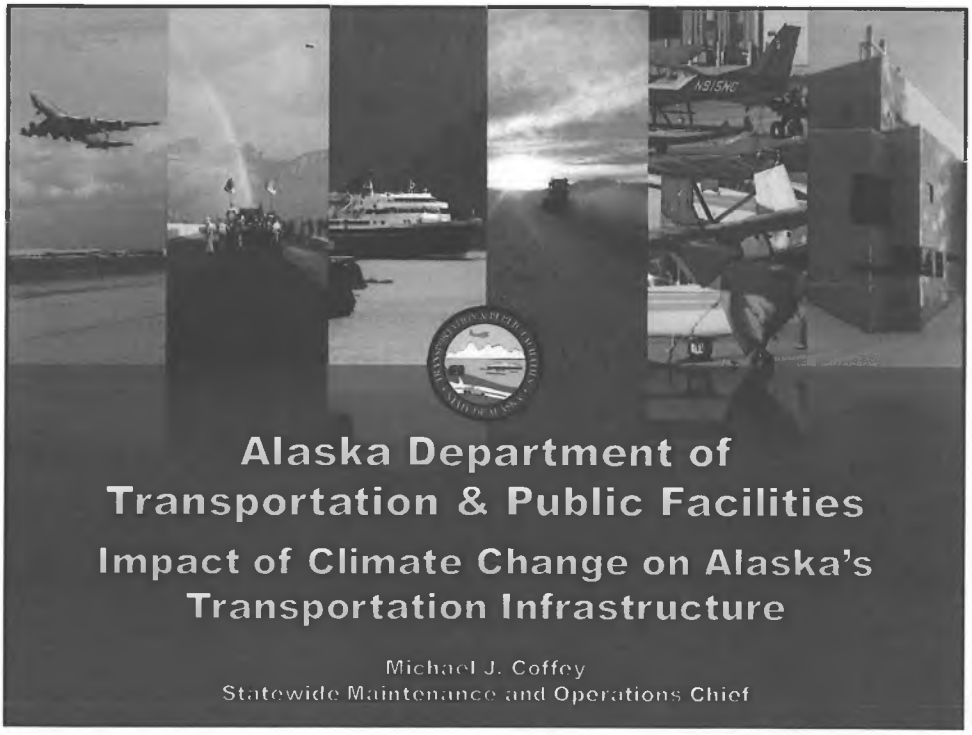
THANK YOU FOR YOUR ATTENTION

Contact: Anchorage, AK Office
Cheryl Rosa, Deputy Director
420 L Street, Suite 315, Anchorage, AK 99501
crosa@arctic.gov (907) 271-4577

Contact: Washington, DC Office
John Farrell, Executive Director
4350 N. Fairfax Drive, Suite 510
Arlington, VA 22203
jfarrell@arctic.gov (703) 525-0113

3

Impact of Climate Change on Alaska's Transportation Infrastructure



Alaska Department of Transportation & Public Facilities

Impact of Climate Change on Alaska's Transportation Infrastructure

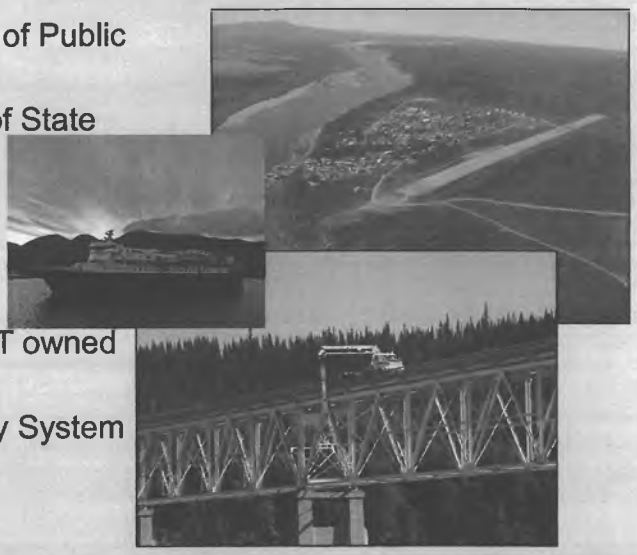
Michael J. Coffey
Statewide Maintenance and Operations Chief

Public Infrastructure and Climate Change – ADOT/PF

- The Alaska Department of Transportation and Public Facilities (ADOT&PF) manages the State's transportation infrastructure in a very challenging environment
- Many facilities in the Alaska's interior, northern, and southwest regions are underlain by ice-rich permafrost

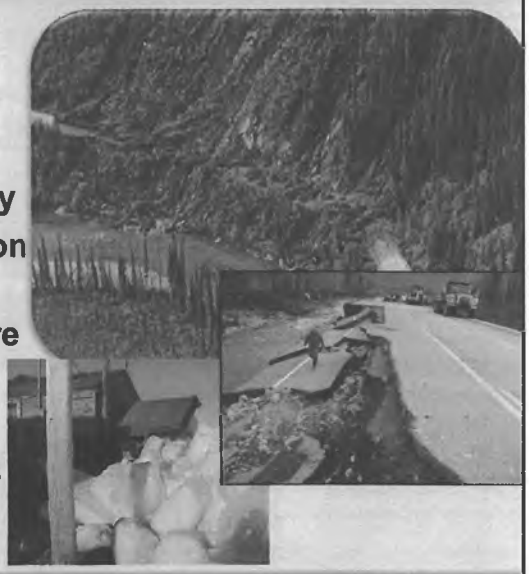
Alaska Department of Transportation and Public Facilities

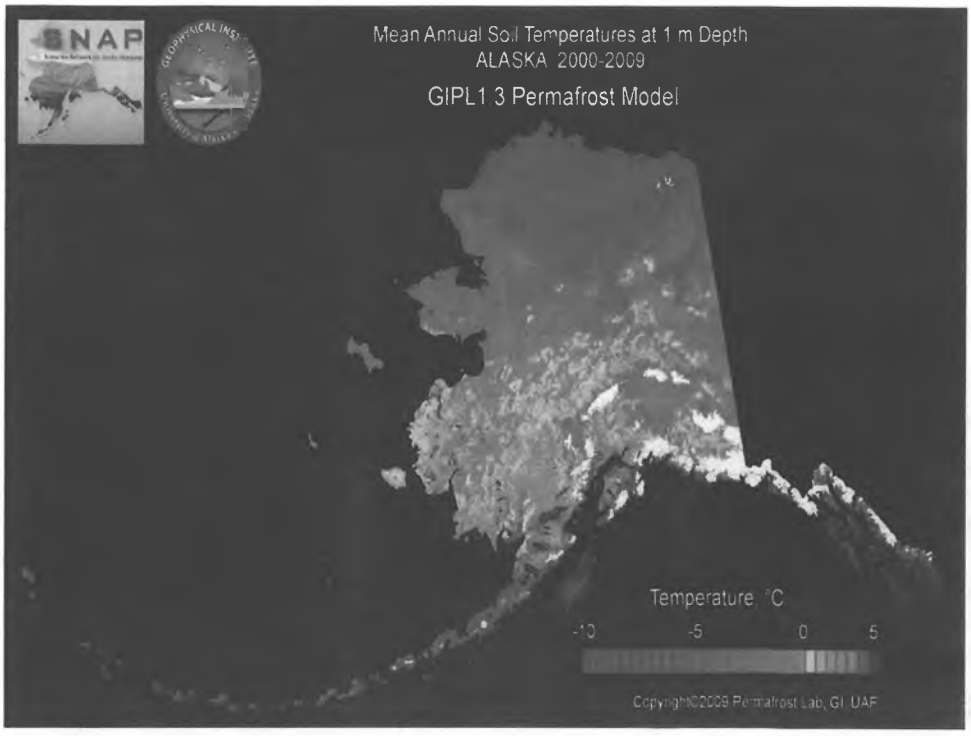
- Over 14,000 Miles of Public Roadway
- Over 5,600 Miles of State owned road
- 845 Bridges
- 255 Rural Airports
- 28 Harbors
- 720 Buildings (DOT owned or managed)
- Alaska Marine Hwy System
  - 33 ports of call
  - 11 vessels
  - 3,500 miles



Climate Change Impacts

- **Melting/Warming permafrost**
- **Increased storm frequencies and intensity**
- **Increased Coastal erosion due to lack of sea-ice**
- **Increased river and shore erosion**
- **Sea-level rise**
- **Increasing temperatures**




SNAP
Mean Annual Soil Temperatures at 1 m Depth
ALASKA 2000-2009
GIPL1.3 Permafrost Model
Temperature, °C
-10
-5
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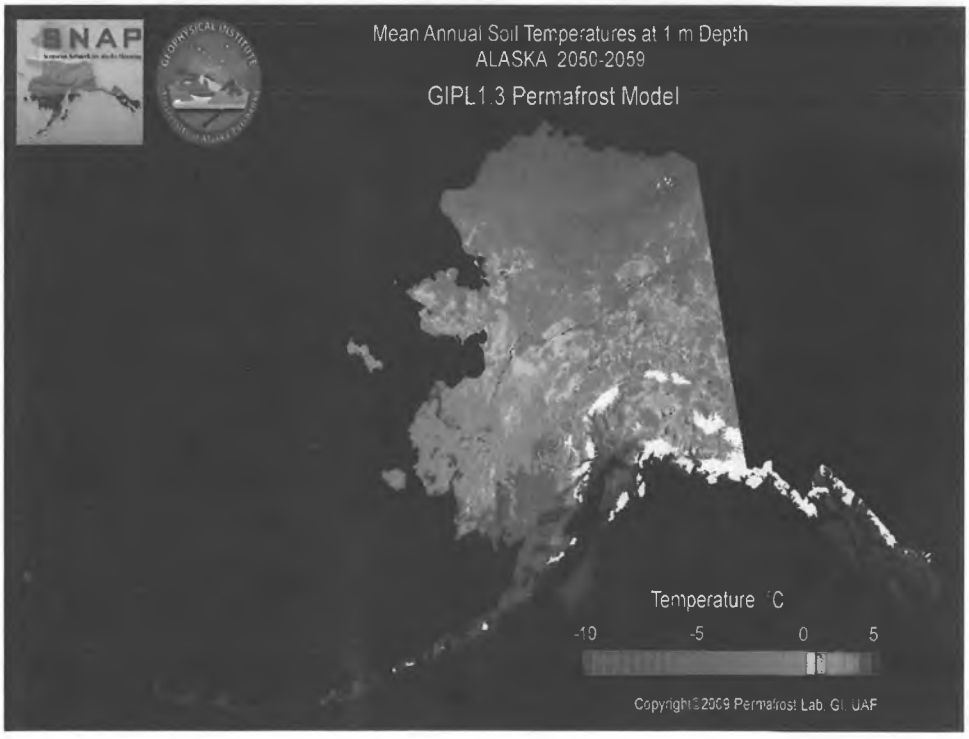
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ALASKA 2050-2059
GIPL1.3 Permafrost Model
Temperature, °C
-10
-5
0
5
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Melting/Warming Permafrost

Tok Cutoff Highway

- Current estimate is the Northern Region M&O spends approximately $10+ million annually due to melting permafrost
- This represents a fraction of the need
- Costs will increase if warming trend continues

Melting/Warming Permafrost

- Increased highway and airport surface distress
- Increased Active Layer Detachments (slope sloughing and failures)
- Embankments built over permafrost will need to be thicker to prevent the underlying ground from thawing
- Public buildings may require relocation/ reconstruction if their foundations thaw

Permafrost Problems

Glenn Highway Distress

Dalton Highway Frost Heaves

Mile 15-18 Elliot Highway Pavement Rutting

Alaska Highway Damage and rutting

Longitudinal Shoulder Cracking

Thaw Settlement

Ice-Rich Permafrost Thawing

Ice-Rich Permafrost Thawing

Increased Storm Frequencies and Intensities

- Changes in timing, frequency, form and/or intensity of precipitation may cause related and increasing natural processes, including:
  - Debris flows
  - Avalanches
  - Floods
- Significantly increases M&O costs

Increased Storm Frequencies and Intensities

- Coastal communities and their infrastructure are vulnerable to accelerated coastal erosion due to storm activity and wave action eroding shorelines once protected by shore-fast sea ice

Loss of Shore-fast Sea Ice

Open Water Jan 2007

Open Water Feb 2006

Loss of Shore-fast Sea Ice

- Erosion rate: These two photos were taken 2 hours apart, note the ATV tracks in the road (note the 55 gallon barrel). This road no longer exists.
- In 1997, Shishmaref lost 125 feet of beach in a single storm

Flooding

Flooding

Eagle/Yukon River Ice Jam

The Eagle Flood/Ice Dam

- A long cold winter combined with higher than usual snow pack (up to 150% of normal), higher than usual ice formation on the river (up to 140% of normal) and several days of unseasonably warm weather, which caused rapid melting and ice movement downstream on the Yukon

The Eagle Flood/Ice Dam

The Eagle Flood/Ice Dam

The Eagle Flood/Ice Dam

Taylor Highway Flooding 2010

- Three significant rainfall and flooding events occurred in just over three weeks in the Fortymile River and adjacent American Creek basins during July 2010. To have three weather systems of this magnitude impact this otherwise climatologically dry region in such a short period of time is highly unusual and unprecedented. Several weather stations along the Taylor Highway reported close to their annual average precipitation during this period.
- Annual precipitation in the region is between 10-12 inches, so roughly one quarter of the annual precipitation fell in just over a day.

Taylor Highway Flooding 2010

General Warming Trend

A longer seasonal transition period from fall to winter and winter to spring may require a different and potentially more costly approach to snow and ice control

General Warming Trend

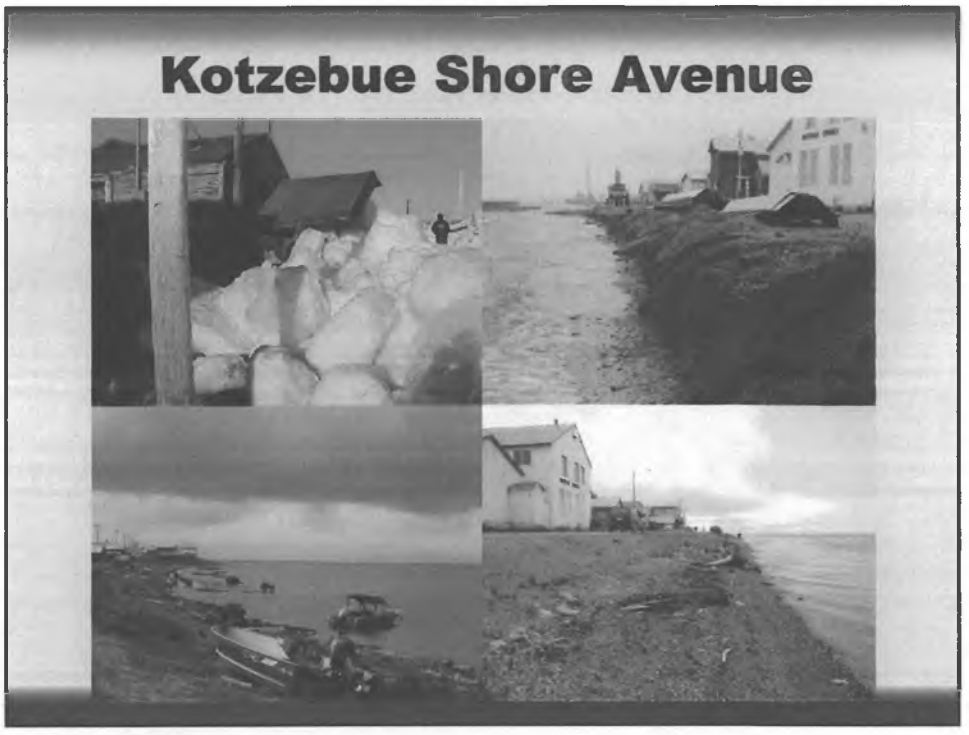
- The continued warming trend will likely result in the increase in erosion of shorelines and riverbanks which will impact any facility constructed adjacent to the waterbody
- Aufeis problems will likely increase as melt water flows out of warming zones of permafrost, requiring additional maintenance

General Warming Trend

- Warming temperatures are altering the blend of vegetative growth on the North Slope of Alaska
- Increasing temperatures will allow a variety of invasive plants and insects to prosper in Alaska

ADOTPF Adaptation Strategies

- **Shoreline Protection**
- **Relocation**
- **Evacuation Routes/Shelters**
- **Flood Mitigation**
- **Drainage Improvements**
- **Permafrost Protection**
- **implementation of new technologies**


Kotzebue Shore Avenue

Kotzebue Shore Avenue

Unalakleet Dynamaically Stable Beach

Unalakleet Airport Road as constructed Sept. 2008

Average 8" stone randomly placed at about a 1.5 to 1 slope prior to re-shaping.

Some reshaping toward its' final design profile has taken place after two years and several major storms. Structure remains intact.

Note logs thrown over top of structure from high wave action.

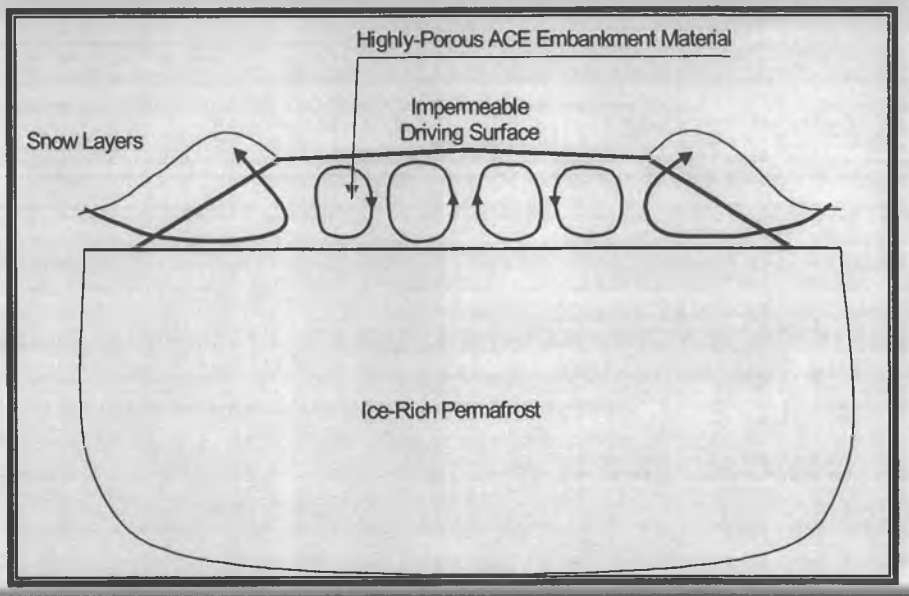
Koyukuk Airport Improvements

- Airport project completed in 2006
- Lengthened and widened runway.
- Raised grade above the 100 year flood levels
- Total Cost: $9.2 M

Koyukuk Airport

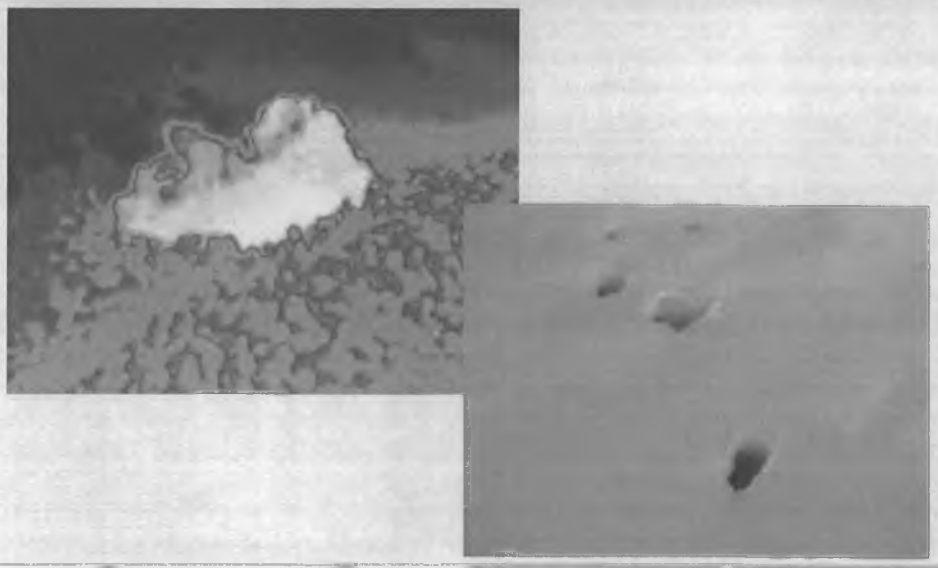
Completed runway above flood levels in 2006

Air Convection Embankment Concept



ACE – Thompson Drive Fairbanks

ACE in Action



Additional Permafrost Construction Techniques

Newtok Relocation Example

ADOT/PF's Involvement

- Designed and constructed new barge landing facility (2009), partially funded by EDA grant
- Worked cooperatively with the USACE on road design and permitting (State funded)
- ADOT/PF purchased 4900CY of road construction materials (Newtok Traditional Council also contributed funding)
- US Military (IRT) personnel constructed a 14 foot wide, 1500 foot road last summer with ADOT/PF oversight
- Oversaw the design and first phase of construction for the evacuation shelter funded by State grant to Newtok
- Developed mining plan for quarry development which produced approx. 100,000 CY of material this year

IRT Involvement

2011 Construction Season

What Needs to be Done

- Increase the collection and density of data ranging from
  - stream flow records
  - precipitation and other weather related data records
  - geotechnical and foundation information
  - other hydrologic data
- Investigate alternative design, construction, and maintenance techniques to address the changing environment

What Needs to be Done

- Continue partnering with the University of Alaska and other State and Federal agencies to address the most immediate needs of communities already being impacted
- Identify the critical information we need to gather to be able to address future impacts of climate change

Ongoing AUTC and DOT/PF-Sponsored Research

- Characterizing and adapting to changing permafrost dynamics:
  - Engineering Techniques to Control Permafrost Degradation under Roads Preservation of the Alaska Highway
  - Use of Shallow Anchors and Anchored Mesh System for Cut Slope Protection in Ice-Rich Soils
  - Documenting Best Management Practices for Ice-Rich Soils and Permafrost Sites (recently completed)
  - Design Manual for Air Convection Embankment (ACE)
- Meteorology & Hydraulics research and climate monitoring.
  - Impacts of Climate Variability and Change on Flood Frequency Analysis for Transportation Design
  - Updated Precipitation Frequency Analysis for the State of Alaska

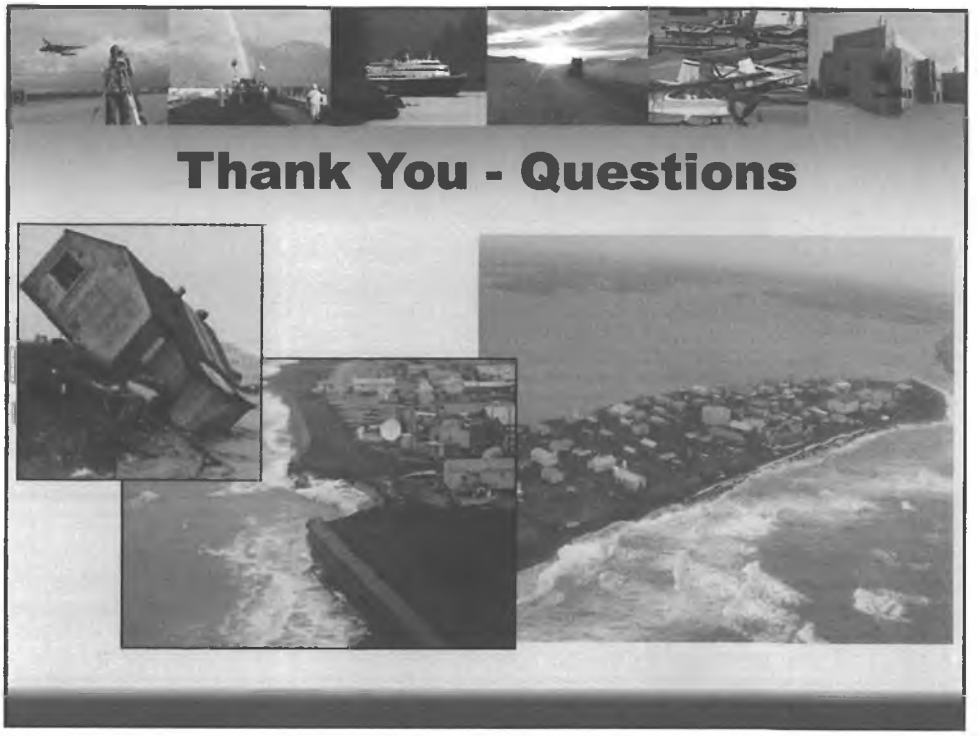
Final Thoughts – Why is this Important

- The USACE has identified over 180 communities that are threatened by erosion

Six Communities in Jeopardy

- Kivalina*
- Shishmaref*
- Newtok*
- Unalakleet
- Koyukuk
- Shaktoolik

* Have already begun relocation plans


Thank You - Questions

4

Important Subsistence Issues in the AVCP Region

Important Subsistence Issues in the AVCP Region

For the Northern Waters Task Force

Bethel, Alaska

October 10, 2011

Yupiit Piciryarait Cultural Center

Prepared by

Timothy Andrew, Director of Natural Resources for the Association of Village Council Presidents

Myron P. Naneng Sr., President

Raymond J. Watson, Chairman

AVCP Regional Subsistence Facts

- Highest per capita consumption of wild foods in the State of Alaska: 664 pounds
- Fish are the highest contributor to the subsistence diet: 60%
  - Salmon are very likely a high contributor, up to 80%
- Land mammals are the second highest: 20%
  - Moose, caribou, bear and musk ox contribute largely to the subsistence harvest.
- Marine mammals are third: 14%
  - Seals, walrus, and whales are the highest contributors.
- The remaining six percent consists of birds, shellfish, and plants.
  - The AVCP Region has the highest documented subsistence harvest of migratory birds in the state of Alaska (195,082 birds in 2009 compared to the Bering Straits-Norton Sound at 123,257 in 2007.

Subsistence Fisheries

- Salmon
- Halibut
- Herring
- Capelin
- Cisco
- Resident Species
  - Burbot
  - Sheefish
  - Whitefish
  - Blackfish
  - Rainbow Trout
  - Dolly Varden
  - Arctic Char
  - Needle Fish
  - Pike

Subsistence Birds

- Migratory Birds
  - Tundra Swans
  - Pacific White-fronted Geese
  - Cackling Canadian Geese
  - Emperor Geese
  - Black Brant
  - Ducks
  - Cranes
  - Spectacled Eiders
  - Stellar's Eiders
  - King Eiders
- Resident Species
  - Ptarmigan
  - Grouse

Subsistence Big Game Animals

- Moose
- Black Bear
- Grizzly Bear
- Caribou
- Musk Ox

Subsistence Small Game Animals

- Beaver
- Lynx
- Snowshoe Hare
- Tundra Hare
- River Otter
- Muskrat

Subsistence Marine Mammals

- Beluga Whale
- Pacific Walrus
- Ringed Seal
- Spotted Seal
- Harbor Seal
- Bearded Seal
- Ribbon Seal
- Sea Otter

Subsistence Plants and Berries

- Fireweed
- Wild Rhubarb
- Wild Celery
- Fiddlehead Ferns
- Sourdock
- Mouse Food
- Buttercups
- Willow greens
- Cloudberries
- Blue Berries
- Cranberries
- Raspberries
- Moss Berries
- Rose Hips

Subsistence Issues with Fisheries

The MOST IMPORTANT of subsistence fisheries issues is the state of our Chinook Salmon.

•The Yukon and the Kuskokwim River derive 80% of the State of Alaska's subsistence harvest of Chinook salmon.

•The returns of all salmon species crashed in the summer of 1998 due to unknown reasons. During that time, the Alaska Department of Fish & Game, A-Y-K Management staff came to AVCP and asked that we co-endorse a windows schedule in order to minimize the harvest of Yukon Kings and summer chums.

- •Since 1998, the Yukon River King Salmon have never fully recovered despite conservation measures imposed by both the Alaska Department of Fish & Game and the Office of Subsistence Management.
- •Conservation measures included 10-day closures which placed hardships on many of our Yukon River subsistence dependent communities.

Subsistence Issues with Fisheries

Continued:

•In 2007, the Bering Sea Pollock Fishermen harvested an estimated 122,000 Chinook salmon as bycatch.

•In 2009, during the North Pacific Fisheries Management Council meeting held in Anchorage, the former Commissioner of the Alaska Department of Fish & Game, Denby Lloyd, put forward a motion to allow the Bering Sea Pollock fishermen to harvest as bycatch upto 60,000 Chinook salmon with a performance cap of 47,500. This measure was beyond the AYK supported amount of 30,000.

•For several years, the Pilot Station Sonar has not been fully operational due to high water conditions, debris flow, and silt. During this time period, the Alaska Department of Fish & Game instituted conservative counting measures which placed undue restrictions on the subsistence and commercial fishermen of the Lower Yukon.

•There has not been a Chinook directed commercial fishery on the Lower Yukon River since 2007. In the subsequent years, a prohibition on the sales of Yukon Chinook salmon during chum directed fisheries was imposed.

Subsistence Issues with Fisheries

•On the Kuskokwim River, for three years in a row, the Lower Kuskokwim River tributaries of the Kwethluk, Kiseralik, and the Tuluksak have not achieved their escapement goals.

•In the summer of 2011, the Alaska Department of Fish & Game instituted windows and the U.S. Fish & Wildlife Service instituted a closure from the mouth of the Kuskokwim River to the Aniak River. Many people were dismayed and frustrated with the dual management system and the lack of communication.

Subsistence Issues with Fisheries

AVCP Recommends the following:

1. Institute a multiple user process to help determine the best rebuilding plan for the Yukon River Chinook salmon to include Tribal interests based on the best available science and traditional ecological knowledge.
2. Develop a run reconstruction model to assist the Alaska Department of Fish & Game in accurately reporting Chinook salmon passage at the Pilot Station Sonar during years of high debris flow, high water conditions, and silt.
3. Develop and utilize a total human-caused mortality enumeration model to include at-sea (Pelagic fisheries by-catch and environmental conditions), in-river (subsistence, commercial, sport and customary trade), and spawning ground mortalities (mining, sport fisheries, spawning stream.
4. Improve all means and methods of salmon enumerations projects to allow for any environmental condition that may affect counts in spawning streams and in-river

Subsistence Issues with birds

The current most important birds to the subsistence diet in the AVCP Region are: Black Brant, Lesser Pacific White-fronted Geese, Cackling Canadians, Lesser Snows and the Emperor Geese. (92,837 harvested in 2009 followed by ducks at 66,303)

- The Cackling Canadians and the White-fronted Geese have surpassed their population objectives
- The Emperor Geese and Black Brant populations have remained relatively stable but experience variations in population.
- The EMPEROR GEESE are one of the species of most concern.
  - Despite conservation efforts, the population remain relatively low with an occasional increase.
  - Issues that may affect population include continued hunting pressure, development in the wintering areas and environmental factors in their wintering and rearing colonies.
  - HABITAT important to the Emperors include Izembek National Wildlife Refuge and the mid-coastal areas.
- Spectacled Eiders are also one of the species of most concern.
  - Like the Emperor's, despite conservation measures , the population remains relatively lower than historical levels.
  - Issues that may affect populations include hunting, predation, and environmental factors
  - Habitat important to spectacled Eiders include the Bering Sea and Chukchi coastal areas and a portion of the Bering Sea south of St. Lawrence Island.

Subsistence Issues with big game animals

Moose and Caribou contributes the most to subsistence from big game animals.

The lower Yukon and Unit 18 remainder moose populations are the most dense while the Lower Kuskokwim Moose population remains relatively low.

The Lower Kuskokwim, within the last three years, have just emerged out of a moratorium and the population continues to build. Hunting seasons remain relatively short (10 days) with a registration requirement.

The Mulchatna Caribou Herd and the Western Arctic Caribou Herd are the most frequent visitors of the AVCP Region.

Caribou from the Mulchatna Herd contributes the most to the subsistence diet of the region.

The Mulchatna Caribou Herd experienced a historical high of 220,000 animals in 1996 and decreased to possibly less than 30,000 animals today. Hunting season are getting more restrictive and bag limits are decreasing.

Subsistence Issues with marine mammals

The ringed, bearded and spotted seals were recently listed as possible candidates under the Endangered Species Act due to global warming and the receding seasonal ice in the Bering Sea. Additional factors that may threaten the Bering Sea populations of marine mammals may include increased shipping traffic as the Bering Sea remains Ice free for longer durations and the northward expansion of the Bering Sea trawl fisheries into the currently closed Northern Bering Sea Research Area.

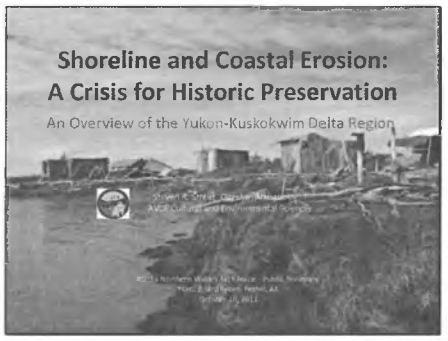
Very little scientific information is known about the marine mammal populations in the AVCP Coastal Areas, but traditional and ecological knowledge indicates the erratic movement of ice may affect their availability. As winds blow ice seaward, marine mammal availability decreases and as the winds blow the ice towards land, marine mammals availability increases.

Toi, quyana!
Questions?

5

Shoreline and Coastal Erosion: a Crisis for Historic Preservation

Slide 1



A contemporary fish camp on the middle channel of the Yukon River – A historic site "in the making"

The site exhibits all of the characteristics of shoreline erosion typical to a riverside environment in the Yukon-Kuskokwim Delta.
Note that the site is located on the active bend of the river because of ease of access along the bank; unfortunately, also the bank most prone to destruction.

Note also, with increased thawing, even the vegetated shoreline in the foreground is receding very rapidly.
The location and aspect of the site are very typical.

Slide 2

56 tribal service areas – based on federally-recognized tribes in the region, each with ANCSA village corporations, municipalities and at least one Tribal government.

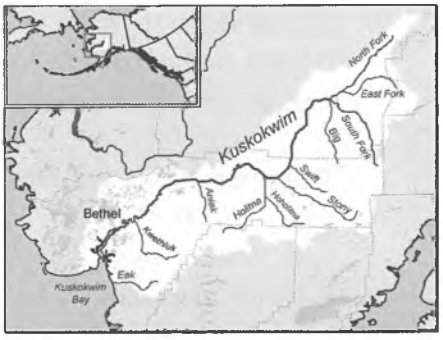
10 AVCP Units – reflect some real cultural relationships; representatives on the AVCP E-Board

Note that ANCSA selections and village corporations do not match Tribal service areas!

Note that Native allotments are not under Tribal jurisdiction (or at least within Tribal property boundaries!)

The Calista/AVCP region generally coincides with Central Yup'ik speakers or Cup'ik/Cupiq in certain sub-regions today.

Slide 3



Kuskokwim River Watershed – the Kuskokwim River Watershed Council (KRWC) is charged with protecting the "subsistence way of life" on the Kuskokwim.
*Note that Yukon watershed is partially visible to the NW – in ancient times, the Kuskokwim was a Yukon river channel.
Earliest people in Alaska likely came through this way!

Most significant historic sites in the region are along the shorelines of the main rivers or tributaries. These locations were focused on marine and riverine resources Almost nothing is known about much earlier sites located in the interior. Some predict climate change might lead to a rise in sea level between 2-4 meters.

Slide 4

Permafrost and ground-ice conditions throughout the arctic and subarctic regions of the world.
[International Permafrost Association, Data and Information Working Group (1998), available from the National Snow and Ice Data Center, Boulder CO]

Note in the Y-K Delta region, the area of continuous permafrost basically coincides with the Yukon National Wildlife Refuge.

More recent research indicates that rapid retreat of arctic sea ice increases the thawing of the permafrost.

Arctic soils hold 30% or more of all stored carbon in soils worldwide; melting likely will increase greenhouse gas emissions significantly

Slide 5

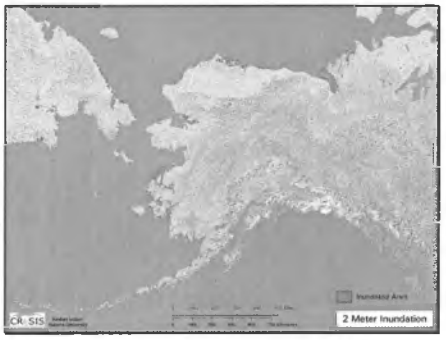
Thermokarst geomorphology -- This is "an irregular land surface containing ... bogs, caverns, pits, and other small depressions, formed in a permafrost region by the melting of ground ice."

YK Delta is predominately "gelisols." Gelisols are soils with permafrost and many are cryoturbated (churning of soils from frost action, including heaving, solifluction and mass movements)

*Though many of our tundra lakes have been relatively stable over time, the topography could change dramatically with increased thawing of the permafrost.

More severe storm surges are also exposing frozen ground and degrading the permafrost.

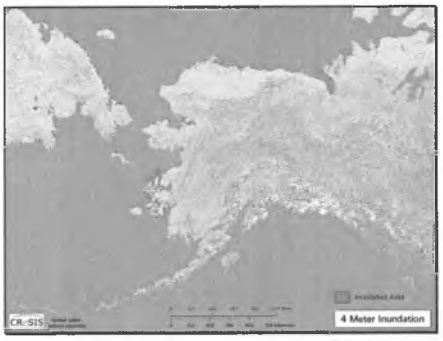
Slide 6



Predicted coastal inundation resulting from sea level rise of approximately 2 m (CReSIS, Center for Remote Sensing of Ice Sheets, The University of Kansas, Lawrence, Kansas, 2011, supported by NSF)

The 2m contour seems to coincide well with areas that are currently under threat from shoreline or coastal erosion and are subject to storm surges. I would contend that this is the best working model for examining the state of these sites today and is a starting point for understanding the threat.

Slide 7



Predicted coastal inundation resulting from sea level rise of approximately 4 m (CReSIS, Center for Remote Sensing of Ice Sheets, The University of Kansas, Lawrence, Kansas, 2011, supported by NSF)

At the 4m contour, most of the contemporary river deltas, most riverine environments in the Y-K Delta, and most contemporary villages would be under water.

Note that in areas of relatively higher elevation (such as on Nunivak Island or along Nelson Island), red spots basically coincide with historic site locations!

This is because access to water along shorelines was a major criterion for site placement in the past and communities were located is relatively low areas near the shore or along the rivers, not areas removed from the water.

Slide 8

This is an example of a historic site in a currently stable environment

Note the boundaries of this very large qasgiq (a communal men's house) – this site is not on the water now, but likely was along an old course of the Yukon River.
(Bureau of Indian Affairs archaeologist Matthew O'Leary is recovering material for radiocarbon dating from the center of the feature)

*Many sites in our region are only accessible in the summer by helicopter (because they are not now on the river system or are not accessible by modern

watercraft); in the winter, you would go past them on snowmachines but you would not be able to see them because of snow cover.

Slide 9

This is an actively eroding historic site on the coast, near the mouth of the Kuskokwim River. Currently, the shoreline may be receding at a rate of several meters a year.

Significant historic sites are being lost much faster than archaeologists can identify them.

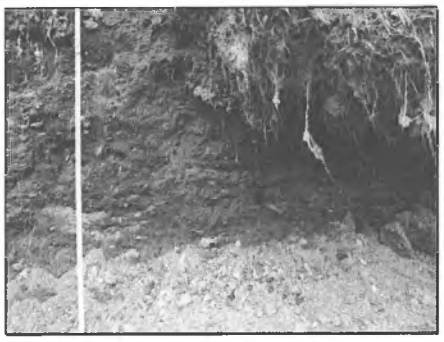
Monitoring or systematic field inventory is nearly non-existent throughout the Y-K Delta region.

Slide 10

This is an actively eroding profile at a coastal site on Nelson Island.

The dark bands that are clearly visible are floor surfaces of semisubterranean houses that have been damaged and lost from erosion from shore-fast ice and tidal action.

Slide 11



Detail of the profile above; note cultural wood, calcine bone, floor surfaces and relatively good preservation.

Preservation in frozen and/or waterlogged contexts is exceptionally good but, with thawing and freezing cycles and exposure on the surface, destruction increases rapidly.

Slide 12

This is a view of the same profile (me in the foreground identifying the cultural lenses and Nick Riordan, sedimentologist and son of anthropologist Ann Fienup-Riordan, to the left).

Notice the rubble where I am kneeling – This is predominately the result of people actively digging into this part of the site.

*Many of the most significant historic sites in the region are easily accessible from existing communities, are on ANCSA village corporation land (which is not protected by many federal and Alaska state historic preservation laws), and because of erosion are more visible to casual observers.

Shoreline erosion has two major effects:

- Direct loss of archaeological context, artifacts and, because of the destruction of context, loss of cultural knowledge
- Increased collecting and looting – with more visibility, more people are involved in actively damaging the sites.

Slide 13

The "built environment," with many significant historic structures in existing communities, is also at risk from shoreline erosion.

Note the historic structure to the left of this photograph which is falling into the river.

Human activity also increases erosion and becomes a significant contributing factor – most of the erosion in this case, for example, is from frequent boat traffic in the community, with large engines and resulting wakes damaging the shoreline.

Slide 14

Burials and human remains that are often present at significant historic places are also at risk.

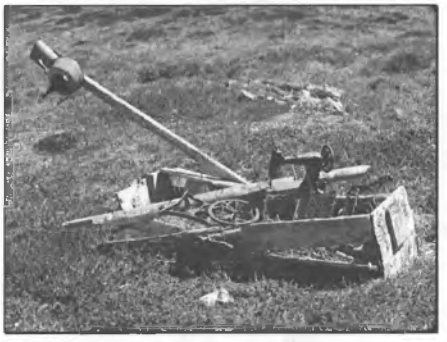
Here I am orienting a human radius that an elder noticed on the surface at an old village site. This particular site is atypical, with an abundance of prehistoric human skeletal remains present on the surface. Many skeletal elements are discovered comingled with artifacts along the beach and are also being lost at an unknown rate on an annual basis.

*Most local people who are concerned about the loss of these cultural resources do not know who to contact and feel these issues should be handled within the community; however, most landowners and Tribal governments are not organized to respond to these concerns.

NAGPRA (the Native American Graves Protection and Repatriation Act), in most cases, does not protect human remains and associated grave goods on private property. NAGPRA does apply on federal lands or federally-restricted property (i.e., Native allotments.)

Alaska state law requires the involvement of law enforcement, the Alaska State Medical Examiner and the State Historic Preservation Officer in the case of inadvertent discoveries.

Slide 15



This is a fine example of a historic surface grave – notice the "gender specific" grave accoutrements, such as the fine treadle sewing machine (photographed during the summer of 1984). These graves are located in a stable landscape of moist tundra vegetation, well away from the shoreline.

The site was a seasonal camp used by a small family. Graves of this young woman, her husband and infant were still visible in good condition during 2007.

Slide 16

This is a cemetery in a contemporary village along the Kuskokwim River that is actively eroding onto the beach and into the water.

Note human skeletal remains visible in the center of the photograph. These are not ***in situ*** (or in their original location) but have been gathered up and placed together by passersby. Most people in the villages have learned from their elders that it is appropriate to replace human remains as best they can as close to their original locations.

*This cemetery is now located on village corporation land and, according to the USACOE, would cost millions of dollars to stabilize. Of course, this is symptomatic of problems in all communities and no one has the money or clear responsibility to do it.

Slide 17

A view along the beach during the summer of 2010; note the small (presumably infant) coffin which has fallen down onto the beach.

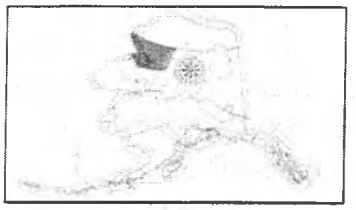
It is likely this had appeared on the surface relatively recently, since it is undamaged and still intact. One suspects that between the time this picture was taken and now, the coffin has disappeared and its contents have washed down the river.

DRAFT

Climate Change Impacts in Northwest Alaska

CCH Bulletin No. 7, October 15, 2011

This bulletin summarizes major climate change impacts, based on the findings from health impact assessments performed in the Northwest Arctic region; including the communities of Point Hope, Kivalina, Noatak, Kiana and Selawik. The purpose is to identify potential climate change-related impacts and provide information for local and regional planning.



Rural Alaska communities are vulnerable to climate change and residents seek adaptive strategies that will protect health, health infrastructure and the traditional way of life. The ANTHC, Center for Climate and Health is performing health impact assessments in Northwest Alaska to describe climate change impacts and provide information for adaptation planning. The work is in partnership with local governments, the North Slope Borough, the Northwest Arctic Borough, and Maniilaq Association, the regional tribal health consortium. In Northwest Alaska climate change is impacting the weather, the coastline, land, lakes and rivers, wildlife, plants, and the lives of the people who live here. Specific health concerns include food insecurity, water insecurity, injury, and damage to water and sanitation infrastructure. A summary of regional impacts is provided.

The Northwest is warmer. Gradual warming has occurred over the past sixty years. Average annual temperature has increased by 3.2 °F (1949 to 2006). Winter temperatures have increased the most, by 6.8°F.

The Northwest is wetter. Weather Service data from Kotzebue shows that average annual precipitation is increasing. Despite higher annual precipitation, very hot and dry summers have occurred, especially in upriver communities.

The land is increasingly fragile. Warming is increasing the thaw zone for permafrost, resulting in rapid erosion and subsidence. In areas where the permafrost has been disturbed or exposed, thawing is accelerated.

The land is disappearing. Over 1000 thermokarst slumps have been mapped in the Northwest Arctic Borough and a lot of soil is washing into the rivers. For communities that rely on rivers for water, the high turbidity decreases water quality and can disrupt treatment systems.

The rivers are wider, shallower, and dirtier. Surveys of the Kukpuk, Wulik, Noatak, Kobuk and Selawik rivers have documented miles of severe erosion. Permafrost thaw is a major factor, resulting in meters of lost river bank.

Thermal river break-up is more common. In recent years the Noatak and Kobuk rivers have increasingly had slow thermal break-up rather then the forceful, dynamic break-up that was typical. This may benefit some communities by reducing spring erosion and ice jam related flooding. Earlier break-up may increase the season for boating and for making community water.

The coastlines are increasingly vulnerable. Delayed freeze-up is increasing the season when storms can cause serious erosion. Warming is contributing by thawing permafrost.

Communities are flooding. Changing ice conditions, erosion and subsidence are contributing to an increased risk of flooding in coastal communities. Establishing evacuation shelters above the flood zone will help reduce anxiety, fear, and risk of injury.

The ice is thinning. The season for travel on ice is shorter. Hunters in Point Hope, Kivalina and Noatak describe falls-through-ice, interruptions and delays to seal and whale.

The tundra is receding. Residents in Noatak are concerned about increasing shrub lands, dry tundra, and impacts on berry harvests, caribou migration routes and wildfire.

The forest is expanding. Warming is resulting in northward expansion of forest and associated wildlife. Increasing moose populations is providing new subsistence opportunities.

The animals are moving. Migrating fish and land mammals provide new economic and subsistence opportunities while displacing some traditional subsistence species.

Lakes are disappearing. Thawing permafrost is causing lakes to warm and shrink. Algae blooms disrupted water treatment in Point Hope causing hundreds or hours of maintenance.

Existing transportation systems are threatened. Low rivers increase damage to boats and increase travel-related risk and cost. Low water is impacting boat and barge travel.

New transportation systems are opening. Sea ice loss has Increased marine vessel traffic, creating opportunity for new industrial and economic activities.

Traditional systems for food storage are failing. Warming is interrupting practices for drying fish, seal, and caribou. Traditional ice cellars are failing because of permafrost thaw.

Houses are breaking. Foundations are sinking causing building system damage. Many structures need to be leveled annually to prevent serious damage. Also homes are not designed for the high summer temperatures. Designs that accommodate cooling are needed.

Traditional sources of water are changing. Traditional sources include water brought to the village or camp for personal use. New species in Arctic rivers may be vectors for disease, such as giardia. Practices for safe use of traditional water sources are changing.

Community water systems are breaking. Permafrost thaw is a causing millions of dollars of damage and disruption to community water systems; impacting source water, and damaging treatment systems, distribution lines, and sewer mains and lagoons.

For more information about these and other health impacts and appropriate adaptation strategies, contact the Center for Climate and Health at ANTHC 907-729-2464.

6
Bering Sea Datapoint Project

The Bering Sea Datapoint Project:

Rescue of environmental data from the records of fishing, naval and other vessels operating in the Bering Sea, 1900 to present

MARK EDWARD SPRINGER
P.O. Box 3311
Bethel, Alaska 99559
543-7704

Abstract

The Bering Sea datapoint Project will echo the **CLIWOC Climatological database for the World's oceans: 1750 – 1850** (http://www.ucm.es/info/cliwoc/) carried out by Universidad Comlutense de Madrid, University of Sunderland, University of East Anglica, Royal Netherlands Meteorological Institute, Instituto de Nivologia, Glaciologia y Ciencias Ambientales (Argentina) with: National maritime Museum (London), the Netherlands Institute for Scientific Information Services and the US National Oceanic and Atmospheric Administration.

CLIWOC concluded in a freely available database of climatological data compiled from sailing ship logbooks of British, Dutch and Spanish and French fleets traversing the trade and naval routes of the globe from 1750 to 1850.

The Bering Sea Datapoint Project proposes to undertake the same effort, utilizing logbook and fisheries data from the commercial fishing fleets (US, Japan, USSR/Warsaw Pact, PRC, etc.) that have operated in the Eastern Bering Sea since the early part of the 20th Century. In addition logbook information from government and merchant vessels will be mined to develop a database that can be inputted to the Arctic Regions Supercomputer resulting in a visualization product that will allow researcher to pick a date and see a multi-dimensional representation of water temperature (at S.L. and depth), air temperature, wind speed and direction, barometric pressure at sea level overlain bathymetric information, historical weather observations, satellite weather photos, shore-side observations, catch-per-unit of effort (CPUE) data (if trawl monitor i.e. "suitcase" data is available). Other overlays may include SOSUS data analyzed for marine mammal sounds.

Western Alaskan residents can carry out a great deal of this data rescue in their home communities following a training period in Bethel. Compiled data will be transferred to UAF by digital means.

If successful, this project should in a few short years begin to yield sufficient data to allow visualization of environmental trends in the Eastern Bering Sea and allow researchers a powerful took in looking at and analyzing signals of short and long-term environmental changes effecting the Bering Sea and Western Alaska bioregion.

Potential partners in this project include the University of Alaska Geographic Information Network of Alaska; Community Development Quota companies; The North Pacific Fishery Management Council; North Pacific Research Board; Office of Naval Research and U.S. Department of State.

The existence of abundant meteorological data from logbooks of different European countries constitutes a common and invaluable heritage of the most outstanding scientific interest. The analysis of the logbooks content will contribute to characterise climate during XVIII th and XIX th centuries and to asses climate change.

These logbooks are an unique source of information which can not be obtained from any other way and will help to understand climate variability for a period and area (the oceans) with scarce data until now. The availability of such data to the scientific community will contribute to a better detection of climate change. The main aim of the project is to produce and make freely available for the scientific community the world's firsts daily oceanic climatological database for the period 1750 to 1850. The database will provide a better knowledge of oceanic climate variability over the study period. Data will be obtained from documentary sources, mostly logbooks records, which are kept in a number of European archives in Spain, Britain, Holland and France.

The original records will be transcribed and introduced into a computer based database.
Better knowledge of climate variability during the study period from sources that have not been exploited until now will be obtained. They will contribute to a better assessment of climate change especially of the behaviour of the major teleconnections. The results will be available for the whole scientific community, which will use them in different types of studies: Climate Variability analysis, modeling testing and calibration or climate change modeling and detection.

CLIWOC

Climatological database for the World's Oceans 1750 - 1850

Universidad Complutense de Madrid
University of Sunderland
University of East Anglia
Royal Netherlands Meteorological Institute
Instituto de Ciencias Humanas, Sociales y Ambientales
with the National Maritime Musuem, Greenwich

EC Framework V Project EVK1-CT-2000-00090

NAVAL LOGBOOKS – SOME BACKGROUND

1

From the earliest days of ocean sailing, mariners have kept accounts of their voyages. Christopher Columbus and the great Portuguese navigators began this tradition that persists to the present day. One of the principal functions of these logbooks was to assist in the navigation of the vessel. This was especially important when ships were out of sight of land and had no points of reference with which to determine their positions. By 1750 the keeping of logbooks was universal amongst the officers of European ships.

LOGBOOKS IN CLIMATIC RESEARCH

One of the factors that a ship's officer needed to take into account for reliable navigation was the weather. Navigation became a precise science only in the nineteenth century. Before that time more approximate methods were used to determine the true direction of the vessel's course and the distance covered each day These all required that wind force and wind direction be carefully recorded, the information being then used to determine the 'leeway', made by the ship. Mariners also kept a careful note of other weather phenomena such as rain, thunder, fog and snow. Because observations were made several times each day during the voyage, logbooks contain huge amounts of such detailed information.

THE ARCHIVES

2

Many logbooks failed to survive the rigours of life at sea but several thousand have come down to the present day. Some date from as long ago as the seventeenth century. Most frequent amongst the survivors are the logbooks of vessels in state service. Many thousands have been gathered together in a number of important archives. The United Kingdom, France, Spain and the Netherlands all possess notable collections. The CLIWOC project is the first attempt at a comprehensive study of this rich source of climatic data. It is curiously ironic that this legacy of the many past wars and conflicts between these nations should offer such an opportunity for co-operative scientific endeavour in this later age.

3

PROJECT OBJECTIVES

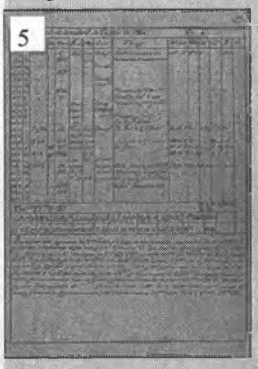
4

The principal objective of the CLIWOC project is to realise the scientific potential of logbook climatic data and to produce a database of daily weather observations for the world's oceans between 1750 and 1850. On completion of the project in 2004, this database will be made freely available to the scientific community. Other objectives are:

1. to provide a comprehensive understanding of the nature of climatic change over the oceans for the century after 1750 when logbooks become abundant
2. to provide secondary databases that summarise the character of climatic change at the annual and decadal scales
3. to link with existing data bases that cover the period from 1850 onwards
4. through the particular abundance of information from the North Atlantic region, to refine our knowledge of the behaviour of the NAO at this critical time before climate falls under any marked anthropogenic influence.
5. to stimulate a wider interest in the value of historical documents for climatic research.

MAKING SENSE OF LOGBOOK INFORMATION

Logbooks were written by seasoned mariners in the vocabulary unique to their profession and their times. Instruments were only rarely used and interest in the weather was limited to those aspects that influenced the navigation and progress of their ships. Seen through the eyes of the modern-day reader the descriptions of the weather are a mixture of the familiar and curious. Because the records were made to serve the needs of the day, and not those of the twenty-first century scientific enquirer, one of the principal challenges to the CLIWOC team is to interpret the weather vocabulary of former times, and thereby determine the true nature of the weather so assiduously recorded in often difficult circumstances.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A WORLD-WIDE DATABASE FOR 1750 TO 1850

The CLIWOC database will include daily observations from all the World's major oceanic areas. The North and South Atlantic and the Indian Oceans are well served in this respect but the vast expanses of the Pacific Ocean are expected to yield less information. The published data will be presented in a processed form using terms conforming to present-day usage and understanding. Information will be based on the most frequently recorded elements of wind strength and direction but data will also be provided on a wider range of commonly recorded phenomena that include rain and snow, thunder, fog and even the incidence of sea ice cover. To render the database more manageable annual and decadal summaries will be included. A meta-database will also allow enquirers to trace and consult the original sources. A CD-ROM will be produced not only of the database but also with digital images of the pages of the logbooks that were used in the project.

6

TURNING WORDS INTO NUMBERS

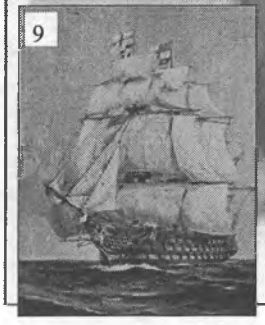
7

Until the closing years of the project's study period, shipboard instruments were an unreliable rarity. The vast majority of the logbook data are therefore in qualitative, descriptive form. This is not however to diminish their scientific value or to deny the possibility of their objective examination by statistical or content analysis. Most logbook entries lend themselves to various forms of frequency analysis. This approach gains added importance as a result of the century-long time span of the project. Within that period it will be possible to see how wind patterns varied, how rainfall frequencies fluctuated even how sea ice advanced and retreated across the frequently-navigated far northern oceans. By these means narrative accounts can be drawn into the arena of scientific debate thereby helping to meet the various CLIWOC objectives.

8

APPLICATIONS AND DEVELOPMENTS

In addition to the project's primary objectives, other valuable outcomes will also be achieved. Important amongst these is the insight that the logbooks will give to the question of climatic change over oceanic areas. These cover three-quarters of the Earth's surface, yet no other source provides a means to examine daily weather variations in these areas in the pre-instrumental period. This unique opportunity will be exploited to its fullest potential whilst not overlooking the importance of longer term trends. The results will provide important information for those engaged in assessing climatic change and its possible consequences.


9

LINKS WITH OTHER DATABASES

The CLIWOC database cannot claim to be the first attempt to provide a summary of marine-based climatic data. The COADS database (developed in the United States) covers the mid-nineteenth century to the present day and has an international reputation, as do the Japanese Kobe collection and the data assembled at the UK's Hadley Centre. These databases are concerned with instrumental information only. CLIWOC's contribution will be to extend the record of oceanic climate back by a century into the period before instruments were widely used.

CLIWOC PROJECT PARTNERS: contacts and addresses

CO-ORDINATION

Universidad Complutense de Madrid
Prof. R. García Herrera, Prof. E Hernández Martín,
Prof. L. Gimeno Presa, Dr. A. López Guttiérrez,
Departamento de Fisica de la Tierra II,
Facultad de CC Fisica, Ciudad Universitaria s/n.
Madrid 28040 SPAIN

Tel +34 (91) 394 4456
Fax +34 (91) 394 5195
e-mail rgarcia@6000aire.fis.ucm.es
emiliano@6000aire.fis.ucm.es
l.gimeno@uvigo.es

PARTNERS

University of Sunderland
Dr. D. Wheeler,
School of Humanties,
University of Sunderland,
Sunderland SR1 3SD UK

Tel +44 (0) 191 515 2233
Fax +44 (0) 191 515 2229
e-mail dennis.wheeler@sunderland.ac.uk

National Maritime Museum
Dr. N. Rigby, Dr. C. Wilkinson,
Greenwich,
London SE10 9NF UK

Tel +44 (0) 208 312 6559 +44 (0) 208 312 6792
Fax +44 (0) 208 312 6632 +44 (0) 208 312 6508
e-mail nrigby@nmm.ac.uk
CWilkinson@nmm.ac.uk

University of East Anglia
Prof. P. D. Jones,
Climatic Research Unit,
University of East Anglia, Norwich NR4 7TJ UK

Tel +44 (0) 1603 592090
Fax +44 (0) 1603 507784
e-mail p.jones@uea.ac.uk

Royal Netherlands Meteorological Institute
Dr. G. Können, F. Koek
KNMI, PO Box 201, 3730 AE, De Bilt
THE NETHERLANDS

Tel +31 (30) 220 6911
Fax +31 (30) 221 0407
e-mail Konnen@knmi.nl
Frits.Koek@knmi.nl

Instituto de Ciencias Humanas, Sociales y Ambientales
Dr. M. del Rosario Prieto
Instituto de Ciencias Humanas, Sociales y Ambientales,
CRICYT-CONICET
Calle A. Ruiz Leal s/n, Mendoza (5500), ARGENTINA

Tel +54 261 4288797
e-mail mrprieto@lab.cricyt.edu.ar

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CLIWOC

Climatological database for the World's oceans: 1750 – 1850

Universidad Complutense de Madrid
University of Sunderland
University of East Anglia
Royal Netherlands Meteorological Institute
Instituto de Nivología, Glaciología y Ciencias Ambientales
with:
the National Maritime Museum
the Netherlands Institute for Scientific Information Services and
the US National Oceanic and Atmospheric Administration (NOAA)

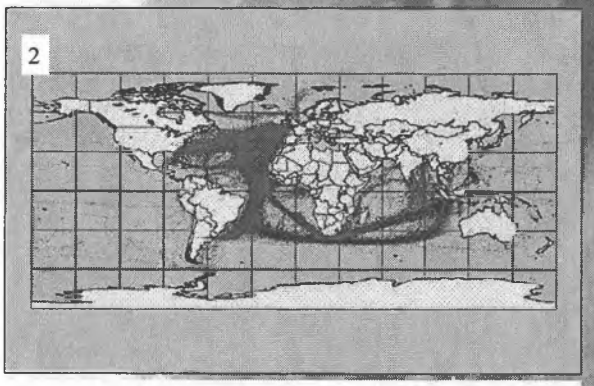
EC Framework V Project EVK1-CT-2000-00090

INTRODUCTION

At completion of the CLIWOC project, the team can look back upon a successful undertaking. The principal objective of the preparation of a database drawing on British, Dutch, French and Spanish ships' logbook records for the immediate pre-instrumental period (1750 to 1850) has been achieved. The database is freely available and we anticipate its widespread use. CLIWOC has established early ships' logbooks as another source available to those rising to the challenge of understanding climatic change, and can be set alongside proxy and instrumental data. The restrictions on the time span embraced by the available historical marine data are compensated by the fine scale of temporal resolution of the data (daily noon observations), and by the extensive geographical range of the observational record (only the Pacific Ocean lacks detailed coverage for this period). The maritime character of the data adds further to their value as oceanic areas are not well-served by data for this period.

LOGBOOKS IN REVIEW

Eighteenth and early nineteenth century logbooks had previously been used only in case studies of individual events of historic or climatic interest. Hitherto no comprehensive review of their scientific potential had been undertaken. CLIWOC's endeavours in this field have confirmed that they cast a new and more detailed light on the climate over the oceans in the immediate pre-instrumental period. It has also shown, however, that the data need to be treated with caution, and subjected to careful scrutiny. The range of information is consistent between the different national sources, and consists of wind force terms, wind directions and general weather descriptions. It is largely non-instrumental and based on the observations made by experienced officers.



CLIWOC data coverage: red—English sources, blue—Dutch sources and purple—Spanish sources

THE DICTIONARY – A SCIENTIFIC KEY

The weather terms employed by mariners before 1850 could not be taken at face value; the words they used were familiar, but their exact meanings initially uncertain. Wind force descriptors presented a great challenge, but had to be 'homogenised' through conversion to their present-day Beaufort Force equivalents. Only then could their scientific value be realised. The vocabulary differed between the national sources. English mariners used a relatively narrow range of terms, whereas their Dutch, French and Spanish counterparts employed a much more varied set of descriptors. In all cases, however, the majority of wind force entries were accounted for by just twelve or so terms. Content analysis and other methods were used to prepare a dictionary in which the majority of all wind force terms were defined on the Beaufort Scale. This multi-lingual dictionary has now been published.

ACHIEVING CLIWOC'S OBJECTIVES

The project has achieved success in drawing a new data source into the scientific realm, and has provided an enduring legacy of methods, data and understanding. In doing so it has:

1. established a freely-available database of calibrated climatic data that will be of continued and growing value in climatic studies
2. confirmed by objective means the reliability of logbook data
3. provided a dictionary of terms that allows other scientists to decipher more readily the descriptions contained in logbooks
4. developed a statistical algorithm by which fields of collated logbook data can be used to reconstruct atmospheric pressure fields over the oceans
5. the CLIWOC database is also being used to extend the record from instrumental logbooks contained in the well-established I-COADS dataset. The CLIWOC data and investigations have also provided a valuable complement to the US Maury dataset being developed by the I-COADS team.

DATA VERIFICATION

The intrinsic reliability and consistency of the logbook weather record was determined by sampling from the large number of logbooks where ships were in convoy or travelling in close company. These voyages often lasted several weeks giving large replicate samples. The degree of correlation in recorded wind forces was consistently high, as was the degree of similarity in recorded wind directions. On a number of occasions, however, small but persistent differences were found between absolute wind force records prepared on vessels of different sizes. Whilst not materially influencing the scientific outcome of the project, it remains a matter for further investigation. Further tests have been carried out to compare the aggregated logbook wind field records with the I-COADS maritime database and the NCEP/NCAR reanalysis.

THE DATABASE

Version 1.0 of the database was released in late 2003. The database is available as a CD-ROM, but can also be interrogated through a dedicated CLIWOC website (see below). An important development is its simultaneous availability through the I-COADS site. Release version 1.0 is based on the International Maritime Meteorological Archive (IMMA) format, which is being developed under the joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (documentation at I-COADS website; see contacts). Version 1.0 has over one quarter of a million records, but this will increase quickly in the planned later versions as more data are processed for inclusion. The database includes information on date and time of each observation, the latitude and longitude of the recording vessel and its country of origin. This is followed by the key climatic information for wind direction and wind force. Where such data are available, and this is generally only found in the more recent records, instrumental observations are also included.

3

Front cover of CLIWOC's multilingual dictionary

DATA CORRECTION

Logbook data often need correction as well as verification. Not only did archaic wind force terms require conversion to Beaufort scale equivalents, but wind directions had to be adjusted if they had been made by reference to magnetic, as opposed to true, north. This correction varied over space and time, but could be as much as 30 degrees. Latitude and, more especially as precise navigational methods were commonplace only towards the close of the study period, longitude sometimes required correction using specifically designed software to detect and rectify logbook errors.

CLIWOC DATA APPLICATIONS

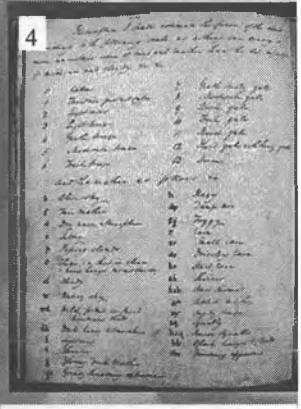
The CLIWOC team are calibrating statistical models with which the database information for wind force and direction can be processed to provide monthly pressure field reconstructions for the Indian and the South and North Atlantic Oceans. These will provide a means for studying climatic change over the oceans in the 100 years beginning in 1750, and will permit important measures such as the North Atlantic Oscillation and Southern Oscillation indices to be estimated for this pre-instrumental period.

CLIWOC IN THE FUTURE

The CLIWOC project closed in 2003, and has as its most durable legacy the database and the knowledge that a new climatic data source has been confirmed. The British, Dutch and Spanish sources have contributed equally to the database, each providing approximately 100,000 days of noon observations. French logbooks have also been used, but no other significant European sources exist for ocean voyages prior to 1850. The database will, however, continue to develop. Whilst the Spanish logbooks have been extensively studied, over 50 per cent of Dutch and over 90 per cent of British and French logbooks remain wholly unexamined. There are several thousand such items. They cover most of the oceanic areas and embrace the CLIWOC period and earlier times as far back as the mid-seventeenth century. All national sources, however, include many non local-noon observations that also require consideration. In many respects the close of the formal CLIWOC programme serves only to open a longer phase of fruitful investigation.

To obtain a copy of the data (CD-ROM or via ftp) please go to www.ucm.es/info/cliwoc for details.

4



Francis Beaufort's first wind and weather scale (1806)

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CLIWOC PARTNERS AND PARTICIPANTS: contacts and addresses

CO-ORDINATION

Universidad Complutense de Madrid

Prof. R. Garciá Herrera, Prof. E. Hernández Martin,
Prof. L. Gimeno Presa, dr. A. López-Gutiérrez,
Departamento de Fisica de la Tierra II,
Facultad de CC Fisica, Ciudad Universitaria s/n,
Madrid 28040 SPAIN

Tel. +34 (91) 394 4456
Fax. +34 (91) 394 5195
e-mail rgarcia@6000aire.fis.ucm.es
URL www.ucm.es/info/cliwoc

PARTNERS AND PARTICIPANTS

University of Sunderland
Dr. D. Wheeler,
School of Health, Natural and Social Sciences,
Priestman Building,
University of Sunderland, Sunderland SR1 3SD UK

Tel. +44 (0) 191 515 2233
Fax +44 (0) 191 515 2229
e-mail dennis.wheeler@sunderland.ac.uk
URL www.nmm.ac.uk/cliwoc

National Maritime Museum
Dr. N. Rigby, Dr. C. Wilkinson,
Greenwich,
London SE10 9NF UK

Tel. +44 (0) 208 312 6792
Fax. +44 (0) 208 312 6508
e-mail nrigby@nmm.ac.uk
CWilkinson@nmm.ac.uk

University of East Anglia
Prof. P. D. Jones,
Climatic Research Unit,
University of East Anglia, Norwich NR4 7TJ UK

Tel. +44 (0) 1603 592090
Fax. +44 (0) 1603 507784
e-mail p.jones@uea.ac.uk

Royal Netherlands Meteorological Institute
Dr. G. Können, F. Koek,
KNMI, PO Box 201, 3730 AE, De Bilt,
THE NETHERLANDS

Tel. +31 (30) 220 6911
Fax. +31 (30) 221 0407
e-mail Konnen@knmi.nl
Frits.Koek@knmi.nl
URL www.knmi.nl/~koek/cliwoc.htm

Instituto de Nivologia, Glaciologia y Ciencias Ambientales
Dr. M. del Rosario Prieto, CRICYT-CONICET,
Calle A. Ruiz Leal s/n, Medoza (5500) ARGENTINA

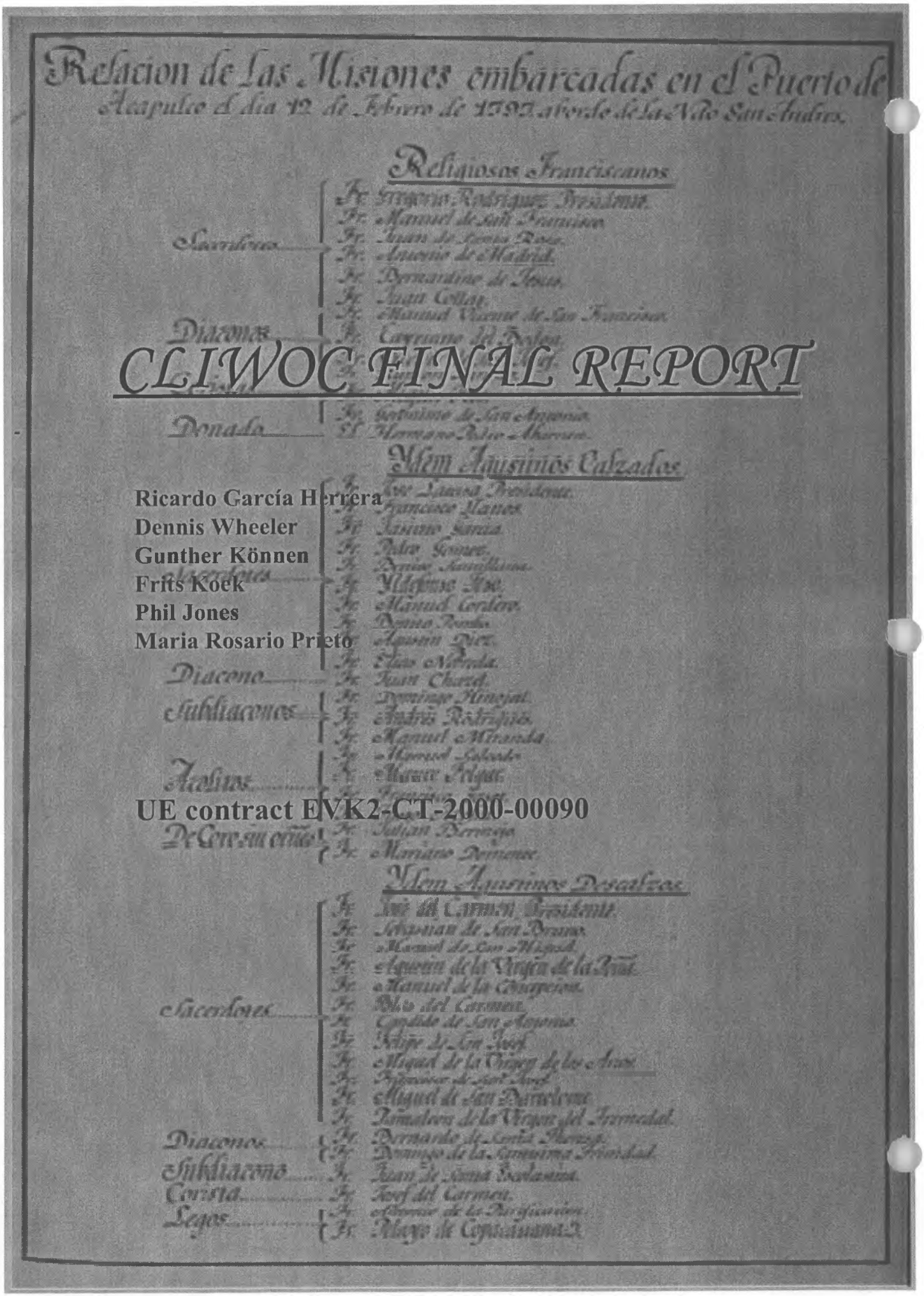
Tel. +54 261 4288797
e-mail mrprieto@lab.cricyt.edu.ar

Netherlands Institute for Scientific Information Services
Dr. P. Doorn, B. Feith
NIWI, Joan Muyskenweg 25, 1096 CJ Amsterdam,
THE NETHERLANDS

Tel. +31 20 462 8600
e-mail Peter.Doorn@niwi.knaw.nl
Berry.Feith@niwi.knaw.nl

US National Oceanic and Atmospheric Administration (NOAA), and the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) Project
Scott Woodruff
NOAA Climate Diagnostics Center
325 Broadway, Boulder, CO 80305 USA

Tel. +1 303 497 6747
Fax. +1 303 497 7013 or 6449
e-mail Scott.D.Woodruff@noaa.gov
URL http://www.cdc.noaa.gov/coads &
http://www.cdc.noaa.gov/e-doc/imma/imma.pdf


Relacion de las Misiones embarcadas en el Puerto de Acapulco el dia 12 de Febrero de 1797 a bordo de la Nao San Andres.

Religiosos Franciscanos

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Fr. Gregorio Rodriguez Presidente.
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Fr. Juan Gallag.
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Fr. Andres Rodrigues.
Fr. Manuel Miranda.

Acolitos
Fr. Manuel Salcedo.
Fr. Manuel Delgado.

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Descalzos
Fr. Julian Berrueco
Fr. Mariano Bermeno.

Idem Agustinos Descalzos

Sacerdotes
Fr. Jose del Carmen Presidente.
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Legos
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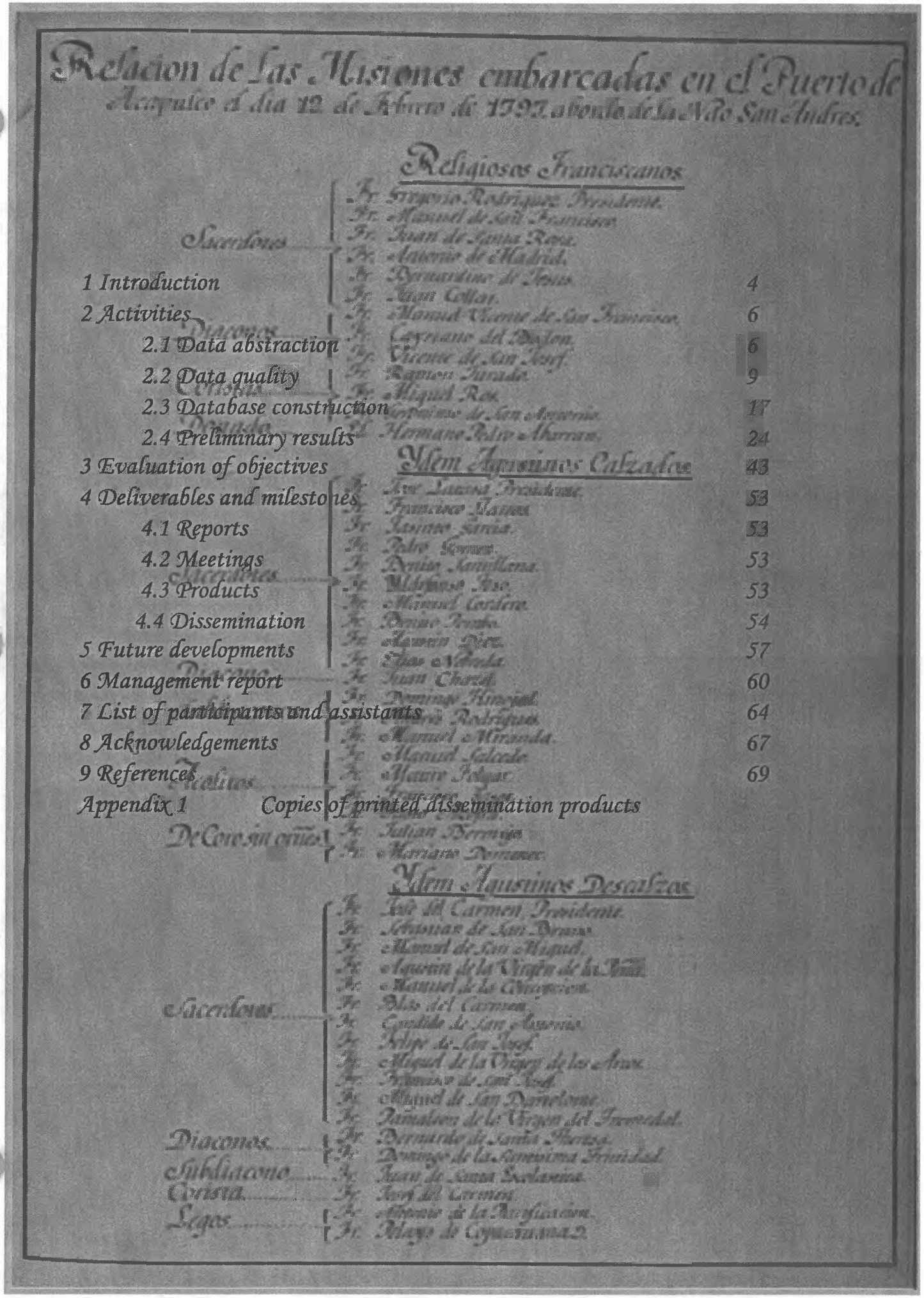
Fr. Diego de Cupertino.

CLIWOC FINAL REPORT

Ricardo García Herrera
Dennis Wheeler
Gunther Können
Frits Koek
Phil Jones
Maria Rosario Prieto



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Relacion de las Misiones embarcadas en el Puerto de Acapulco el dia 12. de Febrero de 1797. abordo de la Nao San Andres.

Religiosos Franciscanos

- Sacerdotes
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  - Fr. Juan Gillar.
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  - Fr. Francisco Xaret.
  - Fr. Juan de Acosta.
- De Coro sin orden
  - Fr. Julian Dominge.
  - Fr. Mariano Dominge.

Idem Agustinos Descalzos

- Sacerdotes
  - Fr. Jose del Carmen Presidente.
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  - Fr. Manuel de la Concepcion.
  - Fr. Blas del Carmen.
  - Fr. Candido de San Laurnio.
  - Fr. Felipe de Jesus Josef.
  - Fr. Miguel de la Virgen de los Dolores.
  - Fr. Francisco de Sant Josef.
  - Fr. Miguel de San Dionisio.
  - Fr. Jamalcon de la Virgen del Arrocidad.
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  - Fr. Bernardo de Santa Theresa.
  - Fr. Domingo de la Santissima Trinidad.
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- Corista
  - Fr. Josef del Carmen.
- Legos
  - Fr. Dionisio de la Purificacion.
  - Fr. Diego de Cayetano.

1 Introduction

1 Introduction

This is the final report of EU funded CLIWOC project (EVK2-CT-2000-00090). The project started on 1 December 2000 and continued until 30 November 2003. Project partners are: Universidad Complutense de Madrid, Spain (partner 1 and coordinator), University of Sunderland, UK (partner 2), Royal Netherlands Meteorological Institute (KNMI), the Netherlands (partner 3), IANIGLA, CONICET, Argentina (partner 4) and University of East Anglia, UK (partner 5). A warm and highly cooperative working environment has developed among the partners. This has led to a very active and fruitful interchange of experiences that has resulted in the efficient and successful completion of the project.

The aim of this report is to provide a global view of the main project activities and achievements. Chapter 2 reviews the four principal activities as described in the working packages: data abstraction (wp 1-4), control of the data quality (wp 5), database construction (wp 6) and the first scientific results (wp 7). In chapter 3 the project objectives are evaluated, while the milestones and deliverables are reviewed in chapter 4. Fortunately, the results have been so encouraging and successful that CLIWOC related undertakings have not ended with the formal conclusion of the project. The partners are committed to continuing the activities of the CLIWOC project and building on its successes; these activities are described in chapter 5. The management report is included as chapter 6, while chapters 7 and 8 include the complete list of participants and the acknowledgements.

Relacion de las Misiones embarcadas en el Puerto de Acapulco el dia 12 de Febrero de 1797 a bordo de la Nao San Andres.

Religiosos Franciscanos

Sacerdotes
- Fr. Gregorio Rodriguez Presidente.
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- Fr. Bernardino de Jesus.
- Fr. Juan Collazo.

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- Fr. Manuel Vicente de San Francisco.
- Fr. Cayetano del Doylon.

Coristas
- Fr. Vicente de San Josef.
- Fr. Ramon Jurado.
- Fr. Miguel Ros.

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- Fr. Gregorio de San Agustin.
- El Hermano Pedro Abarran.

Idem Agustinos Calzados

Sacerdotes
- Fr. Jose Zamora Presidente.
- Fr. [illegible]
- Fr. Pedro Gomez.
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De Comunidad
- Fr. Juliano Dorronsoro.
- Fr. Mariano Dominec.

Idem Agustinos Descalzos

Sacerdotes
- Fr. Josè del Carmen Presidente.
- Fr. Sebastian de San Bruno.
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- Fr. Miguel de la Virgen de los Dolores.
- Fr. Francisco de San Josef.
- Fr. Miguel de San Buenaventura.
- Fr. Inmaculada de la Virgen del Fromedal.

Diaconos
- Fr. Bernardo de Santa Maria.
- Fr. Domingo de la Concepcion Fromedal.

Subdiacono
- Fr. Juan de Santa Ysabel.

Corista
- Fr. Josef del Carmen.

Legos
- Fr. Antonio de la Purificacion.
- Fr. Diego de Cupertino.

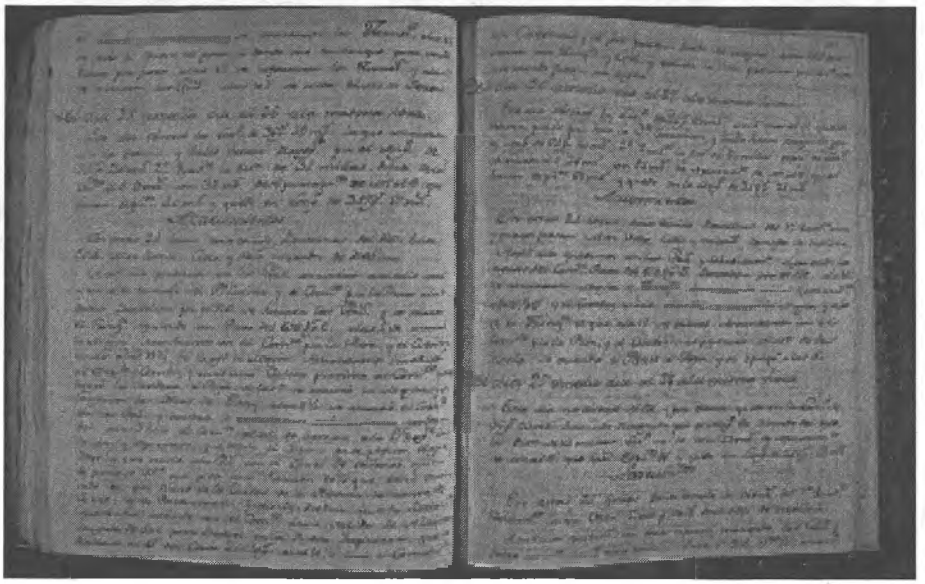
2 Activities

2 Activities

2.1 Data abstraction

The partners in the abstraction process employed different strategies. These were designed to adapt abstraction methods as efficiently as possible to the particular requirements of the Archives in each country. Thus, the abstraction from Spanish and Dutch logbooks has been made after producing digital images of the original logbooks preserved in the respective archives (Archivo del Museo Naval and Archivo General de Indias in Spain and the Nationaal Archief in The Netherlands). This procedure fosters better preservation of the original documents and minimises the working time at the archives. Additionally it contributes to a better access to the document contents, which includes a large volume of non-climatic information. This activity is one of the many multidisciplinary features of the project. After solving some of the copyright issues, which vary among the countries, the projects web page (www.ucm.es/info/cliwoc) will host all the images of the logbooks that are made freely available by the host archives. Figure 1 shows some examples of logbook pages from the different countries.

a)



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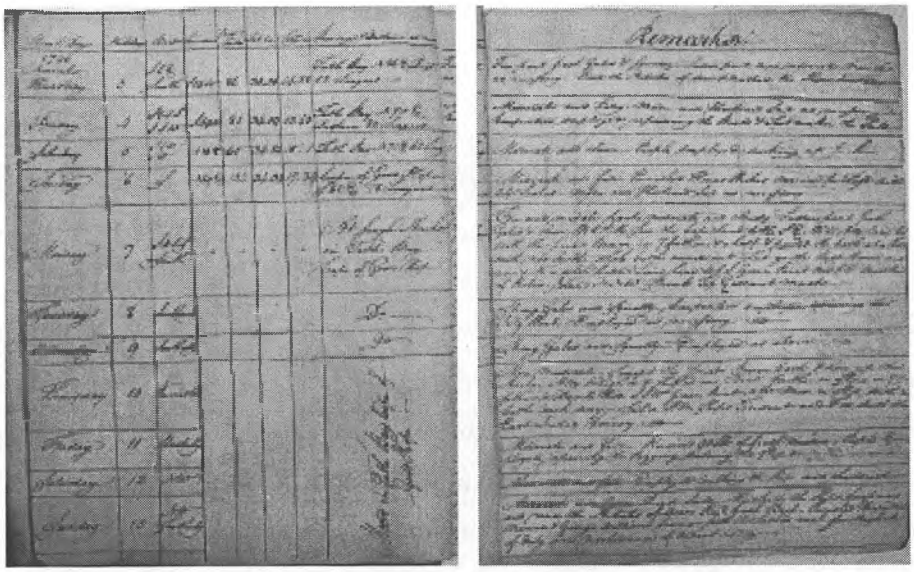

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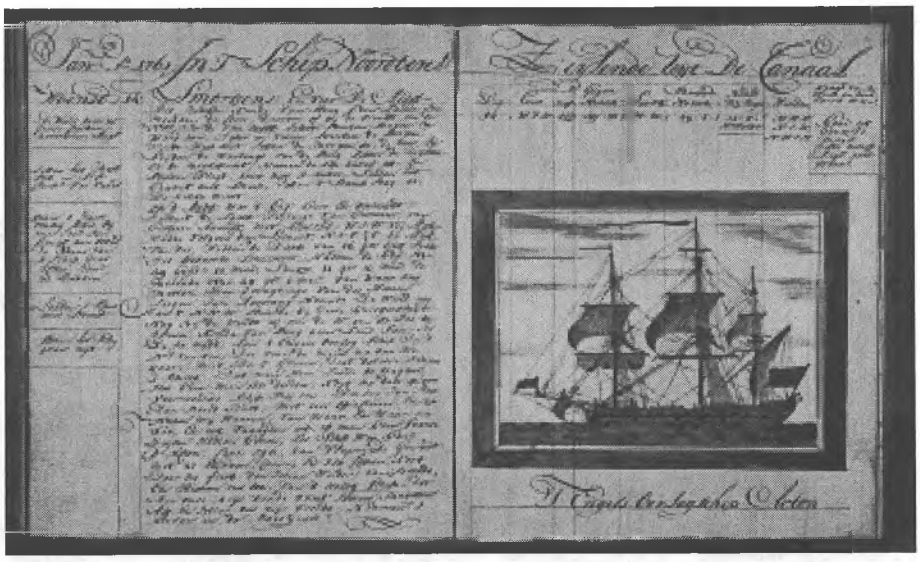


Figure 1. *Sample logbook pages from different countries showing typical layout. a) from Spain, b) England and c) the Netherlands*

Because of the much greater volume of logbooks to be consulted and the different logistic requirements, the English data have been abstracted directly from the original documents into the database. In addition, Partner 2's team were based in the Archives of the National Maritime Museum (Greenwich, London) thereby minimising the need to prepare 'transportable' digital images.

Finally, many French logbooks have been abstracted from microfilm images that have been bought from CARAN (Centre d'Accueil et de Recherche des Archives Nationales).

To ensure homogeneity in the abstracted data, the partners agreed:

1) To use a common protocol for the raw database. All meteorologically relevant data of the midday (noon) observation were extracted, i.e. the date, geographical position, wind direction, wind force, present weather, sea state and, when available, sea ice reports, air temperature and air pressure data. Spanish and French logbooks contain usually one observation per day, generally at noon, but UK and Dutch logbooks include sub daily observations as well, although with less detail than the noon observations. For reasons of efficiency, the sub-daily observations were generally ignored in the extraction, but metadata such as the archive where the logbook is kept and its catalogue code, the ship's name and type, the names of the logbook keepers, reports of encounters at sea and, for users outside the climatological fields, recordings of notable events on board were all abstracted. The latter includes references to deaths on board, punishments, sightings of birds, whales, etc., as well as other information. This subset of information may be particularly relevant to historians interested in non-climatic applications of the database, such as military studies, trade and economic history etc.

2) To abstract the logbook observations into the working database without any preliminary conversion or elaboration of the content. This allows for greater flexibility in the post-processing and in the preparation of the different versions of the database, thereby optimising its potential and permitting easy reference back to the source material.

3) To make preliminary and intermediate integration exercises. From the outset this has been a highly successful exercise, allowing data inhomogeneities and

curiosities to be detected, speeding the production of the final database and permitting the easy integration of information from the different sources.

In total, 1,624 logbooks were digitized, comprising of 273,269 observations. Table 1 shows the distribution over the countries.

	Logbooks	*Observations*
Spain	408	50,935
UK	591	88,475
Netherlands	613	126,541
France	12	7,318
TOTAL	***1,624***	***273,269***

Table 1. *Number of CLIWOC logbooks and observation by country.*

2.2 Data quality

One of the main objectives of CLIWOC was to obtain a high quality dataset. Consequently much effort has been invested in checking and assuring the quality of the abstracted data. Package 5 was principally devoted to the many quality issues. Three main levels of quality control may be distinguished:

1) quality of the data transcription,
2) quality of the data interpretation,
3) quality checks of the derived observations.

1) Quality of the data transcription

In order to evaluate and minimize the errors when keying the data from the original documents into the raw database, a common procedure was implemented. A sample of 5% of the total keyed pages was routinely sampled every month to check for typing or

other errors. Where significant errors were found that month's work, it was re-abstracted.

2) Quality of data interpretation

The correct typing of the original logbooks was only the first step of the process. These raw data were, however, written in archaic versions of four languages (Spanish, English, Dutch and French), all of which had to be translated into their modern English equivalent if the database was to be useful and accessible.

With this aim in mind, a multilingual dictionary was produced. It is currently available from the project web page, and is one of the first attempts in the literature to express the wealth of archaic logbook wind force terms in a form that is comprehensible to the modern-day reader. Oliver and Kington (1970) and Lamb (1982) have drawn attention to the importance of logbooks in climatic studies, and Lamb (1991) offered a conversion scale for early eighteenth century English wind force terms, but no studies have thus far pursued the matter to any greater depth. At an early stage in the project it was apparent that many of the logbook weather terms, whilst conforming to a conventional vocabulary, possessed meanings that were unclear to twenty-first century readers or had changed over time. This was particularly the case for the important element of wind force; but no special plea is entered for the evolution in nautical vocabulary, which often reflected more wide-ranging changes in the respective native languages.

The key objective was to translate the archaic vocabulary of the late eighteenth and early nineteenth century mariner into items in the current international standard of the Beaufort Scale. Only then could the project's scientific programme be embarked upon. The dictionary is the result of the largest undertaking into logbook studies that has yet been carried out. Several hundred logbooks from British, Dutch, French and Spanish archives were examined, and the exercise offered a unique opportunity to explore the vocabulary of the one hundred year period beginning in 1750. The logbooks from which the raw data have been abstracted range widely across the North and South Atlantic and the Indian Oceans. Only the Pacific, largely in consequence of the paucity of regular naval activity in that area, is not well represented. The range of climates encountered in

this otherwise wide geographic domain gives ample opportunity for the full range of the mariner's nautical weather vocabulary to be assessed, from the calms of the Equatorial regions, through the gales of the mid-latitude systems to the fearsome storms of the tropical latitudes. The Trade Winds belts, the Doldrums, the unsettled mid-latitudes, even the icy wastes of the high latitudes, are all embraced in this study. The text seeks to provide a means of understanding archaic wind force terms and, other than to indicate those items that were not commonly used, no information is given on the frequency with which different terms appeared in the logbooks. The work is offered to the wider academic community in the hope that it will prove to be of as much value as it has been to the CLIWOC team. The complete text of the dictionary can be obtained in PDF-format from the project web page: www.ucm.es/info/cliwoc

3) Quality checks of the derived observations

After the extraction and an initial quality control, which included a calendar check of data from English logbooks prepared between 1750 and 1752 (a period when the Julian calendar was still in use), the data were sent to the Dutch partner. For every ship, the route was plotted, checked and adjusted according to the present-day prime meridian convention (i.e. Greenwich). In total, 636 different zero meridians were identified as being used over the study period. The reason for this vast number is the habit in those days of changing the zero meridian at each major landfall or sighting. Despite such longitude corrections, some coordinates continued to suggest overland and otherwise obviously erroneous positions. This is because most of the longitude determinations were based on dead reckoning, and the accumulation of small errors could result in an increasing miscalculation of the ship's longitude as the voyage progressed. After determining the part of the voyage that needed correction, the final step was to apply incremental adjustments to the ship's longitudes throughout that leg of the voyage and thereby to estimate the most likely track. This was done according to the method originally developed by Jackson et al. (2000). Figure 2 shows an example of the effect of longitude adjustments on the track of a ship's voyage. Note that in this example the outward journey contained many more land sightings and hence more changes in longitude zero points than the return trip, which went over the open ocean with far fewer land sightings.

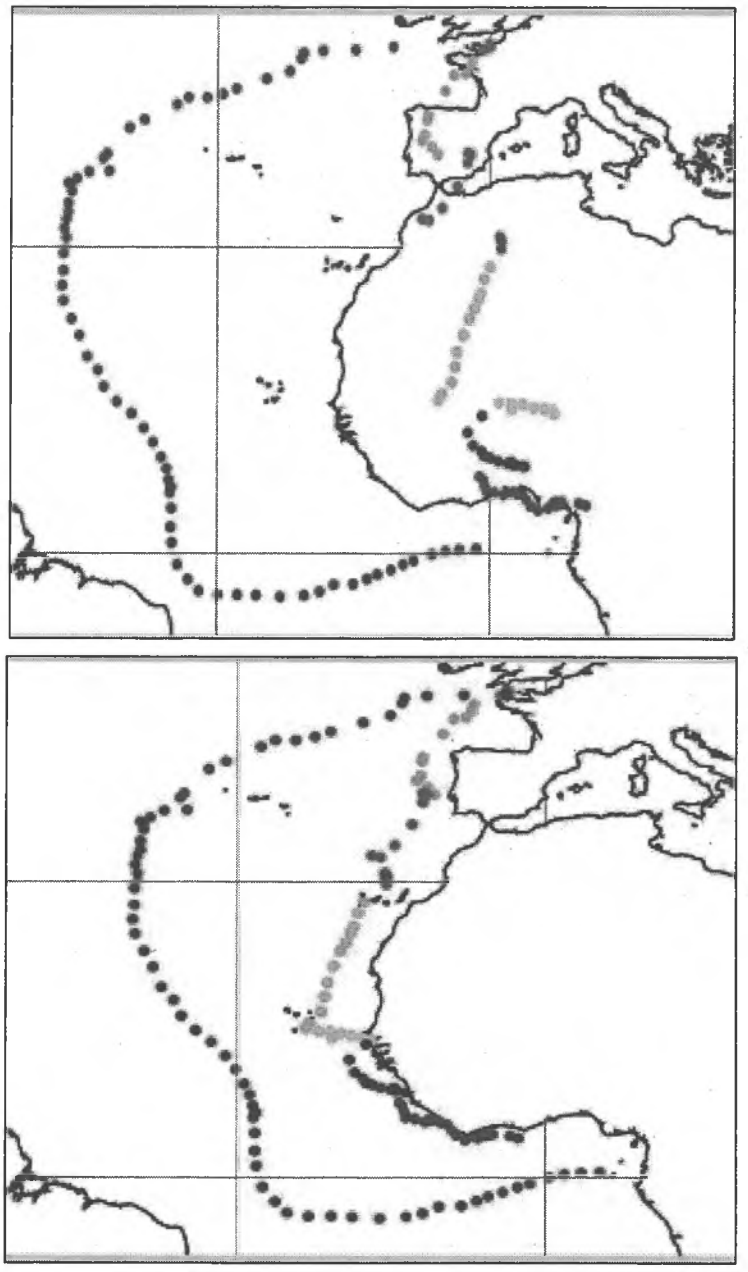


Figure 2. *The top figure shows the positions of HMS* Surprise *(1750-1751) without correcting the longitude to the current standard, i.e. Greenwich. Each different colour corresponds to a different zero meridian, which are, in order: Start Point, Ushant, Cape Roxent, Madeira, Point Negro, Isle of May Bay, Cape St. Maries, Bananas and (at the return trip) St. Thomas's. The bottom figure shows the corrected positions.*

The figure is typical for CLIWOC in the sense that more than 50% of ship tracks needed major revision. Only when the reliability of the original data had been confirmed and corrected if necessary, could attention could turn to the question of observational bias and intrinsic errors in the key meteorological observations.

The first task was to search for bias in the scale used for recording of wind direction. In theory, winds were recorded on 32-point compass, but a sample of over 4000 observations showed that there was a bias towards using only the 16- (NNE, SSE etc.), 8- (NW, SW etc.) and 4-point (N, W, etc.) elements of the compass. Table 2 shows the observed – expected values and chi-square statistics over the first eight decades of the study period. In all decades except the 1810s this tendency is statistically significant at the 0.01 level.

Decade	4-point	8-point	16-point	32-point	Test Stat
1750s	171.25	764.25	423.5	-1359	**1278**
1760s	116.25	252.25	201.5	-570	**482**
1770s	97.75	215.75	77.5	-391	**403**
1780s	72.75	223.75	208.5	-505	**433**
1790s	35.63	192.63	65.25	-293.5	**266**
1800s	75.75	114.75	123.5	-314	**240**
1810s	14.75	1.75	-7.5	-9	4.5
1820s	20.63	17.63	39.25	-77.5	**50.7**

Table 2. *Observed minus expected frequencies based on the null hypothesis of no bias in the use of the 32-point compass. Chi-square statistics in bold are statistically significant at the 0.01 level.*

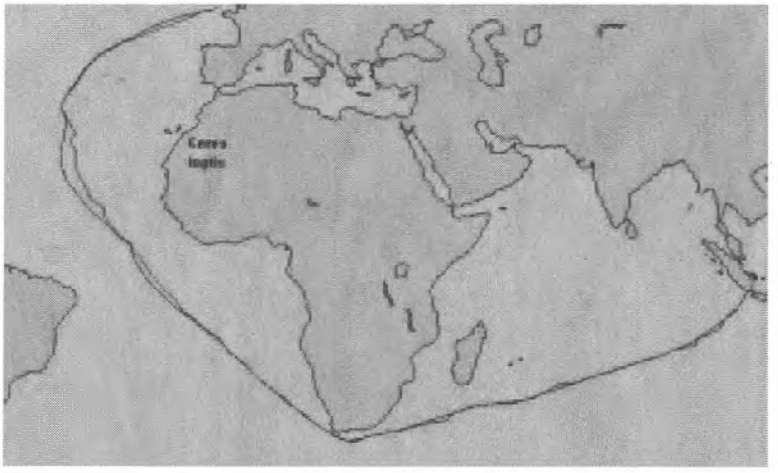


Figure 3. *One of the 'dual' voyages (East India Company ships* Ceres *and* Inglis*) used in the study of data consistency.*

Secondly, an examination was made of the consistency with which wind force and wind direction (the two principal weather elements) were recorded. This was performed by taking records from ships in company over long voyages. The differences between such independently derived data sets provided a measure of data reliability. The results for wind direction are shown in Figure 4, in which the mean difference is 2.47 compass points, with a modal class of 1 compass point. It shows also that 45 per cent of differences were 1 point (22 degrees) or less.

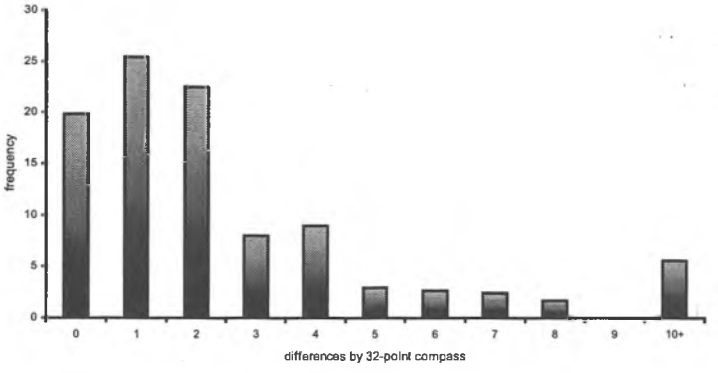


Figure 4. *Histogram of wind direction differences from independent observations of the same conditions. Sample size = 413 pairs of observations.*

Finally, wind force records were compared after their conversion to present-day Beaufort Scale equivalents. The sample size was 461 pairs of records. Figure 5 summarises the differences and shows a mean of 0.9 of a wind force and a modal class of zero. Table 3 provides a more detailed statistical summary of the wind force analysis. All correlations between the series were significant at the 0.05 level (all except one at the 0.01 level). The mean differences in all pairs of voyages were less than one force on the Beaufort Scale (but were significant in a number of cases).

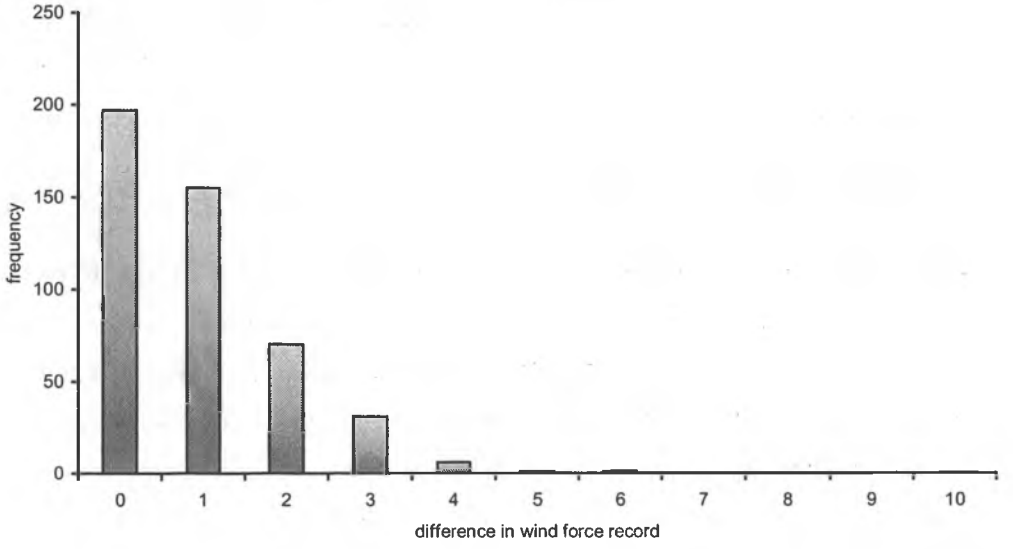


Figure 5. *Histogram of wind force differences from independent observations of the same conditions. Sample size = 461 pairs of observations.*

Larger Vessel	Smaller Vessel	Dates	Year	Region	Wind Speed Corr.	n	Sig.	T-test of means Diff.	Dig.
Victorious	*Sphinx*	Apr - Jun	1795	N & S Atlantic	0.70	64	**<0.01**	0.28	0.15
Jupiter	*Star*	Jan - Jul	1800	Indian Ocean	0.77	94	**<0.01**	0.40	0.02
Diana	*Calypso*	Sep - Nov	1799	N Atlantic	0.75	53	**<0.01**	0.12	0.48
Lancaster	*Rattlesnake*	Jul - Nov	1800	Indian Ocean	0.84	41	**<0.01**	0.41	0.04
Ceres	*Inglis*	Feb - May	1816	Atl & Ind Oceans	0.74	75	**<0.01**	0.17	0.20
Warley	*Ceres*	Apr - May	1815	N & S Atlantic	0.75	32	**<0.01**	-0.55	0.01
Belleisle	*Decade*	Jun - Aug	1806	N Atlantic	0.67	40	**<0.01**	-0.34	0.07
Neirede	*Camel*	Apr-May	1806	N & S Atlantic	0.61	41	**<0.01**	-0.44	0.01

Table 3. *Summary table showing the comparisons between wind force records from nine dual voyages.*

A final issue surrounded the question of wind direction. These records were usually based on readings from a magnetic compass, the use of which was widespread in the CLIWOC period. Navigators were aware of the differences between the direction of true and magnetic north, termed the 'magnetic variation'. The absolute magnetic variation could be as much as 10 degrees, sometimes even over 30 degrees. The question arose as to whether the reported wind directions were related to true north or magnetic north There were no international conventions at the time and studies of contemporary texts did not answer this question adequately or consistently for all of the participating countries, although it did provide some useful information the case of English logbooks. Consequently additional analysis of the CLIWOC database was carried out. A comparison of the average wind directions of the four nations in an area of relatively constant winds (the Trade winds belt in the North Atlantic) with the present-day climatic values indicate that the British used magnetic wind directions throughout the CLIWOC period. The pre-1800 Spanish data shows a preference for wind directions relative to true north, while the Dutch made a switch from magnetic to

true directions somewhere in the period 1790-1810. For the French data and the post-1800 Spanish data the analysis was inconclusive. Table 4 shows which north is assumed in the CLIWOC wind direction procedure.

Spain	≤1800	True
	>1800	True*
UK	≤1800	Magnetic*
	>1800	Magnetic*
Netherlands	≤1800	Magnetic
	>1800	True
France	≤1800	Magnetic*

Table 4. *Recording of wind direction with respect to magnetic or true north by country and period. In the CLIWOC database, this table is used to convert to true wind direction. Values marked with an asterisk are not based on empirical evidence.*

The conclusions of this chapter can be summarized as follows:

a) The results of the verification/quality control analysis strongly suggest that the CLIWOC data are based on reliable and consistent records of the conditions at the time, in particular: 1. magnetic and true wind directions can be identified and 2. the majority (67%) of recorded wind directions are reliable to within 22 degrees.
b) Wind force records are reliable to within one force on contemporary 12-point scales.
c) *N*-sample independent wind force series are significantly correlated.
d) Wind force terms in all participant languages can be confidently and reliably expressed in modern-day Beaufort scale equivalent forces and speeds.

2.3 Database construction

The construction of the database was the main objective of working package 6. This section summarizes the main results obtained using release 1.5. The previous versions were more limited in scope.

After being properly corrected for position and date, the observations were put in the

database in IMMA standard format (Woodruff, 2003). This format allows the use of the present day unit conventions in a core record along with the original data in attachments to the core. For all records, the original data were kept. These were stored in the original languages; their equivalents being derived from the dictionary. The meteorological content was treated similarly: the original units and descriptive wind force terms were kept and linked to the values in modern units by a lookup table. The wind force dictionary, which is presented in four principal sections, one for each partner-language, provides a means of converting wind descriptors into Beaufort force numbers and is included as a dynamical module within in the database, which allows for efficient updating. Temperature recordings were converted to Celsius, while barometer readings were converted to hPa from a variety of units. Again the original recordings are kept in the IMMA-attachments and the converted recordings are in the IMMA core.

The CLIWOC philosophy recognized the need for easy accessibility to the data. Since a long-term aim of the project team was incorporating the data into the ICOADS database, early contacts were made with its management group. It was agreed subsequently that the format for the final CLIWOC database would accord with the IMMA standards. The core of the records in this format contain the basic coordinates and meteorological elements in present SI units, together with pointers to attachments, where the original recorded material is stored. For wind speed, the transformation from the original terminology to the SI units involves two steps: first from the old terms to those of the Beaufort scale, using the dictionary and, second, by assigning average m/s values to the Beaufort forces according to the WMO code 1100 scale. See Table 5 for this conversion series, and for the assignment of non-integer Beaufort force numbers where greater descriptive detail allowed for such more detailed identifications.

Beaufort	Class boundary [m/s]	Lower-half value [m/s]	Midpoint value [m/s]	Higher-half value [m/s]	Class boundary [m/s]
0	0	0.0	0.0	0.1	0.2
1	0.3	0.6	1.0	1.2	1.5
2	1.6	2.0	2.6	2.9	3.3
3	3.4	4.0	4.6	4.9	5.4
4	5.5	6.1	6.7	7.3	7.9
5	8.0	8.7	9.3	10.0	10.7
6	10.8	11.6	12.3	13.1	13.8
7	13.9	14.7	15.4	16.3	17.1
8	17.2	18.1	19.0	19.8	20.7
9	20.8	21.7	22.6	23.5	24.4
10	24.5	25.5	26.8	27.4	28.4
11	28.5	29.5	30.9	31.6	32.6
12	32.7	33.9	35.0		

Table 5. *Assignment of m/s values to the Beaufort forces.*

Temperature, and other instrumental data were standardized to SI units using conventional arithmetic conversion factors. Barometer readings were converted to hPa using basic procedures. First the readings were converted to millimeters (using 25.4 and 27.0699534 millimeters for English and French inches, respectively) and then to hPa after which the pressure was reduced to standard gravity. No correction for the temperature or the height above the sea surface was applied to the pressure data The adjustments for magnetic wind directions were calculated with software that was kindly made available by Andrew Jackson of the University of Leeds Geophysical Research Group. Pointers are also included in the database to non-meteorological data such as casualties and conditions on board, and to pathways to digital images of the pages (where available) of the logbook from which the data were abstracted.

All data are available individually i.e. daily, but they are also presented in monthly summaries of u and v vectors in 8°×8° grid boxes for wind. For the period 1824-1854 there were sufficient data for monthly summaries of pressure and temperature also. In

due course, the data will be incorporated in the monthly summaries of ICOADS and integrated with the Maury data collection. To facilitate an even larger group of users, the data are stored in Microsoft Access format as well. Both Access97 and Access2000 are downloadable from the CLIWOC website.

Partner 1 will maintain the CLIWOC database. The data will also be accessible through KNMI and ICOADS as a separate data set. Future investigations will determine if the methodologies developed during the production of the CLIWOC database are applicable to other data sets from similar sources.

The database is currently available as CD-ROM, and from the website. Table 6 shows the number of CLIWOC data days by ocean, country of origin and 50-yr period. Here, the border between the Atlantic and Indian Oceans is put at 20°E (near Cape Town); the border between the Indian and Pacific Oceans at 120°E (a meridian that runs close to Manila), and the border between the Pacific and Atlantic Oceans at 70°W (Drake Strait). Figure 6 show the geographical coverage of CLIWOC by country over its entire 1750-1854 period.

		N-Atlantic	S-Atlantic	Indian Ocean	Pacific	All Oceans
Spain	≤1800	28,236	11,622	319	1,614	41,791
	>1800	399	190	301	89	979
UK	≤1800	31,603	12,530	16,104	1,281	61,518
	>1800	9,270	5,202	7,002	200	21,674
Netherlands	≤1800	20,045	5,109	5,142	0	30,296
	>1800	31,932	18,348	26,617	1,481	78,378
France	≤1800	3,898	158	159	896	5,111
	>1800	32	28	46	0	106
TOTAL		***125,415***	***53,187***	***55,690***	***5,561***	***239,853***

Table 6: *Number of CLIWOC data per ocean, country and period.*

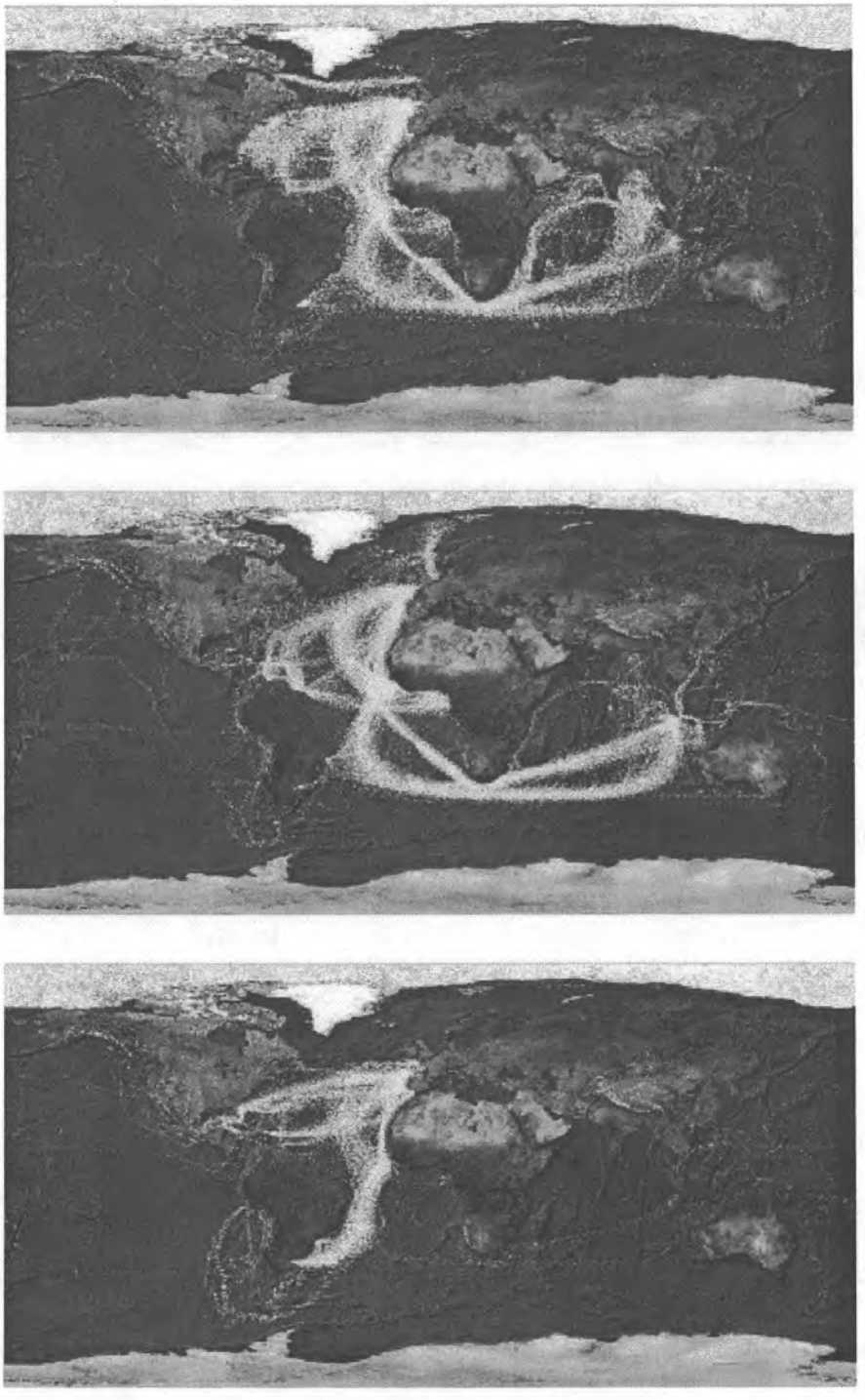
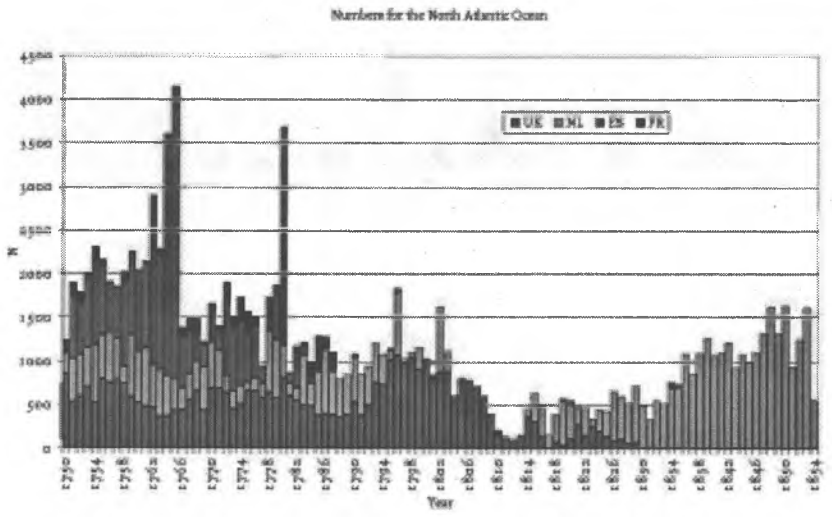


Figure 6. *Geographical distribution of the observations per collecting country; from top to bottom: United Kingdom, The Netherlands and Spain.*

Table 6 and Figures 6 and 7 show the following three features. First, the Atlantic and Indian oceans are well covered with data; but the Pacific coverage is poor. Second, the UK and Dutch cover the Atlantic and the Indian Oceans, in both the 18th and the 19th century. Third, the Spanish and French ships' tracks are predominantly from the 18th century, and principally enhance the data density over the Atlantic Ocean.

a)



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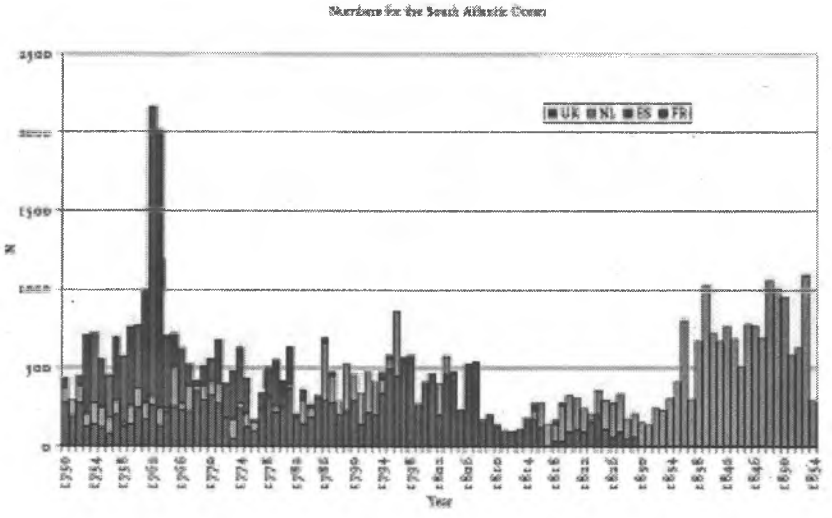

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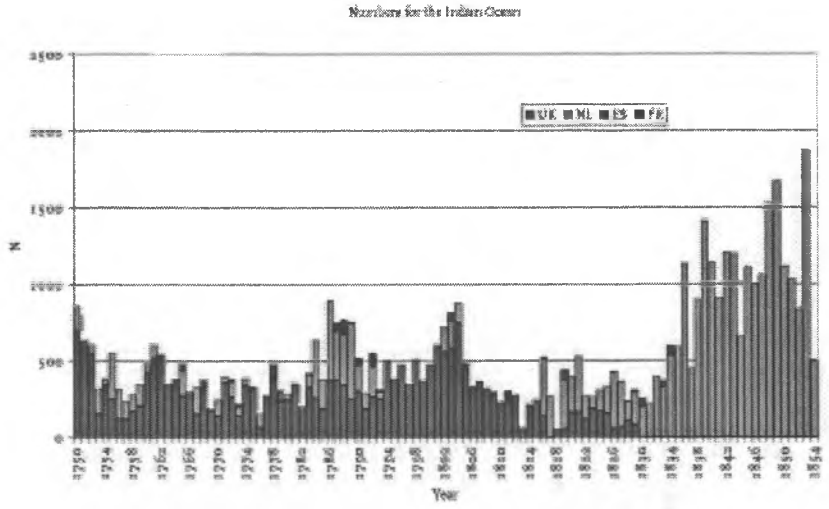

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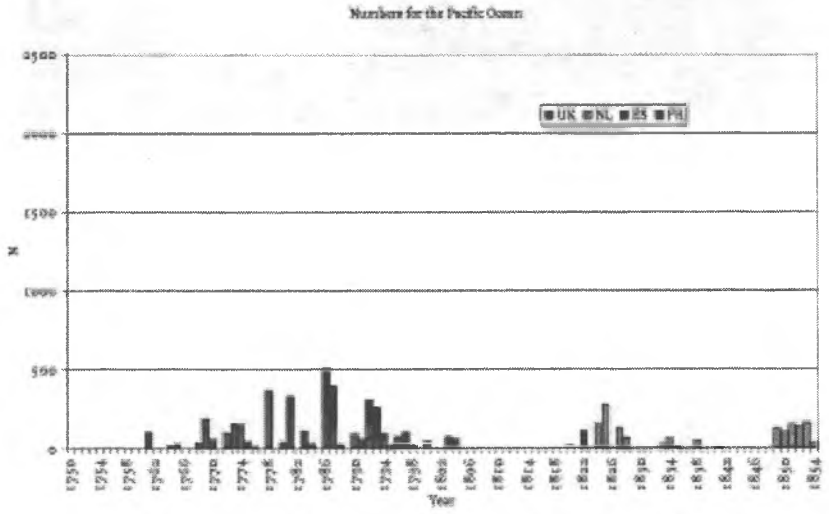


Figure 7. *Number of observations per year per ocean area for each country. Graph 7a and 7b show the North and South Atlantic Ocean, respectively. Graph 7c shows the Indian Ocean, while 7d depicts the number of observations in the Pacific Ocean.*

Figures 7a and 7b show that the Dutch/UK contributions are such that they produce a consistent temporal coverage for the North and South Atlantic Oceans, while the Spanish and French data are concentrated in the 18th century coverage. Over the Indian Ocean, the data come primarily from the Dutch and UK sources. The number of observations gathered for the Indian Ocean (Figure 7c) is roughly one third of that for the N-Atlantic (Figure 7a). This suggests that evidence of the North Atlantic Oscillation (NAO) may be more confidently derived from the CLIWOC database than of the El Niño Southern Oscillation (ENSO).

Table 7 shows the number of observation that report both wind force and wind direction, as well as the number of reported air pressure and air temperature recordings per ocean for the period 1800-1854. Pre-1800 numbers are not included in the table, as there were few instrumental observations being made at the time. The numbers of pressure and temperature recordings in Table 7 are strikingly similar. This is a consequence of the fact that ships that were instrumented usually carried both a thermometer and a barometer.

	N-Atlantic	**S-Atlantic**	**Indian Ocean**	**Pacific**	**All Oceans**
Wind	38,353	21,533	30,289	1,696	91,871
Air temperature	18,203	11,348	15,833	1,046	46,430
Air pressure	18,294	11,322	16,105	908	46,629

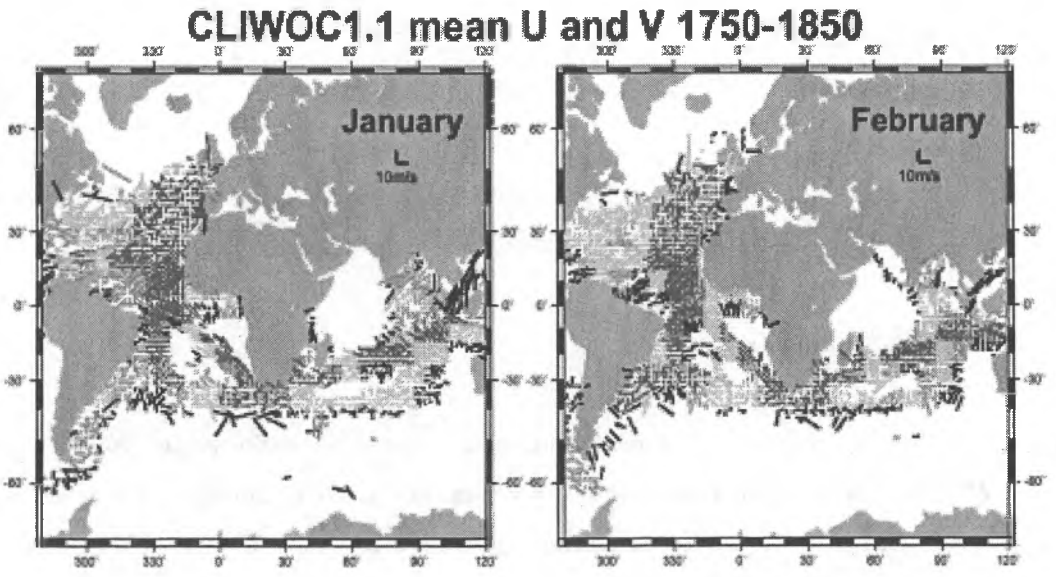
Table 7. *Number of CLIWOC data 1800-1854 per ocean and element; the numbers of pre-1800 pressure and temperature observations are negligible.*

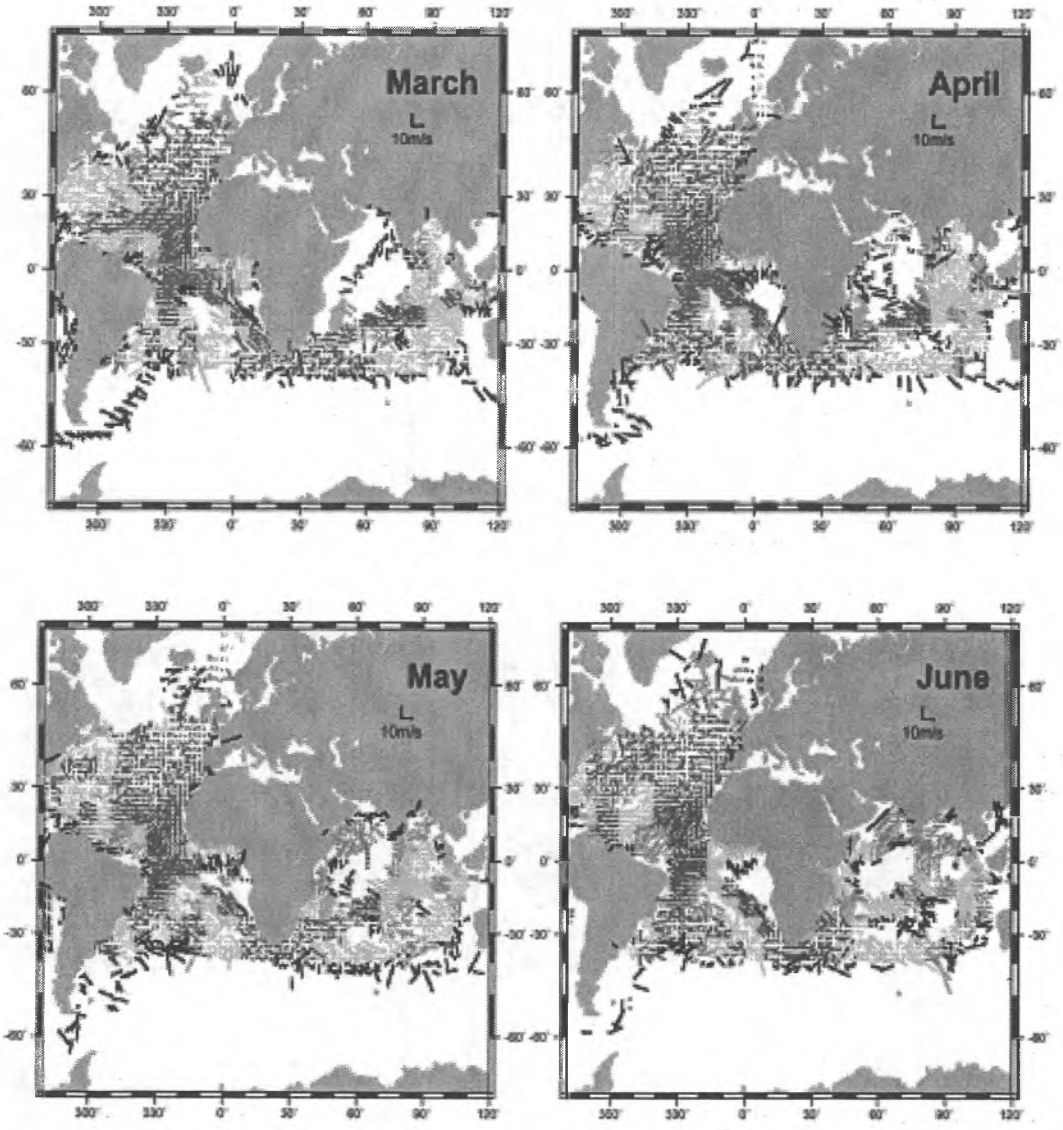
2.4 Preliminary results

This section summarizes some of the most relevant scientific results obtained so far. The partners recognize that the full potential of CLIWOC can only be reached in the long term, and the careful scientific exploitation of CLIWOC data will be matter of years in coming to fruition Consequently, as foreseen in the project contract, these

results are only a minor part of the expected outcomes, and are mostly intended to show the great potential of CLIWOC. Additionally, and again as noted in the contract, they are focused on obtaining a reconstruction of the North Atlantic Oscillation index (NAO).

The first derivative is the provision of surface wind climatologies for the period 1750-1850. Figure 8a shows monthly maps of surface winds, in which the seasonal and spatial patterns of average conditions can be clearly seen. Using this wind climatology (with average values of *u* and *v* components for 1961-90) we reduced all the ICOADS and CLIWOC data to anomalies for each month in each year, 1750-1997. In addition to the *u* and *v* wind anomalies, we also retained the number of observations each month in each 2°x 2° square. Figure 8b shows the difference in vector winds for the 12 months of the year between the CLIWOC average (for 1750-1850) and ICOADS (for 1961-90). There is little difference between the two fields, and the consequent anomaly-difference vectors are small compared to those for the absolute winds in Figure 8a. Differences are larger in regions of sparser coverage and where day-to-day variability is high (e.g. the westerlies at high latitudes in the Southern hemisphere and in the northern North Atlantic). This high level of agreement between CLIWOC and ICOADS climatology serves as an additional check and confirmation of the high quality of the data abstracted in CLIWOC.

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May
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June
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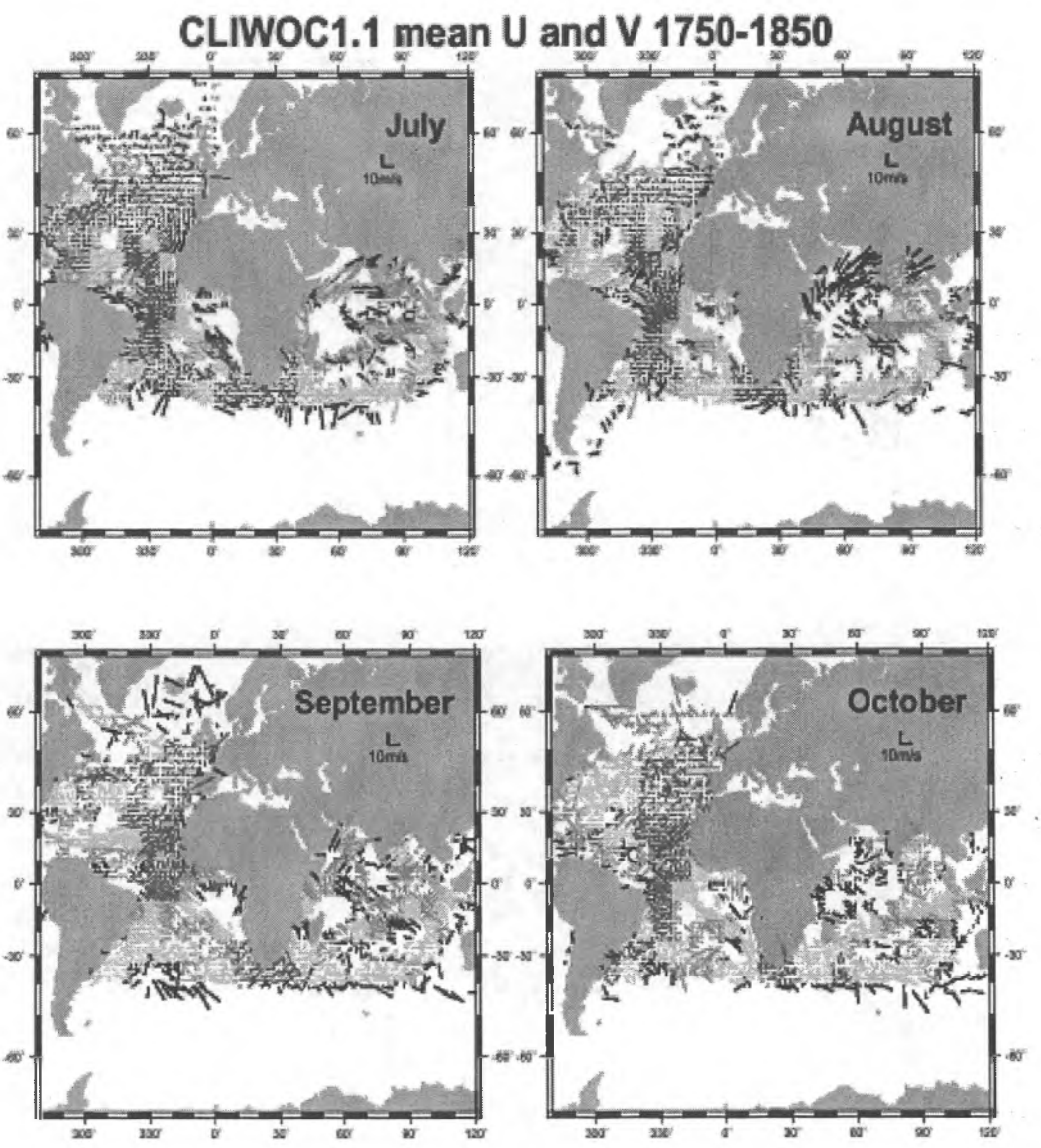
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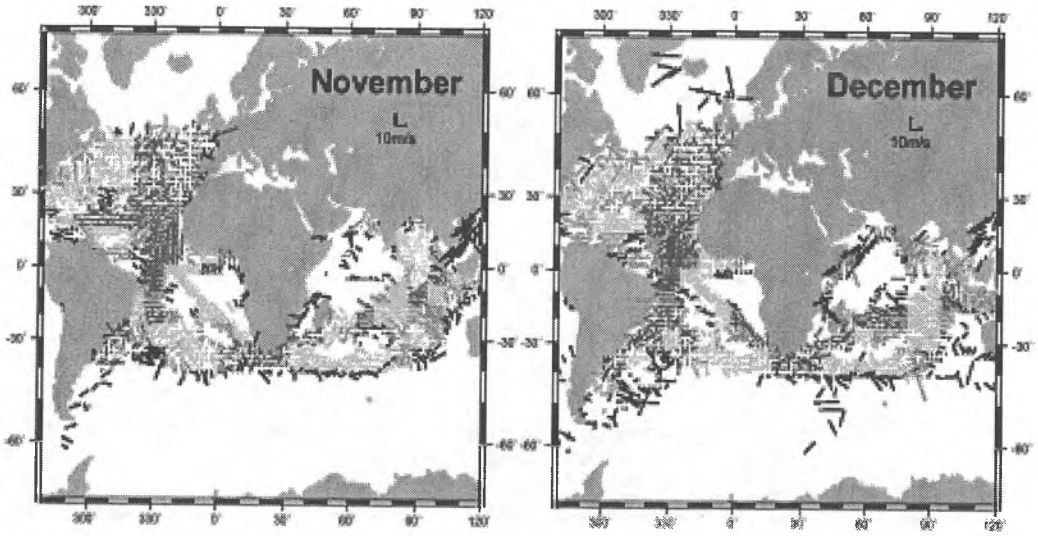
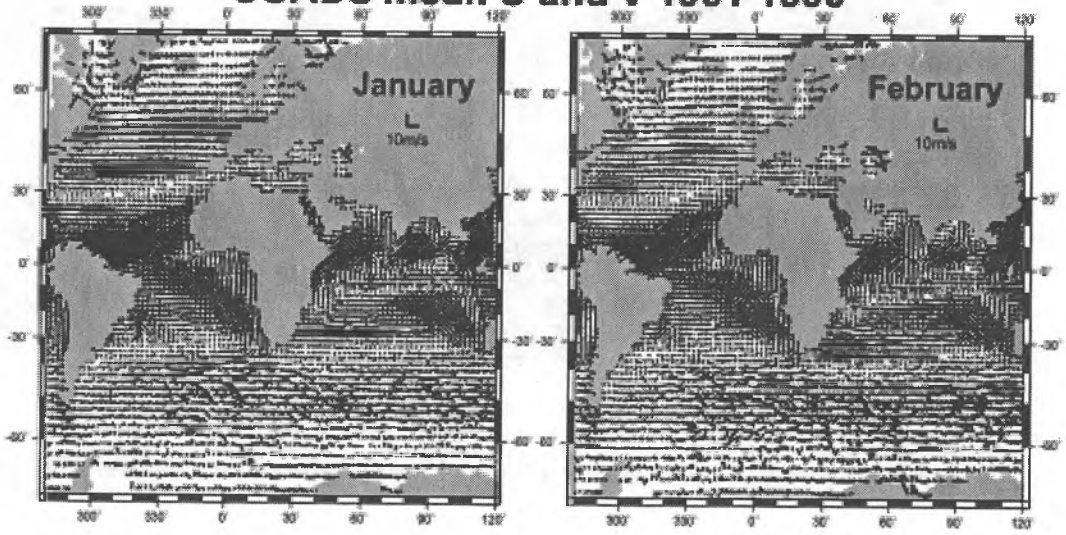
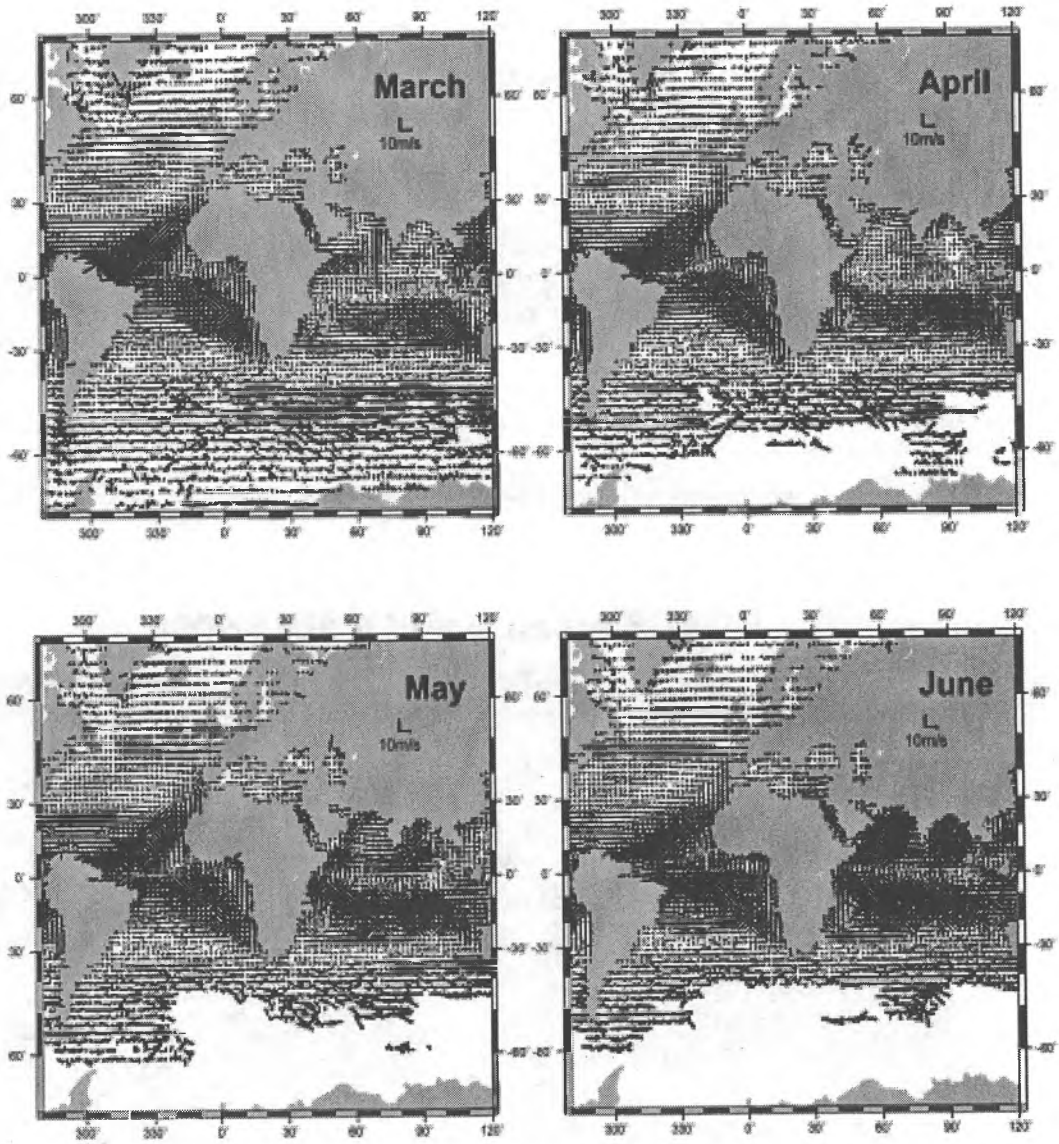


COADS mean U and V 1961-1990

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June
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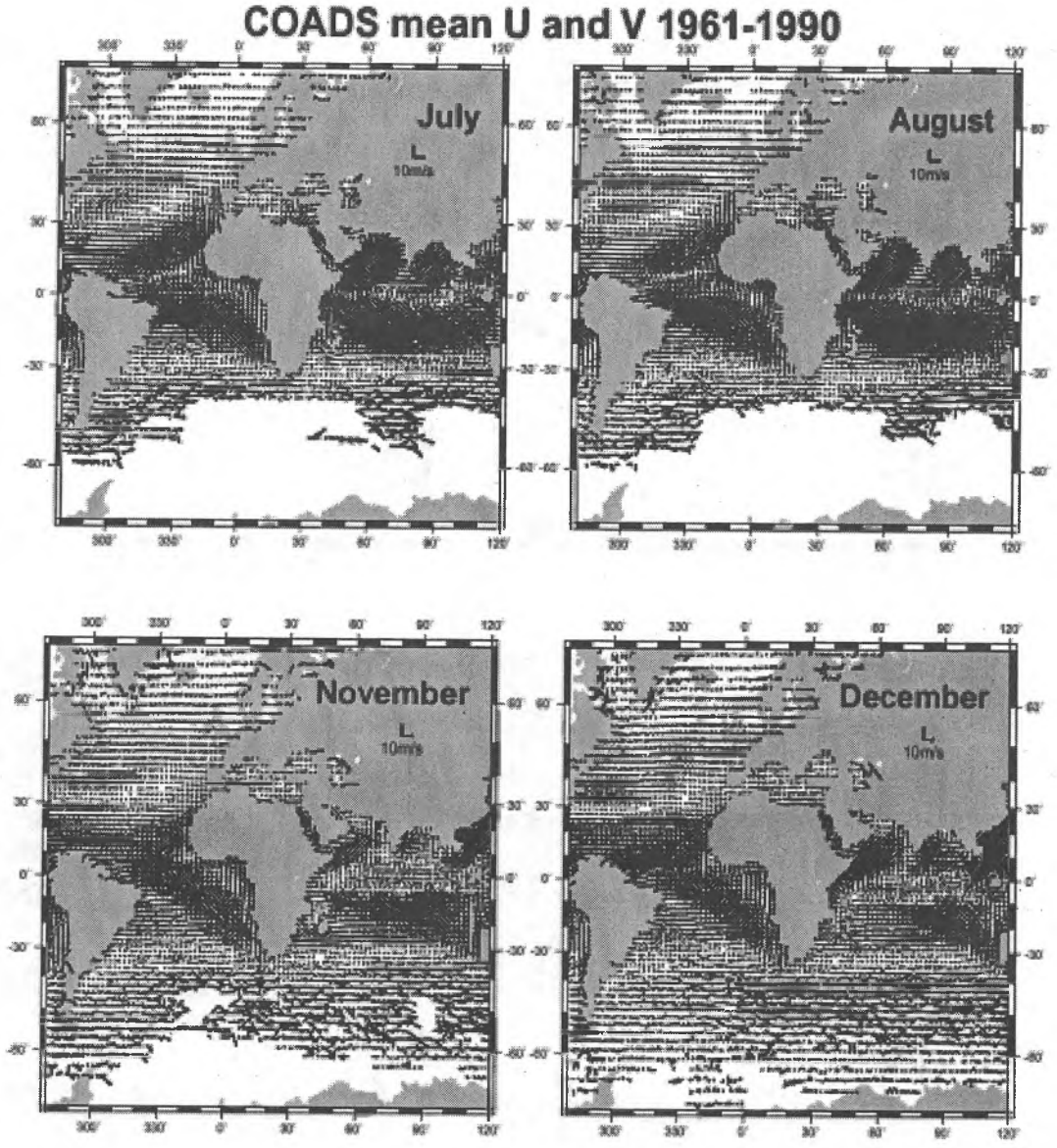
COADS mean U and V 1961-1990
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August
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November
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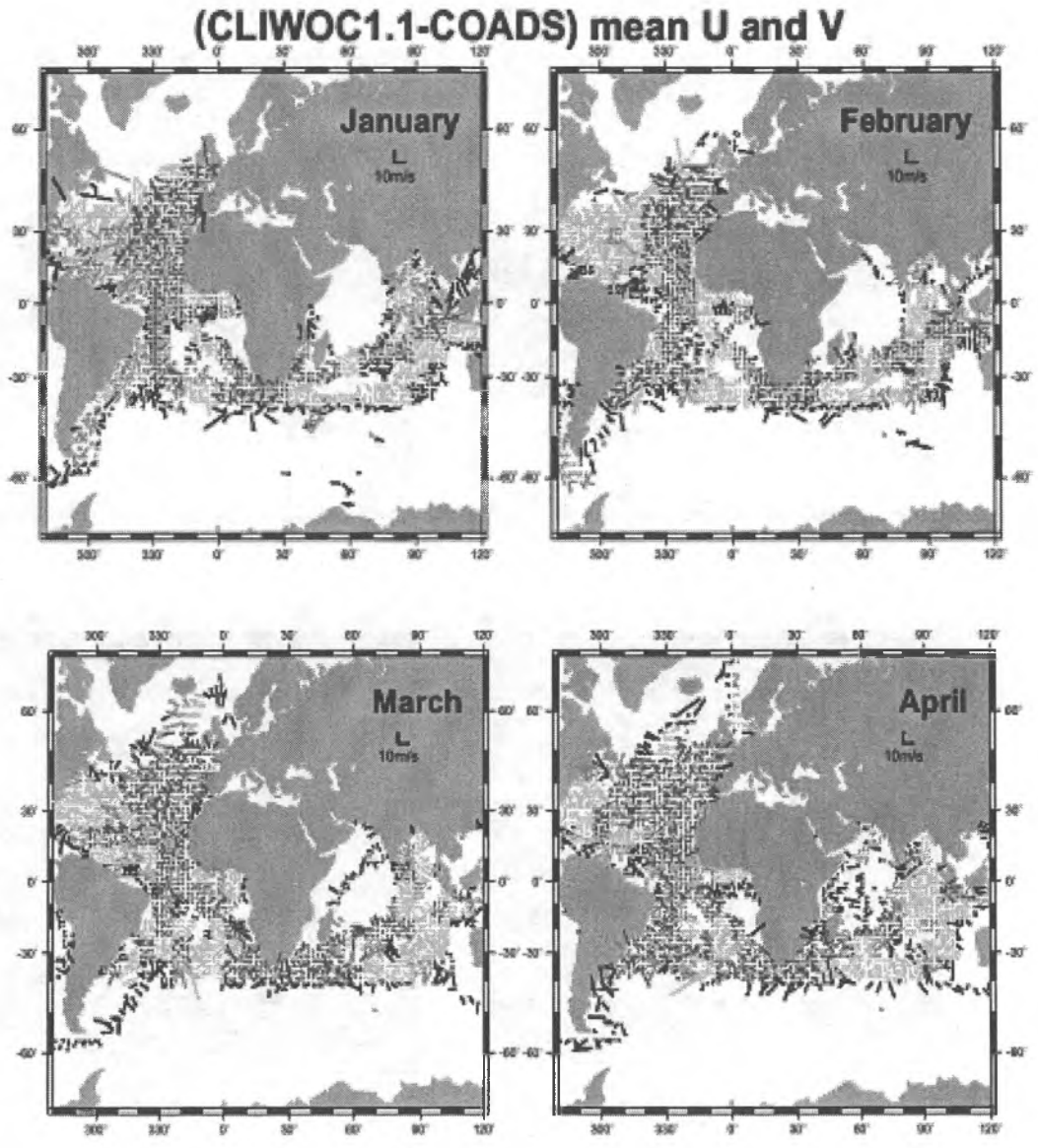
December
10m/s


(CLIWOC1.1-COADS) mean U and V
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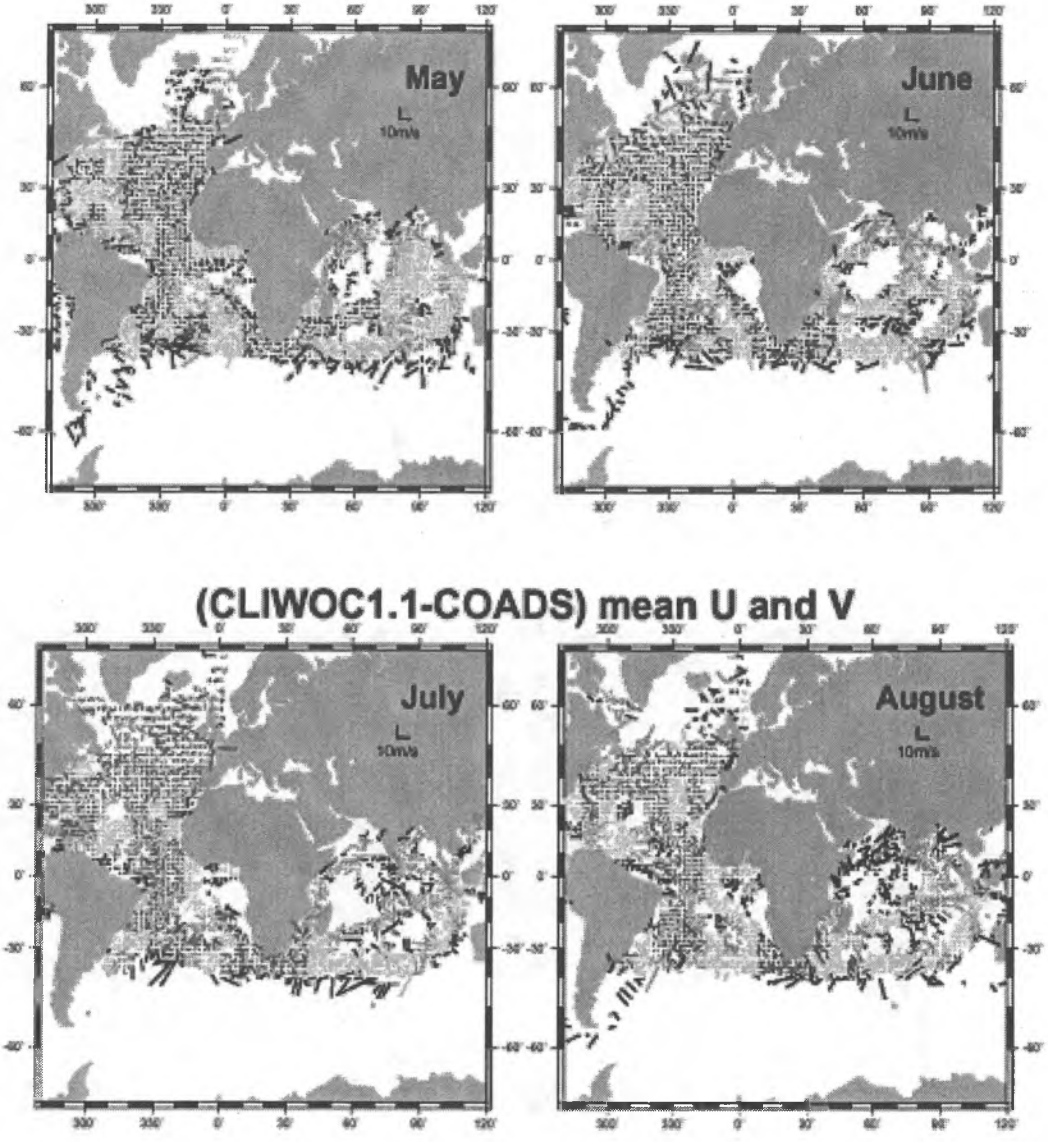
February
10m/s
March
10m/s
April
10m/s


May
10m/s
June
10m/s
(CLIWOC1.1-COADS) mean U and V
July
10m/s
August
10m/s

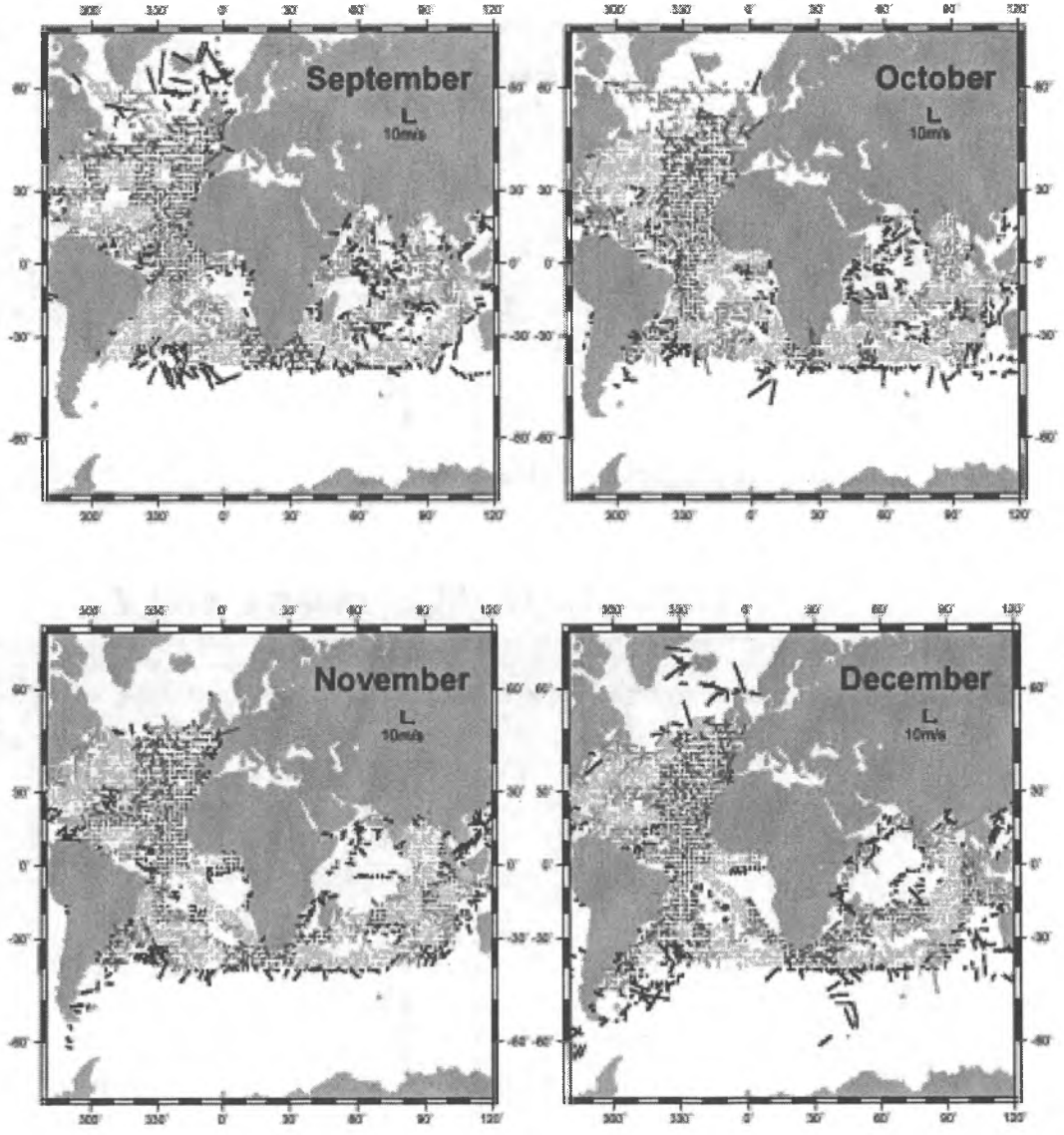


Figure 8. ***a)*** *average CLIWOC and ICOADS wind vectors for each of the 12 months for the 1961-1990 period on a 2° grid.* ***b)*** *differences in wind vectors for each of the 12 months, CLIWOC for 1750-1850 minus ICOADS for the 1961-1990 period on a 2° grid. The colours on this plot represent the following: dark red, <20; red, <50; light green, <100, and dark green >100 observations during the 101 years on the 2° grid.*

Orthogonal spatial regression (OSR) techniques were used to relate the predictor variables (u and v components of the wind) to the predictand data (circulation index). In OSR, the amplitude time series of the Principal Components (PCs) of the u and v wind component series for each ocean basin are offered for regression against the circulation data (single time series of the NAO). PCs are retained only when their eigenvalue exceeds one.

OSR is a form of multiple linear regression, simplified by the orthogonality constraint on the variables on both sides of the equation. This means that the whole procedure is relatively simple compared to stepwise regression. It is a recommended technique when, in response to their spatial character, there are strong interdependencies between the u and v wind components. The technique remains principally regression-based, however, and it is essential to develop the equations over one period (calibration) and to test them over an independent (verification) period. Here we use 1881-1940 for calibration and 1941-1997 for verification.

Despite the unavoidable limitations of the CLIWOC/ICOADS cover for the study period, sufficient data were available to provide useful reconstructions of circulation patterns. The results also indicated that with additional data of this type yet more comprehensive and detailed reconstructions are possible using the same methods and procedures.

OSR was employed to reconstruct 'seasonal' NAO series based on the u and v wind component data for the N. Atlantic (24°-56°N). Again, the calibration period was 1881-1940 with verification over the 1941-1977 period. Table 8 summarizes the pertinent statistics. The principal conclusion is that the 'winter' season performs much better than the 'summer' season. This has been found for all attempts to reconstruct either circulation indices or pressure data and relates to the less well-organized state of the atmospheric circulation in the NH summer season.

Circulation Index (Season)	Calibration (1881-1940)	Verification (1941-1997)	# PCs [1]	%Variance [2]
NAO (DJF)	0.937	0.907	15	82.5
NAO (MAM)	0.764	0.631	15	82.0
NAO (JJA)	0.555	0 225	15	81.5
NAO (SON)	0.835	0.788	16	83.7

Table 8. *Calibration (1881-1940) and verification (1941-1997) period statistics (correlation coefficients) for 'seasonal' NAO reconstructions. [1] Number of u and v wind component PCs retained (where Eigenvalue > 1). Maximum number of variables for the NAO data was 60 u/v series). [2] Percentage of variance of the accounted for by the PCs.*

Figure 9 presents time series plots for four reconstructions; those for NAO winter (DJF), spring (MAM) and autumn (SON) and the SOI (Southern Oscillation Index). There is obviously good agreement between the reconstructions and the station-pressure-based circulation indices, but apart from the 1820-50 period, which is the 'overlap' period when the index is based on homogenized instrumental data, the CLIWOC data cannot be fully tested, i.e. back to 1750 in respect of the formal NAO series. To assess the reconstructions over their entire period, we compared them with terrestrial-based proxy reconstructions. We made use (Figure 10) of the seasonal values of NAO indices from Luterbacher et al. (2002), in which European documentary and instrumental sources from as early as 1500 are employed. We also compared (Figure 11) our reconstructions of the winter (DJF) NAO estimates from tree-ring measurements from Europe, North Africa and North America (Cook, 2003) and from ice-core isotope measurements from Greenland (Vinther et al., 2003). All such terrestrial based series extend back much earlier than 1750, Luterbacher et al. (2002) to 1500, Cook (2003) to 1400, Vinther et al. (2003) to 1245.

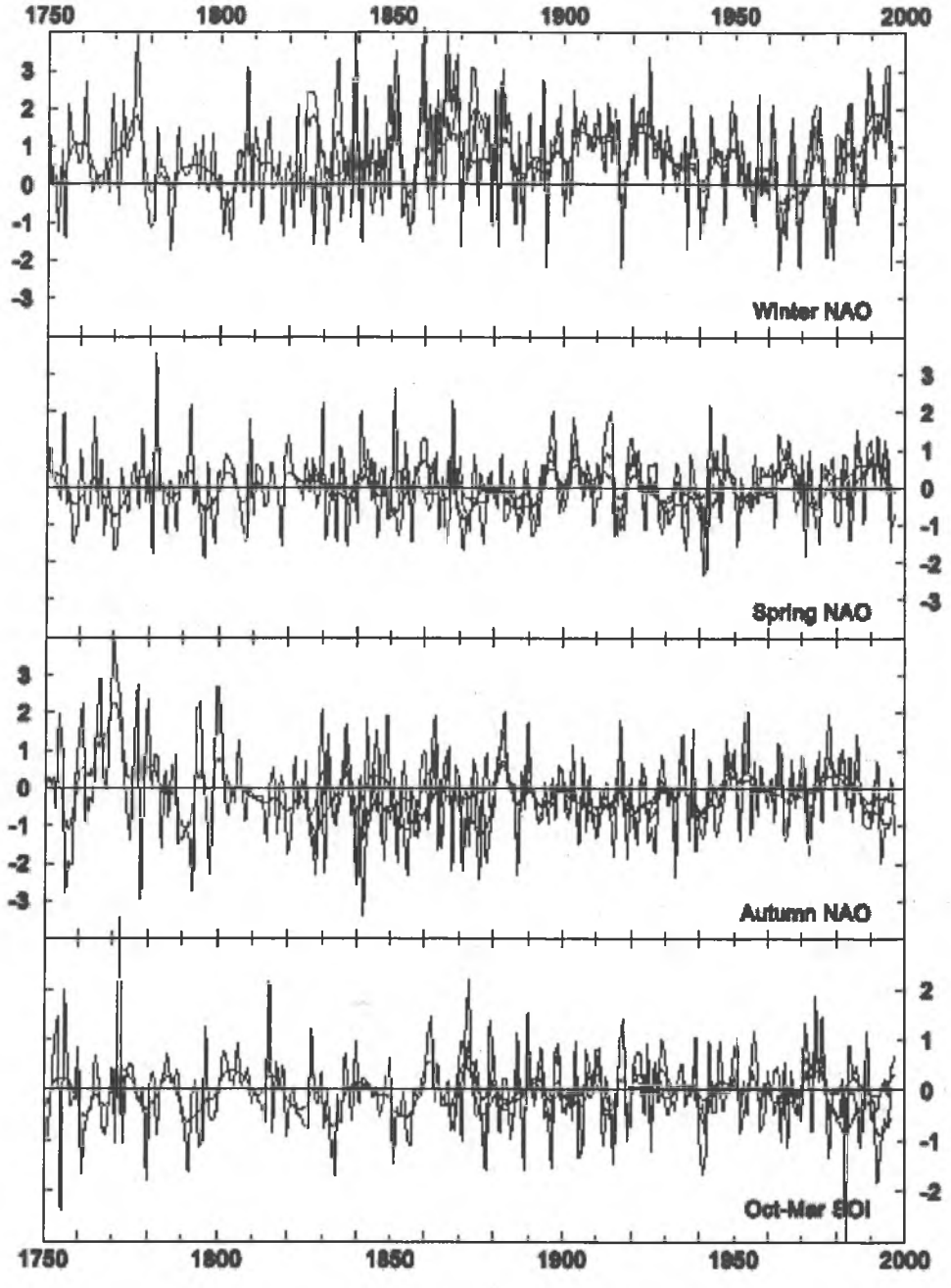


Figure 9. *Reconstructions of the NAO and SOI, 1750-1997 compared with instrumental data.*

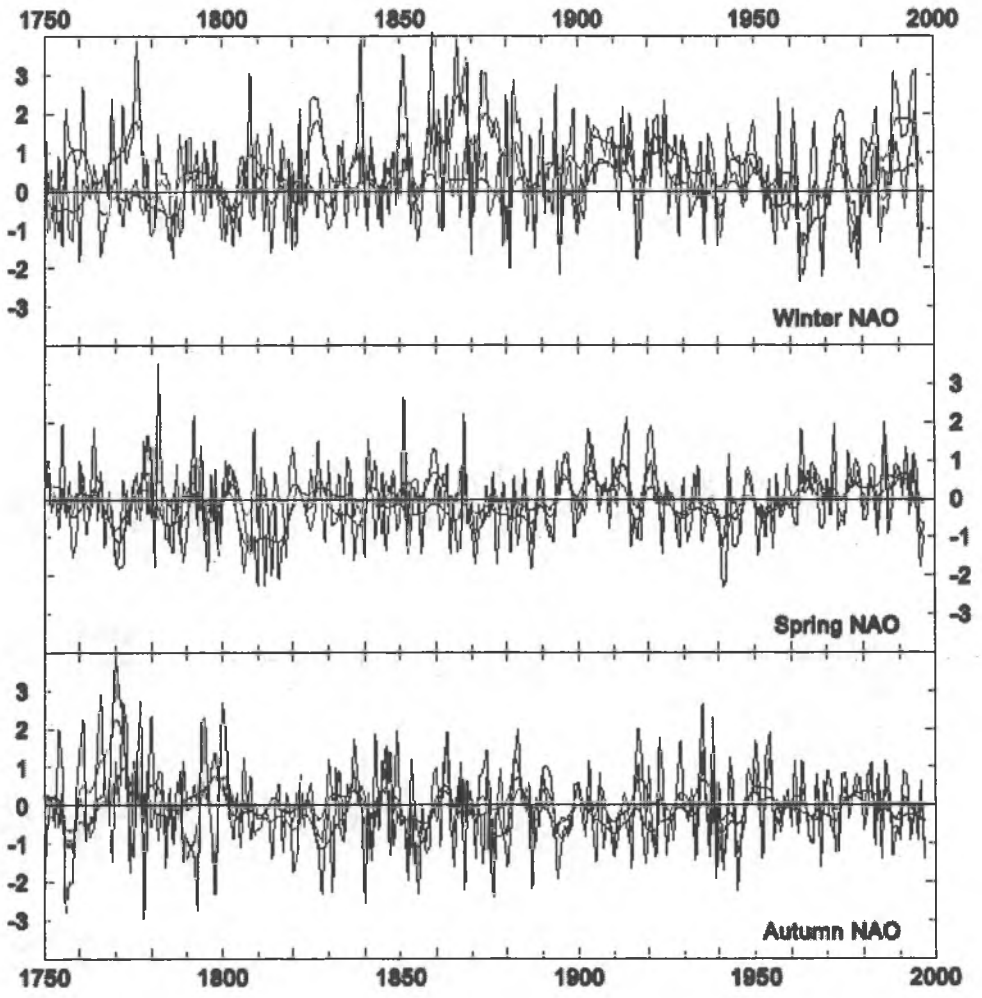


Figure 10. *Comparisons of the wind-based reconstructions (CLIWOC) for the NAO with those from Luterbacher et al (2002) for the winter (December-February), spring (March to May) and autumn (September to November) seasons.*

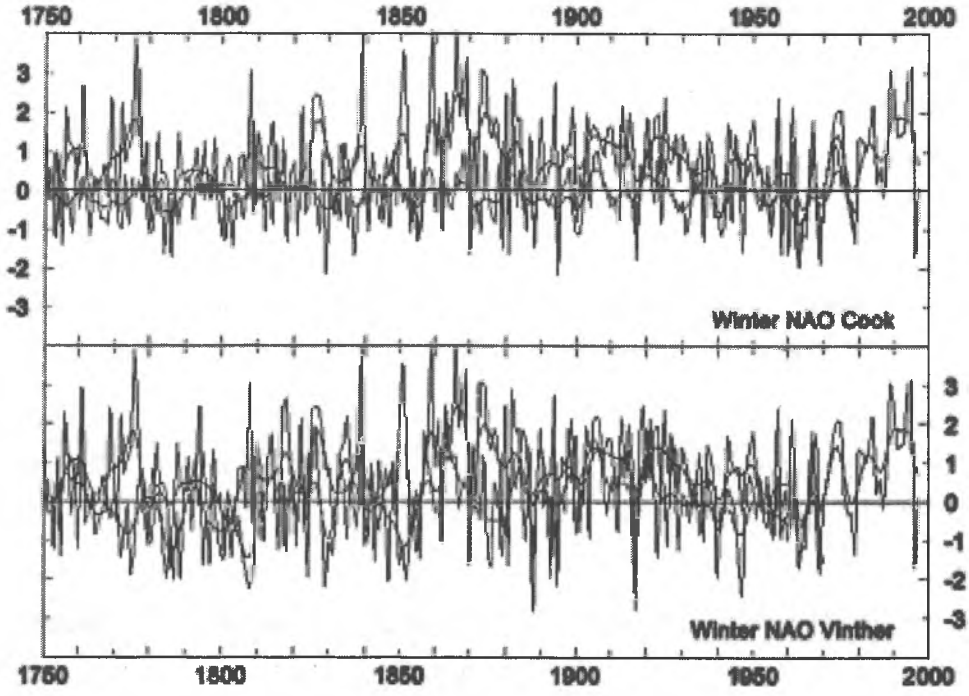


Figure 11. *Comparisons of wind-based (CLIWOC) reconstructions for the NAO with reconstructions from tree-rings and ice-cores by Cook (2003) and Vinther et al (2003).*

Table 9 gives means and standard deviations over two periods (1881-1997 and 1750-1850) for both indices and for 1825-1880 for the NAO from these various sources. Table 10 gives correlations between the series over the same selected periods.

NAO–Winter (DJF)	Instrumental	CLIWOC	Luterbacher	Cook[1]	Vinther[2]
1881-1997	0.58/1.25	0.78/1.18	0.04/0.99	-0.13/0.83	0.09/1.16
1825-1880	0.62/1.26	1.04/1.47	0.14/0.76	-0.16/0.73	0.02/1.16
1750-1850	---	0.54/1.14	-0.14/0.77	-0.13/0.66	-0.13/1.20

[1] Series ends in 1979, [2] Series ends in 1970

NAO – Spring (MAM)	Instrumental	CLIWOC	Luterbacher
1881-1997	0.04/0.89	0.03/0.69	0.00/0.90
1825-1880	-0.10/0.86	0.09/0.78	-0.26/0.83
1750-1850	---	0.00/0.91	-0.27/0.88

NAO – Autumn (SON)	Instrumental	CLIWOC	Luterbacher
1881-1997	-0.18/0.94	-0.16/0.74	-0.02/0.96
1825-1880	-0.48/1.02	-0.20/1.25	-0.12/0.87
1750-1850	---	0.04/0.91	-0.01/0.76

Table 9. *Means/Standard Deviations for the NAO for Winter (DJF), Spring (MAM) and Autumn (SON).*

NAO – Winter (DJF)	CLIWOC	Luterbacher	Cook[1]	Vinther[2]
1881-1997 (Instrumental)	0.91	0.89	0.72	0.52
1825-1880 (Instrumental)	0.52	0.80	0.55	0.43
1750-1850 (This paper)	---	0.17	0.02	0.18

[1] Series ends in 1979, [2] Series ends in 1970

NAO – Spring (MAM)	CLIWOC	Luterbacher
1881-1997 (Instrumental)	0.70	0.72
1825-1880 (Instrumental)	0.27	0.77
1750-1850 (This paper)	--	0.26

NAO – Autumn (SON)	CLIWOC	Luterbacher
1881-1997 (Instrumental)	0.81	0.70
1825-1880 (Instrumental)	0.27	0.68
1750-1850 (This paper)	--	0.23

Table 10. *Correlation Matrices for the NAO for Winter (DJF), Spring (MAM) and Autumn (SON) for selected periods.*

The initial results for the CLIWOC period (1750-1850, using version 1.1 of the database) are relatively poor compared to the land-based proxies of Luterbacher et al. (2002), Cook (2003) and Vinther et al. (2003). From Figures 9, 10 and 11, this can be seen to be due to a few outliers over the 101-year period. Work is still continuing to determine the reason for this, but it is hoped that they will improve with the final version of the CLIWOC database. At the moment it appears that the outliers are due to too few observations in specific seasons in the regions found to be important from the OSR program. The calibration and verification statistics (Table 8) found using the ICOADS data over the 1881-1997 period clearly indicate that wind vector data can produce a reliable NAO reconstructions for all seasons except summer. In Figure 10, comparisons with the Luterbacher et al. (2002) reconstructions (which is considered to

be the best of the 'other' reconstructions used) indicate that low-frequency aspects (on decadal timescales) of the reconstruction are reasonably well produced. As noted in the introduction to this report, the results are preliminary and are likely to be improved as more data for the period are entered into the CLIWOC database.

Relacion de las Misiones embarcadas en el Puerto de Acapulco el dia 12 de Febrero de 1797 a bordo de la Nao San Andres.

Religiosos Franciscanos

- Sacerdotes
  - Fr. Gregorio Rodriguez Presidente.
  - Fr. Manuel de San Francisco.
  - Fr. Juan de Santa Rosa.
  - Fr. Antonio de Madrid.
  - Fr. Bernardino de Jesus.
  - Fr. Juan Cotan.
  - Fr. Manuel Vicente de San Francisco.
- Diaconos
  - Fr. Cayetano del Defsen.
  - Fr. Vicente de San Josef.
- Coristas
  - Fr. Ramon Jurado.
  - Fr. Miguel Rea.
- Donado
  - Fr. Geronimo de San Agustin.
  - El Hermano Pedro Aburran.

Ydem Agustinos Calzados.

- Sacerdotes
  - Fr. Jose Zamora Presidente.
  - Fr. [illegible]
  - Fr. [illegible]
  - Fr. Pedro Gomez.
  - Fr. Dionisio Antillana.
  - Fr. Ildefonso Arce.
  - Fr. Manuel Cordero.
  - Fr. Dionisio Portilla.
  - Fr. Agustin Diez.
  - Fr. Blas Novoa.
- Diacono
  - Fr. Juan Chazel.
- Subdiaconos
  - Fr. Domingo Hinojal.
  - Fr. Andres Rodriguez.
  - Fr. Manuel de Miranda.
- Acolitos
  - Fr. Manuel Galindo.
  - Fr. Mauro Folgar.
  - Fr. Francisco Xavier.
- De Conversos
  - Fr. Julian Bermejo.
  - Fr. Marciano Dominguez.

Ydem Agustinos Descalzos

- Sacerdotes
  - Fr. Jose del Carmen Presidente.
  - Fr. Sebastian de San Bruno.
  - Fr. Manuel de San Miguel.
  - Fr. Agustin de la Virgen de la Vina.
  - Fr. Manuel de la Concepcion.
  - Fr. Blas del Carmen.
  - Fr. Candido de San Antonio.
  - Fr. Felipe de San Josef.
  - Fr. Miguel de la Virgen de los Arcos.
  - Fr. Francisco de San Josef.
  - Fr. Miguel de San Buenaventura.
  - Fr. Tomaleon de la Virgen del Tremedal.
- Diaconos
  - Fr. Bernardo de Santa Theresa.
  - Fr. Domingo de la Santissima Trinidad.
- Subdiacono
  - Fr. Juan de Santa Escolastica.
- Corista
  - Fr. Josef del Carmen.
- Legos
  - Fr. Antonio de la Purificacion.
  - Fr. Diego de Cuyacuana D.

3 Evaluation of Objectives

3. Evaluation of objectives

While chapter 2 is principally concerned with how the project's activities had been developed and with the most relevant results, this chapter reviews how the projects objectives have been achieved.

Objective 1. *To produce and make freely available for the scientific community the World's first daily oceanic climatological database for the period 1750 to 1850.*

This objective has been achieved by producing the database, making it available as CD-ROM, and through the project's web page.

Objective 2. *To realize the potential of the database to provide a better knowledge of oceanic climate variability over the study period.*

The quality checks and the first results show that the data are consistent and reliable. The results obtained in the preliminary analysis of the data show that they can contribute significantly to a better understanding of past climate variability over the ocean and at a global scale.

Objective 3. *To use the information to extend and enhance existing oceanic-climate databases.*

The participation, as adviser, of Scott Woodruff from NOAA has facilitated the integration of CLIWOC data into the ICOADS (International Comprehensive Oceanic and Atmospheric Dataset); the most widely used database of this type among the scientific community. The adoption of the IMMA format provides an integrative connection into ICOADS. Additionally, CLIWOC can be directly downloaded from ICOADS and remains a clearly identifiable European contribution to this system.

Objective 4. *To disseminate the proposal's findings and to stimulate interest and awareness in this source with a view to fostering its further development and realising its scientific potential.*

Throughout the execution of the project, the team members were aware of the importance not only of establishing useful data but also of drawing wide attention to its existence and to the benefits of its application. Dissemination has been a highly successful component of the project, and the following section summarizes the achievements in this area.

a) *Papers in scientific publications which contain references to CLIWOC*

- García-Herrera, R, Wheeler, D., Können, G.P., Prieto, M.R. and Jones, P.D.. 2001. CLIWOC: a cooperative effort to recover data for oceanic areas (1750-1850). *PAGES Newsletter* **9**, 2, 19.
- García, R. and García-Herrera, R.: 2003. Sailing ships records as proxies of climate variability over the world's oceans. *Global Change Newsletter* **53**,10-13.
- García-Herrera, R., García, R., Hernández, E., Prieto, M.R., Gimeno, L. and Díaz, H.F.: 2003. Using Spanish archives to reconstruct climate variability. *Bulletin of the American Meteorological Society*. doi 10.1175/BAMS-84-8-1025; 1025-1035.
- Prieto, M.R., García-Herrera, R. and Hernández, E.: 2004. Early records of Icebergs in the Southern Ocean from Spanish Documentary Sources. *Climatic Change* (accepted).
- Wheeler, D. and Wilkinson, C.: 2004. From calm to storm: the origins of the Beaufort wind scale. *Mariners Mirror* (accepted)
- Wheeler, D.: 2003. Naval documents in historical climatology: an example from a seventeenth century logbook. *Journal for Maritime Research* (accepted).

b) Forthcoming papers

- Monographic issue on *Climatic Change*. Expected publication date: Summer 2005. Content outline:

1. García-Herrera, R., Können, G.P., Wheeler, D., Prieto, M.R., Jones P.D., and Koek, F.B.: 2005a, 'CLIWOC: A climatological database for the world's oceans 1750-1854'
2. García-Herrera, R., Wilkinson, C., Koek, F.B., Prieto, M.R., et al.: 2005b,

'Description of logbooks'.

3. Prieto, M.R., et al.: 2005, 'Determination of terms for wind force/present weather.
   The Spanish and French cases',
4. Wheeler, D., et al.: 2005a, 'Determination of terms for wind force/present weather.
   The English case'
5. Koek, F.B., and Können, G.P.: 2005, 'Determination of terms for wind force/present weather. The Dutch case'
6. Wheeler, D., et al.: 2005b, 'Quality of CLIWOC data'
7. Können, G.P., and Koek, F.B.: 2005, 'Description of the CLIWOC database'
8. Jones, P.D., Salmon, M.I. et al.: 2005, 'Interpretation and Preliminary Results'
9. Wilkinson, C. et al.: 2005, 'Other potential usages including non-climatic ones'
10. Woodruff, S. D., and Diaz, H. et al.: 2005, 'ICOADS/Maury records in the 19th century'

c) Presentations in scientific meetings and Conferences

- R. García, D. Wheeler, G.P. Können, M.R. Prieto and P.D. Jones. CLIWOC: A climatological database for the world's oceans 1750-1850. Poster at: *AGU NAO Chapman Conference*. Ourense, Spain. 28th November –1st December 2001.
- D. Wheeler. Historical sources from English Archives. Oral presentation at: *Workshop on Atlantic Basin Hurricanes Reconstruction from High Resolution Records*. Columbia, S. Carolina, USA. 25- 27, March, 2001.
- R. García-Herrera. Spanish sources to reconstruct climate in the Americas during the 19th century. Invited oral presentation at: *Fall Meeting of the American Geophysical Union*. S. Francisco, USA. 10-14, December 2001.
- R. García-Herrera, E. Hernández, F. Rubio and M. R. Prieto. Historical sources from English Archives. Oral presentation at: *Workshop on Atlantic Basin Hurricanes Reconstruction from High Resolution Records*. Columbia, S. Carolina, USA. 25- 27, March, 2001.

- R García-Herrera, D. Wheeler, G.P. Können, M.R. Prieto and P.D. Jones. CLIWOC: a database for the World's Oceans 1750-1850. Overview and preliminary results. Solicited oral presentation at: *EGS-AGU-EGU Joint Assembly*. Nice, France. 6-11 April 2003.
- R. García-Herrera, D. Wheeler, G.P. Können, M.R. Prieto and P.D. Jones. CLIWOC: a database for the World's Oceans 1750-1850: Overview and Preliminary results. Oral presentation at: *IUGG Conference*. Kyoto, Japan, 6-15 July 2003.
- R. García-Herrera, D. Wheeler, G.P. Können, M.R. Prieto and P.D. Jones. CLIWOC: base de datos climáticos sobre los océanos entre 1750 y1850. Poster at: *XXIX Reunión Bienal de la Real Sociedad Española de Física.* Madrid, Spain, 7-11 July 2003.
- R. García-Herrera, D. Wheeler, G.P. Können, M.R. Prieto and P.D. Jones. CLIWOC: a cooperative effort to recover climate data from oceanic areas (1750-1850). Oral presentation at *2nd International Conference of the European Society for Environmental History.* Prague, Czech Republic, 2-7 September 2003.
- D. Wheeler. The CLIWOC project: important steps in providing reliable climatic data from logbook accounts. Oral presentation at *2nd International Conference of the European Society for Environmental History*. Prague, Czech Republic, 2-7 September 2003.
- F.B. Koek and G.P. Können. CLIWOC extends the pre-instrumental meteorological databases back in time with quantitative data over the oceans. Oral presentation at *2nd International Conference of the European Society for Environmental History*. Prague, Czech Republic, 2-7 September 2003.
- R. García-Herrera, D. Wheeler, G. Konnen, M. R. Prieto and P. Jones. CLIWOC: A database for the world's oceans 1750-1850. Oral presentation at *2nd JCOMM Workshop on Advances in Marine Climatology (CLIMAR-II)*. Brussels, Belgium, 17-22 November 2003.

Forthcoming meetings

- Proxy, documentary and early instrumental marine climate data. Scheduled EGU session CL21, to be held at the 1st General Assembly, Nice, France 25-30 April, 2004, convened by R. García-Herrera, S.D. Woodruff and P.D. Jones.

c) Papers in non-scientific journals

- 'Windkracht 2 heette op zee Labberkoelte', *De Volkskrant*, April 2001, The Netherlands
- 'Klimaatkenners gebruiken oude scheepsjournalen', *Nederlands Dagblad*, 20 April 2001, The Netherlands
- 'Zoektocht naar scheepsjournalen', *De Telegraaf*, mei 2001. The Netherlands.
- 'CLIWOC', *NIWI Nieuws*, No. 50, December 2001 The Netherlands.
- 'Viento en popa a toda vela'. 2002. *Gaceta Complutense*. Madrid, Spain.
- 'Klimaatonderzoek in scheepslogboeken', *De Telegraaf Online*, 31 July 2003, The Netherlands.
- 'Weerkundigen bestuderen logboeken', *Trouw*, 31 juli 2003. The Netherlands.
- 'Scheepslogboeken inzicht oud klimaat', *Spits,*31 juli 2003. The Netherlands.
- 'Oude logboeken bron voor klimaatonderzoek', *Algemeen Dagblad*, 31 juli 2003. The Netherlands.
- 'Logboeken navlooien op weergegevens', *Utrechts Nieuwsblad*, 1 augustus 2003. The Netherlands.
- 'De computer als tijdmachine', *Automatisering Gids*, 15 augustus 2003. The Netherlands.
- 'Bramzeilskoelte uit 't zuidoosten', *Eindhovens Dagblad Online*, 18 augustus 2003. The Netherlands.
- 'Weersinformatie in oude scheepslogboeken', *Zeilen*, September 2003. The Netherlands.

- 'Logbook project comes alive at the Museum'. *The Martime Year Book* 2002-3 (National Maritime Museum, Greenwich), vol.10, pp.15-17.
- 'Whatever the Weather', *Maritime Life and Traditions* 19, 76, Summer 2003.
- 'Nelson's Weather Eye', *New Scientist* 180, 40-43. December 2003.
- 'Nelson helps in battle to understand climate crisis', *Eastern Daily Press,* December 2003.
- 'Weerbericht uit logboeken'; *Intermediair-2*, 8 January 2004. The Netherlands.
- 'Bovenmarszeilskoelte ofwel windkracht 2'; *Het Parool*, 22 January 2004. The Netherlands.
- 'Los cuadernos de bitácora de los siglos XVIII y XIX, claves en el estudio del cambio climático', *ABC*, 19 January, 2004

- 'Logging a Century of Climate Change'; *Science*, 30 January 2004.

d) TV presentations

- D. Wheeler, *'Battlefield Detectives: the weather at the Battle of Waterloo'*, Granada TV, UK, March 2003 (rebroadcast Sept 2003).
- F.B. Koek; *'Short news'*, RTV Utrecht (TV), The Netherlands, 31 July 2003.
- F.B. Koek, F. Barnhoorn; *'Stem van Nederland'*, SBS6, The Netherlands, 31 July 2003.
- F.B. Koek, G.P. Können, F. Boekhorst; *'Twee Vandaag'*, TV2, The Netherlands, 6 August 2003.
- BBC http://news.bbc.co.uk/2/hi/science/nature/3344749.stm (Ranked in the BBC top-30 most visited websites.
- D. Wheeler; Channel 4 National News item, UK, 10 February 2004

e) Radio presentations

- D. Wheeler and C. Wilkinson *'Captain's log'*. BBC Radio 4 on 10th September 2001. (rebroadcast July 2002, BBC Radio 4) UK.

- F.B. Koek, *'MaDiWoDo'*, VPRO radio 747, The Netherlands, 22 May 2003.
- F.B. Koek, *'Short news'*, RTV Utrecht (Radio), The Netherlands, 31 July 2003.
- F.B. Koek; *'Short news'*, Business News Radio, The Netherlands, 5 Augustus 2003.
- F.B. Koek, *'Short news'*, Wereldomroep, The Netherlands, 7 August 2003.
- R. García Herrera, *'El Laboratorio*?, Telemadrid Radio, Spain, 19 January 2004.
- R.García Herrera, *'La tierra a tus pies'*, Onda Cero, Spain, 21 January 2004.
- R. García Herrera, *'Esto es vida'*. Radio Intereconomía, Spain 21 January 2004.

f) Conferences and Lectures for a general audience

- C. Wilkinson. **'Exploiting the Scientific Research of National Museums'** Natural History Museum, London, UK, 22 July, 2001.
- F.B. Koek, *'CLIWOC'*, NIWI, Amsterdam, The Netherlands, 15 January 2002.
- C. Wilkinson. Sept 2003. "*Investigating past Climate from Ships' Logbooks*" National Maritime Museum, Greenwich, London UK; (Archives Awareness Month) in association with the Open University.
- F.B. Koek, *'CLIWOC, Onderzoek naar klimaatverandering op de oceanen'*, Stichting Kaap Hoorn-vaarders, Hoorn, The Netherlands, 19 October 2003.
- C. Wilkinson. Nov 2003. *'Royal Navy Logbooks and the American Revolution'*, Charleston Museum, Charleston South Carolina, USA.
- C. Wilkinson. Nov 2003. *'Ships' Journals: Evidence of the changing Experience of Sea Voyages in the 18th Century'* National Maritime Museum, Greenwich London, UK.
- D. Wheeler March 2003 *'Diarios de navegacion – Fuentes antiguas para datos climatologicos'*, University of Barcelona, Spain.

g) Miscellaneous

- CLIWOC figures have been included in the book: *'Patrick O'Brian's Navy'*; R. O'Neill (ed). 2003 Salamander Books, London 160pp.
- More than 2900 web pages contain citations to CLIWOC. The most relevant being:

http://www.ucm.es/info/cliwoc

http://www.knmi.nl/~koek/cliwoc.htm

http://www.nmm.ac.uk/site/navId/005002007004

http://www.knmi.nl/onderzk/hisklim/CLIWOC/CLIWOC.html

http://www.worldchanging.com/archives/000256.html

http://www.niwi.knaw.nl/en/geschiedenis/projecten/cliwoc/toon

http://www.cdc.noaa.gov/~sdw/cliwoc/

http://www.cosis.net/abstracts/EAE03/00098/EAE03-J-00098.pdf

http://dss.ucar.edu/datasets/ds530.0/docs/cliwoc/

http://www.nationaalarchief.nl/nieuws/pers/klimaatonderzoek.asp?ComponentID=7404&SourcePageID=5084

http://www.port.nmm.ac.uk/ROADS/subject-listing/hier/res.html

http://www.ifremer.fr/envlit/actualite/20040105.htm

http://www.scitech.org.au/sciencewa/current_stories/int/story_int_sailing.html

http://www.sunderland.ac.uk/caffairs/noticeb.shtml

http://www.innovations-report.com/html/reports/earth_sciences/report-23950.html

http://www.rnw.nl/wetenschap/html/klimaat030909.html

http://www.business.com/search/rslt_default.asp?r4=t&query=meteorological+instruments&type=news

http://pub59.ezboard.com/faboutnelsonfrm1.showMessage?topicID=385.topic

http://www.cru.uea.ac.uk/cru/research/

http://nationalmuseums.org.uk/science_technology.html

http://www.scirpus.ca/cgi-bin/dictqaa.cgi?option=c

http://www.nsnet.com/

http://www.24hourmuseum.org.uk/nwh_gfx_en/ART18922.html

http://www.royal-met-soc.org.uk/othermeet.html

http://www.americanrevolution.org/charleston.html

http://unfccc.int/resource/docs/gcos/eugcos.pdf

http://www.aamsept2003.com/whatson-event-000413.html

http://www.radio.com.pl/news/nauka/default.asp?newsID=2802

http://www.dar.csiro.au/library/whatsnew/bp0336.html

http://grads.iges.org/c20c/related/Report_WMOBulletin_27mar02.doc

www.giub.unibe.ch/~juerg/Final_Past_Medclivar.doc

http://www.sciencemag.org/content/current/netwatch.shtml

Appendix 1 contains a copy of all the printed dissemination activities.

Relacion de las Misiones embarcadas en el Puerto de Acapulco el dia 12 de Febrero de 1797 a bordo de la Nao San Andres.

Religiosos Franciscanos

Sacerdotes
- Fr. Gregorio Rodriguez Presidente.
- Fr. Manuel de Soñ Francisco.
- Fr. Juan de Santa Rosa.
- Fr. Jacinto de Madrid.
- Fr. Bernardino de Jesus.
- Fr. Juan Cellas.

Diaconos
- Fr. Manuel Vicente de San Francisco.
- Fr. Cayetano del Doglon.

Coristas
- Fr. Vicente de Sn. Josef.
- Fr. Ramon Jurado.
- Fr. Miguel Ruiz.

Donado
- El Hermano Pedro Marran.

Ydem Agustinos Calzados

Sacerdotes
- Fr. Abad Zamora Presidente.
- Fr. [illegible]
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4 Deliverables and milestones

4 Deliverables and milestones

This section reviews the achievement of deliverables and milestones included in the project contract. They can be divided into four different classes: reports, meetings, products and dissemination activities.

4.1 Reports

It was agreed to produce 5 progress biannual reports and seven meeting reports. They were all produced on time, and sent to the scientific officer. Additionally, 30 quality control and assessment reports were produced, as planned, during the abstraction process.

4.2 Meetings

Finally seven meetings were held:
Kick-off meeting in Seville (Spain), February 2001
Meeting 2 in Greenwich (UK), September 2001
Meeting 3 in Córdoba (Spain), February 2002
Meeting 4 in De Bilt (The Netherlands), September 2002
Meeting 5 in La Gomera (Spain), February 2003
Meeting 6 in Prague (Czech Republic), September 2003
Closing meeting in Brussels (Belgium), November 2003.

4.3 Products

The main products of CLIWOC are the dictionary and the database. The dictionary was initially scheduled for month 12 and was conceived as a task of the highest priority. However, it was soon realised that the dictionary could only be properly developed after a careful examination of a representative sample of the terms used in the logbooks. Thus it was decided to postpone it until month 33. This has allowed us to prepare a dictionary, which not only includes all the terms of the database, but also provides

accurate modern equivalents and valuable additional material gathered during the progress of the project.

The database is currently available as version 1.5. A previous version was freely available as release 1.0. Release 2.0 will be available in the CD-ROM format during the spring of 2004.

4.4 Dissemination

The web page has been operational since month 6; the University Complutense of Madrid will continuously update it. It has received a total of 5379 visits during the period 15-March-2001 to 15 February 2004. Their distribution is shown in table 11.

	Country		
1.	USA	1811	33.7 %
2.	Spain	985	18.3 %
3.	UK	694	12.9 %
4.	The Netherlands	685	12.7 %
5.	Canada	212	3.9 %
6.	Australia	120	2.2 %
7.	Germany	107	2.0 %
8.	France	60	1.1 %
9.	Belgium	55	1.0 %
10.	Denmark	46	0.9 %
	Unknown	158	2.9 %
	Others	446	8.3 %
	Total	5379	100.0 %

Table 11 *Distribution of the visits received by the CLIWOC project web paged in the period 15-March-2001 to 15-february-2004.*

The opening and concluding brochures were ready in months 6 and 35, as expected. They are included in Appendix 2 of this report. The papers and presentations derived from CLIWOC have been summarised in section 3 of this report. They are much greater in number, and wider in terms of the media used for their dissemination, than had originally been envisaged. This development reflects not only the scientific but also the high level of general interest engendered by CLIWOC. A workshop was initially planned, however, in the course of the project, the partners agreed to its substitution by a themed session to be held at the European Geophysical Union's first Assembly. The session is titled 'Proxy, documentary and early instrumental marine climate data', it is scheduled by EGU for session CL23 at their *1st General Assembly*, to be held in Nice, France 25-30 April, 2004. R. García-Herrera, S.D. Woodruff and P.D. Jones will act as conveners. It is believed that this session will contribute more effectively to CLIWOC's dissemination than the planned workshop.

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5 Future developments

5. Future developments

The social and scientific interest generated during CLIWOC led the partners to believe that it will be a lasting initiative. It has proven that logbooks data contain significant climatic information, and it has provided a useful methodology to make the old logbooks understandable and accessible to the scientific community. Thus, there is no doubt that the project will continue after the formal ending in December 2003. Additionally the cooperative environment and collaborative team spirit reached among the partners, supports the continuation of the project. There are a number of means by which the impetus of the CLIWOC project can be sustained. Initially, the partners will try to maximize the dissemination initiatives and offer more detailed accounts of the project's achievements. This will be done through the *Climatic Change* monographic issue, described in section 3 and which is currently in preparation, and through a synthesis paper in a major journal with a more multidisciplinary character. The next stage will involve the detailed exploitation of the database. This will be done directly by the project's partners and by encouraging other teams not directly involved with CLIWOC. In addition, it must not be thought that the abstraction of the logbook collections currently available in the European archives has been completed. Much remains to be done, and Table 11 shows the best estimate of the volume of data in the remaining logbooks.

	Main Period	Keyed Data	Data/yr	Available	Exhaustion	Data/yr if Exhausted
CLIWOC	**1750-1854**	**0.3 M**	**3 k**	**2.2 M**	**14 %**	**22 k**
CLIWOC/Spanish	1750-1800	0.1 M	2 k	0.1 M	100%	2 k
CLIWOC/Dutch	1750-1854	0.1 M	1 k	0.2 M	50%	2 k
CLIWOC/UK	1750-1850	0.1 M	1 k	1.4 M	7 %	14 k
CLIWOC/French	1750-1800	7 k	0.14 k	0.5 M	1 %	5 k
US Maury	1830-1859	1.0 M	30 k	1.5 M	100%	30 k
ICOADS*	1854-1870	0.2 M	12 k	0.2 M	100%	12 k

* Excluding the US Maury collection

Table 12. *Volume of data in the CLIWOC database and in the US Maury collection, and in the 1854-1870 period of ICOADS. All values are reduced to the number of ship-day observations.*

The results obtained at present confirm the high scientific interest and value of any additional abstraction exercises aimed at extending the time and space coverage and increasing the data density achieved in CLIWOC. This will require a combined effort from different institutions, and is an enterprise that the partners will actively promote.

Finally, the partners consider that CLIWOC experience can be used as guideline into a more general context of documentary sources. Thus, they will apply within FP6 call INFRASTR-4 with a proposal titled ENABLE. Its main objective being to perform a design study to create a European database of paleoclimatic data from a much wider range of documentary sources.

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6 Management report

6. Management report

This section reviews the management of the project, and is focused on the main items included in the project contract. According to the latter, the key areas with respect to management at the team level are:

i. *Appointment of suitably qualified staff for data abstraction*

Every team recruited the required personnel depending on their administrative procedures and the team's responsibilities. A small delay in the initial contracts occurred, but it was corrected during the project's lifetime and did not materially influence the outcomes or management of the project.

ii. *Quality control of primary data abstraction*

As described in section 2.2, the abstraction quality control procedure was common for all the partners and based on a 5% sample of the total abstracted data. The *a posteriori* checks provided additional verification of the abstraction quality.

iii. *Working database management*

The intermediate inter-group comparison exercises, which started in month six, have allowed a flexible design of the working database, which has grown in quality (including more accurate fields and information) and quantity. It has been managed on a real time basis and has always been accessible to all the project participants

iv. *Preparation of twice-yearly team reports (for inclusion in full report)*

The annual reports have been produced on schedule and approved by the scientific and administrative officials. Funding has arrived from the EU Commission and been distributed subsequently to all the participants without significant delays.

v. *Coordination with secondary level team groups*
The coordination within the groups has been made by the respective team leaders and did not present any significant problems.

vi. *General aspects of team management and communication with the coordinator and other team leaders*
The warm and friendly environment reached among the participants has allowed for easy communication and cooperation. The meetings have been very useful for discussion and consensus agreements, and have allowed for a fruitful exchange of ideas. As a result, the integration of all the working packages proceeded efficiently.

In addition to these responsibilities the project coordinator had to ensure:

i. *that deliverables are achieved,*
ii. *milestones are reached on the specified dates,*
iii. *the preparation of the full reports,*
iv. *overall project management including effective communication between the teams and communication with the EU.*

As described in the previous sections, all the deliverables have been achieved, with the exception of the workshop, which was substituted by the EGU session with the agreement of all the partners. After obtaining the proper permission, the money initially budgeted for the workshop was invested in increasing the personnel for data abstraction. The only milestone suffering a significant delay was the dictionary, which was postponed from month 12 to month 33. This decision was not the result of any problems in the project process, but brought about by a carefully considered change of strategy. The final result, that of a complete multilingual dictionary capable of providing the modern equivalent of all the archaic terms, whatever their original language, has fully justified this decision.
No problems arose in the project reporting or in the overall communication processes.

Summing up, the management of the project did not present any significant problems. Personnel were contracted by the different partners, in some cases with a small delay due to administrative requirements, and the money arrived on time. During the rest of the period, standard management procedures have been followed.

The final cost justification is included as Appendix 3 of this report.

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7 List of participants and assistants

7. List of participants and assistants

- From partner 1 Profs. Emiliano Hernández, Luis Gimeno and Pedro Ribera and in the abstracting team: Natalia Calvo, Guadalupe Fernández, David Gallego, Esther González, Eneko Mazo, Daniel Paredes, M. José Portela, Francisco Rubio. Pilar del Campo and Dolores Higueras at the Archivo del Museo Naval and Antonio López at the Archivo general de Indias.

- From partner 2 Dr. Clive Wilkinson (office manager) and the abstraction team of Ellie Gatrill-Smith, Catharine Ward and Simon Bailey worked diligently towards the successful conclusion of the abstraction of data from the English logbooks at the National Maritime Museum, Greenwich, Excellent coordination with the Museum was maintained through Dr. Nigel Rigby (NMM Director of Research).

- From partner 3: the abstraction team: Esther Balkestein, Florie Barnhoorn, Pauline Beckers, Denise Berck, Frank Boekhorst, Chantal Dekker, Inge Hickmann, Niels Hupkes, Roel Huttenga, Maarten Koek, Renate Meijer, Bruni Oehlers, Simone Pathuis, Rob de Rooij, Jolanthe Schretlen, Ronald Schurink, Marja Segers, René Snoey Kiewit, Toni Spek, Tineke Tegelaers, Theo Tieken, Pim Vente, Eric Verlinde, Rolf de Weijert; Netherlands Institute for Scientific Information Services (NIWI): Richard Bos, Sirius Bosch, Dr. Peter Doorn, Drs. Berry Feith, Iolando da Mata Brito; Nationaal Archief: Suzanne Barbier, Liesbeth Keijser, Joop Korswagen, Ton van Velzen; Others: I. van den Bout, Prof. Dr. Femme Gaastra, H.A. Hachmer, Irene Jacobs, Drs. W. Kerkmeijer, Juliette Uitdenbogaard and W. Visser.

- From partner 4 The abstraction team: Tech. Carlos Baez, who worked carefully on the abstraction of data from the French and Spanish logbooks and Tech. Fabian Diaz, who contributed to the abstraction of data from French logbooks. Particular mention must also be made of the Executive Secretary of the Centro Regional de Investigaciones Científicas y Técnicas

of Mendoza – Argentina (Ing. Carlos Wuilloud), who lent the microfilm readers and made special provision for the completion of the work. .

- From partner 5 Mike Salmon has performed all the calculations for the reconstruction of the circulation indices and the pressure data.

- David Parker from the UK Hadley Centre and Scott Woodruff, from the NOAA CDC acted as advisers. Their contribution has been valuable and contributed significantly to the project's development and success.

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- Fr. Miguel Rios.

Donado
- Fr. Serbiente de San Antonio.
- El Hermano Pedro Murran.

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8 Acknowledgements

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- Fr. Felipe de Capistrano.

8. Acknowledgements

- Riccardo Casale, CLIWOC EU scientific officer for his friendly attitude and efficient cooperation.

- The project could not have been conducted without the help of a large number of individuals and organisations. We are pleased to acknowledge the assistance of the following: our two official advisers, Dr. David Parker (Hadley Centre, UK Met Office) and Dr. Henry Diaz (NOAA), the staff at the National Maritime Museum (Greenwich), the British Library, the Public Record Office (Kew), the School of Earth Sciences (University of Leeds), Archivo del Museo Naval, (Madrid), Archivo General de Indias, (Seville), the Nationaal Archief of the Netherlands (The Hague), and the staff of the Netherlands Institute for Scientific Information Services (Amsterdam).

Relacion de Las Misiones embarcadas en el Puerto de Acapulco el dia 12. de Febrero de 1797 abordo de La Nao San Andres.

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9. References

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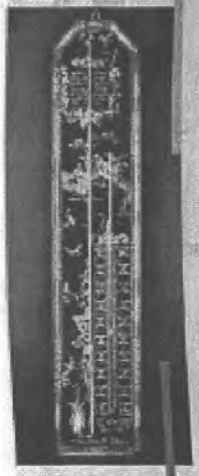
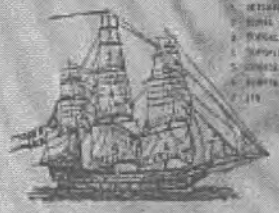
KNMI

CLIWOC MULTILINGUAL METEOROLOGICAL DICTIONARY

An English-Spanish-Dutch-French dictionary of wind force terms used by mariners from 1750 to 1850





Koninklijk Nederlands Meteorologisch Instituut

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Roberto Gustavo Herrera

During the course of the preparation of this dictionary, one of the contributors, Roberto Gustavo Herrera, passed away. This completed work is dedicated to his memory.

A la memoria del Roberto Gustavo Herrera, que contribuyó con su entusiasmo y buenhacer a este diccionario. ¡Que tengas buena travesía, marinero!

Many people have contributed towards the preparation of this volume.

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INTRODUCTION

This dictionary is the first attempt to express the wealth of archaic logbook wind force terms in a form that is comprehensible to the modern-day reader. Oliver and Kington (1970) and Lamb (1982) have drawn attention to the importance of logbooks in climatic studies, and Lamb (1991) offered a conversion scale for early eighteenth century English wind force terms, but no studies have thus far pursued the matter to any greater depth. This text attempts to make good this deficiency, and is derived from the research undertaken by the CLIWOC project[1] in which British, Dutch, French and Spanish naval and merchant logbooks from the period 1750 to 1850 were used to derive a global database of climatic information. At an early stage in the project it was apparent that many of the logbook weather terms, whilst conforming to a conventional vocabulary, possessed meanings that were unclear to twenty-first century readers or had changed over time. This was particularly the case for the important element of wind force; but no special plea is entered for the evolution in nautical vocabulary, which often reflected more wide-ranging changes in the respective native languages.

The key objective was to translate the archaic vocabulary of the late eighteenth and early nineteenth century mariner into expressions directly comparable with the Beaufort Scale (see Appendix I). Only then could the project's scientific programme be embarked upon. This dictionary is the result of the largest undertaking into logbook studies that has yet been carried out. Several thousand logbooks from British, Dutch, French and Spanish archives were examined, and the exercise offered a unique opportunity to explore the vocabulary of the one hundred year period beginning in 1750. The logbooks from which the raw data have been abstracted range widely across the North and South Atlantic and the Indian Oceans. Only the Pacific, largely in consequence of the paucity of regular naval activity in that area, is not well represented. The range of climates encountered in this otherwise wide geographic domain gives ample opportunity for the full range of the mariner's

nautical weather vocabulary to be assessed, from the calms of the Equatorial regions, through the gales of the mid-latitude systems to the fearsome storms of the tropical latitudes. The Trade Winds belts, the Doldrums, the unsettled mid-latitudes, even the icy wastes of the high latitudes, are all embraced in this study. It is not here intended to pass any judgements on the climatological record of the logbooks, and this text seeks only to provide a means of understanding archaic wind force terms and, other than to indicate those items that were not commonly used, no information is given on the frequency with which different terms appeared in the logbooks. Attention is, furthermore, confined to Dutch, English, French and Spanish because these once great imperial powers were the only nations able to support wide-ranging ocean-going fleets with their attendant collections of logbooks and documents over this long period of time. The work is offered to the wider academic community in the hope that they will prove to be of as much value as it has been to the CLIWOC team.

ACKNOWLEDGEMENTS

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THE BEAUFORT WIND FORCE AND WEATHER SCALES

The period in question (1750 to 1850) was a vital one in the evolution not only of English but, arguably, of nautical vocabularies generally. It was in 1806 that Francis Beaufort first formulated his wind and weather scale (Courtney, 2002). It is to this wind force scale, or to be more precise, its more recent derivatives, that the many and various logbook descriptors are equated

[1] For more information on this project consult the website at http://www.ucm.es/info/cliwoc/

in this dictionary. Although used only in his personal logbooks in the first instance, Beaufort's later influence as hydographer to the Royal Navy led to its formal adoption by the Service in 1838. His first two schemes can be found in Appendix I, but these original proposals have undergone several minor changes over the past century and half, particularly in respect of the names allocated to some of the wind forces. These changes are not discussed here in detail, and the dictionary's attention focuses on the more immutable thirteen numbers used to distinguish the scale. Beaufort's scale was proposed in the age of sail, and the forces from 5 onwards were defined in terms of the type and quantity of sail that could be safely carried in a "well-conditioned man of war". Only in 1906 did George Simpson redefine the scale in terms of the state of the sea that accompanies the different wind forces (Appendix I). The International Meteorological Organisation adopted the Beaufort wind and weather scales in 1939, over 100 years after its first proposal. At the same time, wind speed ranges were included in the scale to define the upper and lower limits of each force. Discussions of the Beaufort Scale, its origin, character and development can be found in Fry (1967), Kinsman (1969) and Crutcher (1975).

AN INTRODUCTION TO NAVAL LOGBOOKS

The dictionary focuses on those terms found in naval logbooks. It is only in such documents that weather terms were used in a regular and broadly consistent fashion. In that important sense they differ from many contemporary landsmen's diaries and letters, in which descriptions of the weather followed few conventions in respect of vocabulary. Only the five-point scheme proposed by the *Societas Meteorologica Palatina* (Kington, 1988) in the late eighteenth century sustains comparison with the wind force scales used by mariners.

The majority of logbooks that have survived from the study period are derived from either the state naval services of Britain, France, Spain and the Netherlands, or from the quasi-colonial joint stock undertakings of the English

East India Company (EEIC) or the Dutch East India Company (VOC – Verenigde Oostindische Compagnie), the West India Company (WIC: Westindische Compagnie) and the Middelburg's Commercial Company (MCC: Middelburgsche Commercie Compagnie).. Each of these sources had a strong and often distinctive tradition of training officers who were responsible for keeping the logbooks. The EEIC enjoyed the services of its own hydrographer, one of whom - Alexander Dalrymple - exercised a profound influence on Francis Beaufort. But long before Beaufort devised his wind force scale in 1806 most officers, and those of the British services in particular, used nationally-based unofficial, but widely-adopted scales when describing wind force. There were of course no anemometers at this time, and estimates were based on experience and judgement.

Logbooks were not, however, weather diaries. They served two, more important, functions. On the one hand they were the officer's official account of the management of his vessel, and could be called upon as legal documents in the event of a court martial or enquiry; a function that they continue to carry out today. On the other hand they were also navigational documents in which the ship's progress was carefully noted and her location estimated. For much of the study period, the most important navigational challenge was the determination of longitude. Although the Harrison chronometer and the method of 'lunar distances' had been fully developed by the close of the eighteenth century, many ships' officers continued to employ the system of 'dead (or deduced) reckoning' when estimating longitude (Hewson, 1983). This reluctance to adopt the new and more reliable methods was a consequence of the cost of a chronometer, and the numerical demands of the method of lunar distances. Dead reckoning, however, was not without its arithmetic challenges, and is described in texts such as Robertson (1786) and, Norie (1889). It is this latter respect that weather observations were so assiduously collected. Wind force and wind direction were needed to provide a measure of the degree to which the vessel's course was offset from its compass bearing; a feature known as 'leeway'. Without these estimates, projected and plotted course could be wildly inaccurate.

Whilst the layout of the logbooks inevitably differed from country to country, the weather information that was collected was confined to the same three categories of wind force, wind direction and weather. Wind force and wind direction were the most important from the point of view of navigation, but notes were also made on the general state of the weather. Thus, entries would appear making reference to rain, snow, fog, thunder, hail or lightning. The sighting of icebergs often excited attention and were usually recorded. For the most part, the terms that were used when describing such events are those that are in common use today. They need no translation, and even the occasional archaic term is usually without ambiguity. For this reason, much of what follows concentrates on the more vexed issue of wind force terms.

Logbooks also contained references to the state of the sea. In the case of Dutch, English and French logbooks such entries were relatively infrequent, and did not conform to any recognisable scale. Spanish officers, on the other hand, paid closer attention to the state of the sea using what appears to have been a standardised set of descriptors. For this reason, a section on sea state terms has also been included.

For the purposes of ease of use, the dictionary is presented in four major sections, each of which represents one of the four languages of the original documents, and each of which is introduced by a general account of the background to the original work as each nationally-based data set provided its own suite of problems and challenges. A concluding summary section provides a multi-lingual overview.

THE DERIVATION OF THE EQUIVALENCE SCALES

The following sections were derived using a variety of methods. Most importantly, a number of contemporary documents and nautical texts exist that shed light on the meanings to be attached to some of the terms. More specific reference is made to these in the introductions to the language-based sections.

Other logbook entries were also of use in respect of defining archaic terms. One of the most valuable of these was the inclusion of the distances covered each day by the vessels (this measure was used with particular, almost daily, frequency in English logbooks). Because there is a well-known relationship between ship speed under sail and wind velocity, which is quasi-linear up to Beaufort force 7 (Harland and Myers, 1984), this allowed the relative strengths of winds described by different terms to be assessed. References to the amount of sail that could safely be carried also clarified the issue, and Beaufort was later to use this criterion to define a number of his wind force terms (Kinsman, 1969). Wheeler's (1995) analysis of an illustrated series of logbooks kept by the eighteenth century mariner Nicholas Pocock was also useful in confirming the definitions of some terms.

Although assistance in interpretation came from several sources, there remained a residual group of terms that defied unambiguous definition. Fortunately such terms were infrequently used, representing less than 2 per cent of the sample of logbook entries that were used in the preparation of this dictionary. These words or descriptions were idiosyncrasies of expression employed occasionally by a few officers, but never consistently. They have, for the purposes of completion, been included within the dictionary but without the benefit of any Beaufort Force equivalent, and in the hope that future editions or later work may provide a resolution to this issue. Also included are those descriptions of wind which, though popular, have no meaning in Beaufort Scale terms ('variable', 'squally' etc.). In order to maintain a measure of consistency with the character of the Beaufort Scale, and not to lengthen the text unnecessarily, the terms listed in the following sections include only the principal adjectival qualifiers ('moderate', 'fresh', 'strong' etc.). Secondary adjectival qualifiers such as 'very', 'slightly' or 'less' (and their equivalents in the French, Dutch and Spanish) have been excluded. Neither is any attempt is made to interpret the vast range of terms peculiar to the management of ships in the age of sail, and the interested reader is referred to the dictionaries listed at the conclusion of this document. Attention is otherwise confined to those terms that relate directly to the description of wind.

The complexities of interpretation that prevailed in respect of wind force terms were not, however, repeated in descriptions of the weather. These, for the most part, consist of expressions, the meanings of which have not changed over the centuries (rain, snow, hail, fog etc.) in any of the languages and, for this reason, they are not included in this dictionary.

KEY TO DICTIONARY ABBREVIATIONS

BF: Beaufort Force

EEIC: English East India Company

IU: infrequently used

NDA: no definition available. This may be because the term refers to wind direction, .e.g. 'fair wind', rather than force, or because of uncertainty or imprecision regarding its point on the Beaufort wind force scale, e.g. 'baffling winds'. Descriptions such as 'variable winds' etc. fall into this same category.

OBT: original Beaufort term, i.e. used in his modified scale proposed in 1807 (English dictionary only)

OED: Oxford English Dictionary

RN: English Royal Navy

VOC: Dutch East India Company (Verenigde Oostindische Compagnie)

In the four language sections that follow, each logbook term is followed by the equivalent Beaufort Force number or NDA. For example, **brisk gale:** BF 6

INTRODUCTION TO ENGLISH TERMS

One of the characteristics of English nautical weather terms is the perceptible evolution of the vocabulary over the study period. In many cases therefore an attempt has been made to indicate not only the Beaufort equivalent force of the term but also to note its origin. The emergence of the Beaufort Scale at this time has been noted above, and the evolving vocabulary that characterises the period can be seen most readily in the gradual adoption before 1790 of the term 'breeze' in its various forms of 'light', 'moderate' etc. The term had been part of the English language since the early seventeenth century, but had been used in only a limited fashion to describe those coastal circulations that are today known as land and sea

breezes. Before 1750 most winds other than 'calms' and 'light airs' had been described as some form of 'gale' varying between the 'strong' and 'hard' down to the 'small', 'soft' and 'feint'. The latter terms are included in this dictionary, but had passed out of use by 1750 for all but the most conservative and long serving of officers. It was these lesser 'gales' that were replaced in the vocabulary by the various forms of 'breeze', light, fresh etc. as appropriate. A full account of late seventeenth wind force terms can be found in Suárez Dominguez (2002).

Specific guidance in understanding archaic English terms was found in contemporary publications. Most important of these is William Falconer's *Universal Dictionary of the Marine,* which ran to several editions in the late eighteenth and early nineteenth century (Falconer, 1780). The *Oxford English Dictionary* (1933) provided historical information on many of the terms. Further guidance was offered by *Horsborough's Sailing Directions* (Horsborough, 1817), the introduction of which is of particular interest.

Whilst the vocabulary changed, becoming generally wider after 1750, there is no evidence to suggest that the meanings of the various terms underwent any significant change, and the dictionary is reliable for the one hundred years beginning 1750 (see Appendix I). It must, however, be noted that a distinction existed between the vocabularies of the officers of the Royal Navy and those of the EEIC. Close examination of many hundred logbooks from both sources confirms that the former used a relatively narrow range of terms that in the years immediately before 1800 closely resembled the Beaufort terms. Beaufort had himself been a naval officer with experience in both services (Courtney, 2002). On the other hand, the EEIC logbooks indicate a much more complex system in which winds were classified not only by strength but also by origin. Thus, for example, distinction is made between 'breezes', 'trades', 'monsoons' and 'gales'. This attention to detail reflects the influence of the Company's first hydrographer – Alexander Dalrymple – and has given rise to a particularly rich vocabulary sub-type.

The following section is based on over 15,000 logbook entries for wind force. Those that are described as IU (infrequently used) represent, in total, less than 0.5 per cent of those entries. There will, nevertheless, be a number

of residual, non-standard descriptions in logbooks not included in this survey. Fortunately it is probable that they represent little more than the idiosyncratic or fanciful employment of terms by individuals, and they enjoyed no wide currency in the officer classes. Plural terms are taken to be synonymous with their singular forms. For example, 'light air' is defined together with 'light airs', 'strong gale' with 'strong gales' etc.

DICTIONARY OF ENGLISH TERMS

baffling airs/light winds/winds: IU, NDA, refers to winds of changeable direction

blows fresh (incl. blowing and blew fresh): IU, but popular before 1700. BF 6

blows hard (incl. blowing and blew hard): IU, but popular before 1700. BF 10

blows strong (incl. blowing and blew strong): IU, but popular before 1700. BF 9

breeze: IU, generic term rarely used without an adjectival qualifier. Derived from Castilian *briza* or north-east wind, introduced into English in C16 (OED). Widespread as a wind force term only after 1750.

brisk gale: BF 6

brisk trade: BF 5

calm (incl. dead calm and flat calm): BF 0

constant breeze/gale/trade/wind: IU, NDA without further qualification such as 'strong', 'fresh'

easy breeze: IU, BF 2

easy gale: IU, but popular before 1700. BF 3

faint breeze, gale: see feint

fair winds: IU, NDA. Refers to direction in relation to the vessel's motion, and is a following wind. It makes no presumption of force.

feint breeze: BF 2

feint gale: BF 3

fine breeze: BF 5

fine gale: BF 5

fine trade: BF 5

fresh breeze: BF 5, OBT

fresh gale: BF 8

fresh monsoons: IU, NDA

fresh trade: BF 6

fresh wind: BF 6

gale: IU, an ancient generic term, rarely used without an adjectival qualifier. Of probable Scandinavian origin (OED). Used before 1770 to describe winds of a very wide range of strengths, including those covered today by various 'breezes' of the Beaufort Scale (see Appendix I).

gentle breeze: BF 3, OBT

gentle gale: BF 3

gentle trade: BF 3

great gales: IU, OBT

hard gale: BF 10

heavy gales: IU, BF 9

hurricane: BF 12, OBT. Introduced into English in the C16 by contact with Spanish navigators who, in turn, adopted the term from the indigenous Carib (West Indian) expression *furacan*.

inclinable to calms: BF 1, almost always used with 'light airs, i.e. 'light airs, inclinable to calm'.

increasing breezes/gales/trade/wind: IU, NDA. The term suggests wind rising from a lower to a higher force.

light airs: BF 1, OBT.

light breeze: BF 2, OBT.

light gale: IU, BF 3. Commonplace before 1700, but rare after 1750.

light monsoons: IU, BF 4

light trade: BF 4

light winds: BF 2

little winds: BF 2

moderate: BF 4. Used abundantly until 1838. Francis Beaufort railed against its seeming ambiguity, but employed it frequently until 1806.

moderate breeze: BF 4, OBT

moderate gale: BF 7, OBT

moderate monsoons: IU, BF 5

moderate trade: BF 5

monsoon: IU, generic term rarely used without an adjectival qualifier. Employed widely by EEIC officers, but rarely by those of the RN. To be found only on those occasions when the vessel was in the Indian Ocean or South China Sea. Derived, through Dutch contacts, from the Arabic *mausim*. Not used in English before C17.

pleasant breeze: BF 4

pleasant gale: BF 5

pleasant monsoon: IU, NDA

pleasant trade: BF 5

pleasant wind: BF 4

small airs: BF 1

small gale: IU but popular before 1750, BF 4

squalls (incl. squally and all derivatives): NDA, squalls appear in association with winds of all forces from 1 upwards, and have no correspondence on the Beaufort Scale. Dalrymple (1789) offers this same interpretation.

steady breeze: BF 5

steady gale: BF 6

steady trade: BF 6

stiff breeze: BF 6, OBT, but changed to strong breeze in the 1838 Beaufort scale

storm (incl. stormy): BF 11, OBT. Also used widely in non-scientific writing. Derived from Old High Gothic *sturm*.

strong breeze: see also stiff breeze, BF 6

strong gale: BF 9, OBT

strong gusts: IU, OBT

strong monsoon: IU, BF 7

strong trade: BF 7

strong wind: BF 8

top-gallant gale: IU, BF 5

tempest: BF 11. Also used widely in non-scientific writings. From the Latin *tempestas*.

trades: IU, generic term rarely used without an adjectival qualifier. Employed widely by EEIC officers, but rarely by those of the RN. To be found only on those occasions when the vessel was in the Trade Winds belts immediately north and south of the Equator. Derived from the expression 'blows trade', which is a wind that blows steadily (it has nothing to do with the business of trade). In the C16 and C17 it was used to describe any such persistent wind, but by 1750 it had assumed (as the logbook evidence confirms) its present-day meaning.

tremendous gales: IU, BF 11

typhoon: IU, BF 12, this term is of uncertain origin. It is often suggested to derive from the Chinese term 'tai fung' (great wind), but may also derived from the Arabic 'tufan', or even the Greek 'tuphon' (whirlwind).

unsettled wind: NDA. The nature of such winds forbids conversion to the Beaufort Scale, see also **variable**.

variable: IU, NDA. Its very nature, and that of its compound uses, denies definition in Beaufort force terms.

violent gales: IU, BF 9

violent storm: IU, BF 11

whole gale: BF 10, OBT

INTRODUCTION TO SPANISH TERMS

One of the greatest difficulties in working with wind and weather terms from Spanish sources is the lack of codes or conventions to govern the use of the many descriptors. The first significant contribution in this field came as late as 1831 from O'Scanlan, whose Maritime Dictionary lamented the absence of any generally agreed scheme until that date. Yet Spanish navigators had been amongst the first to set forth on the high seas in search of trade and empire. A Royal Order issued in 1575 required ships' officers employed in the service of the *Carrera de Indias* (the route from Spain to her American

colonies) to keep a record of each trans-Atlantic journey, paying particular attention to winds, currents and hurricanes. Consequently wind force terms are recorded as far back as this formative period. Prieto and Herrerra (1999) have examined the climatological evidence in some of these records. Whilst every effort was made to gather and record information in the Spanish documents, little attention was given to the question of standardisation of expression or vocabulary. From the mid-eighteenth century a change does begin to take place, and Spanish officers begin to adopt terms not unlike those being used by English mariners at the time. At the close of the century the famous scientist Antonio de Ulloa (1795) published an item in which wind forces were defined with a hitherto unknown degree of rigour, using a system that carries a striking similarity to that being used in England at the same timer. The scheme seems not, however, to have enjoyed the wide popularity of its British counterpart. Such conservatism notwithstanding, by the mid nineteenth century the direct equivalent of the Beaufort Scale had official recognition and appeared in texts such the Spanish translation of Bechet (1863), prepared by M. Lobo, which includes a Spanish version of the wind scale.

Logbooks of Spanish vessels in the service of the government postal system can be found in the Archivo General de Indias (Seville). They cover only the latter half of the eighteenth century, but are homogenous with respect to their routes (one to La Havana, the other to Montevideo), to their officer crews (all of whom were similarly trained) and to the type of vessel that was used. It seems probable that their vocabulary was common to Spanish mariners of the age.

Over 800 wind descriptors were identified at the first stage of the analysis. However, the judicious grouping of terms, for example by standardising spellings and avoidance of multiple adjectival qualifiers, reduced the final count to just 104; a figure only marginally greater than that from the English sources. Of these, the five most frequent account for over 75 per cent of all entries. In common with English logbooks, this suggests that the vocabulary was common to, and understood by, the majority of Spanish

officers despite their tendency often to describe the wind and weather in terms that were frequently lyrical rather than objectively scientific.

The analysis of the equivalence of Spanish terms to the Beaufort scale revealed that a number of items, whilst clearly referring to strong and intense winds, could not confidently be ascribed to a specific point on Beaufort's scale. Such ambiguous items are denoted in the dictionary by BF>8.

DICTIONARY OF SPANISH TERMS

abonanzado: IU, BF 4
abonanzando: IU, BF 4
abonanzo: IU, BF 4
abrisado: IU, BF 2
afugado: IU, NDA.
ahuracanado: IU, BF 12
alterados: IU, BF > 8
altivo: IU, BF 7
amenazante: IU, BF > 8
apacible: BF 4
apaciguado: IU, BF 4
arreciando: IU, NDA
arrecio: IU, NDA
aturbonado: IU, BF > 8
aventolinado: IU, BF 1
benigno: IU, BF 4
blandura: IU, BF 1
bonancible: BF 4, OBT
bonanza: BF 4
borrascoso: IU, BF > 8
brisa: BF 2
brisado: IU, BF 2
calma: BF 0, OBT
calma muerta: BF 0

calmo: BF 0

calmoso: BF 2

constante: NDA

contrario: NDA

contrastado: NDA

de 6 y 7 millas: IU, BF 2

de 8 y 9 millas: IU, BF 3

de alta vela: BF 6

de proa: IU, NDA

de toda vela: BF 6

de toda vela larga: IU, BF 6

debil: IU, BF 0

demasiado: IU, BF > 8

desigual: IU, NDA

durito: BF 6

duro: BF 7

en aumento: IU, NDA

en fugas: IU, NDA

endeble: IU, BF 3

escaso: BF 2

ferocidad extraordinaria: IU, BF 12

firme: IU, NDA

flojito: BF 2, OBT

flojo: BF 3, OBT

fortisimo: IU, BF 11

frescachon: BF 7, OBT

frescachonazo: IU, BF 7

fresco: BF 6, OBT

frescote: IU, BF 6

fresquecito: BF 5

fresquito: BF 5, OBT

fuerte: BF 7

fuertecito: BF 6

fuerza: IU, BF > 8

fugadas: NDA

fugadas huracanadas: IU, BF 12

fugoso: NDA

furia: IU, BF > 8

furioso: BF > 8

huracan: BF 12

huracanado: BF 12

impetuoso: IU, BF > 8

inaguantable: IU, BF > 8

incostante: IU, NDA

insoportable: IU, BF > 8

insufrible: IU, BF > 8

intenso: BF 7

intolerable: BF > 8

moderado: BF 4

muchisimo: IU, BF 8

mucho: BF 7

no ha habido: IU, BF 0

pacifico: BF 0

pardo: IU, BF 2

poco: BF 2

rafagas: NDA

recalmones: IU, NDA

recio: BF 7

regular: NDA

regularcito: IU, NDA

rieguroso: IU, BF > 8

sereno: IU, BF 0

sosegado: IU, BF 0

suave: BF 2

tempestad: IU, BF > 8

tempestuoso: BF > 8

temporal: BF 8, OBT

tormenta: IU, BF 9

tormentoso: BF 9

tormentoso como especie de huracan: IU, BF 12

turbonada: BF > 8

vacilante: IU, BF 2

variable: NDA

variando: IU, NDA

variedad: IU, NDA

ventolinas: BF 1, OBT

ventoso: NDA

vivito: IU, BF 6

vivo: IU, BF 7

INTRODUCTION TO DUTCH TERMS

The most notable feature of the Dutch wind force vocabulary is the remarkable degree to which the terms were based on the maximum amount of sail that a vessel could carry under the prevailing conditions. Indeed, nearly 50 per cent of the expressions make direct reference to specific sails (in English there is only one such expression – topsail gale). Because of the increased stresses on the ship's sails, masts and rigging occasioned by stronger winds, the number and area of sails had to be reduced as wind speeds became greater. If the sails were so removed, the process started with the uppermost and smallest, then progressing to lower and larger sails. Around 1750 sail technology had already improved so far that sails did not need to be taken in completely, but could, by the process of 'reefing'[2], be progressively reduced in area. This technique was refined in the subsequent years, and at the close of the study period in 1850 mainsails could carry as many as four rows of reefs. At the time, sails were described as single, double, triple or close reefed depending upon how many of the rows of reefs

[2] a reef is a line of long canvas tags stitched to the sail that allowed part of it to be hauled in, but leaving all that below the reef exposed to receive the wind.

were taken up. Close reefing would reduce the sail area by most. Further information on reefing and sail management can be found in Harland and Myers (1984).

Until the end of the eighteenth century most of the ocean-going vessels were square-rigged sailing ships, which means that they were equipped with three sails standing above each other. The highest sail was called the "bramzeil" (topgallant sail in English), the middle was the "marszeil" (topsail) and the lower one the "onderzeil" (course or mainsail). Around the turn of the century a sail above the "bramzeil" was added that was called the "bovenbramzeil" (royal sail), leaving the other "bramzeil" as the "onderbramzeil" (topgallant). Later also the "marszeil" was split in the same fashion to give the "bovenmarszeil" and the "ondermarszeil" (upper and lower topsails). The terminology of the wind forces progressed parallel to these developments. Appendix IV provides a complete list of all sail names for ships of this period.

Since the Dutch wind force terminology is so closely linked to the sailing practice, it provides an explicit means of determining the order of the many Dutch wind force terms. This allows for refinements in the Dutch translations to the Beaufort Scale that are not possible in the other languages.

In the Dutch dictionary that follows some individual adverbs and adjectives are also included. This is because they appear very often in the descriptive terminology of the wind forces. As no wind force definition can be applied to them and they were not intended to be used for this purpose, they are distinguished by use of italic script. The frequently used descriptions of the degrees of reefing are similarly identified.

DICTIONARY OF DUTCH TERMS

***afwisselend*:** IU, varying

al de zeilen bij: IU, BF 1, all sails in use

blackstill, bladstil: see **stil**

bovenbramzeilskoelte: BF 2, royal sail breeze (see also later qualified uses of this term)

bovenmarszeilskoelte: BF 5, upper topsail breeze (see also later qualified uses of this term)
bramzeilskoelte: BF 3, topgallant sail breeze (see also later qualified uses of this term)
briesie, briesje: BF 1
buiig, buijig: IU, squally
coeltie, coeltje: see **koelte**
***dicht* (incl. *digt, driedubbel* or *3 gereefde*):** NDA, not a wind force term, but indicates that three reefs on a sail have been taken in, see following items
dicht gereefde marszeilskoelte: BF 9, close reefed topsails
dicht gereefde onderzeilskoelte: IU, BF 10, close reefed mainsails
dood stil, doodstil, doodstilletjes, doodstilte: see **stil**
***doorgaand, doorstaand*:** NDA, constant
***doorkomend*:** NDA, starting, increasing
***dubbel* (incl. *dubbel, dubbeld* or *2 gereefde*):** NDA, not itself a wind force term, but indicates that two reefs on a sail have been taken in (double reefing), see following items
dubbelgereefde bramzeilskoelte: IU, BF 5, double reefed topgallants
dubbelgereefde marszeilskoelte: BF 6, double reefed topsails
***enkelgereefde, gereefde*:** NDA, not itself a wind force term,
but indicates that one reef on a sail has been taken in (single reefing)
enkelgereefde (marszeils)koelte: see **gereefde marszeilskoelte**
***frische* (incl. *frissche, frisse, frissen*):** NDA, fresh
frisse koelte: BF 1
flaauw (incl. flauw, flauwtjes, flouw): BF 1, light, weak
flauwe bovenbramzeilskoelte: IU, BF 2
flauwe bramzeilskoelte: BF 3
flaauwe koelte, flauwe koelte: BF 1
frisse marszeilskoelte: BF 4
***gemeene, gemene*:** NDA, normal or commonplace, see following items
gemene bramzeilskoelte: BF 3
gemene frisse bramzeilskoelte: IU, BF 2
gemene koelte: BF 2

gemene marszeilskoelte: IU, BF 4

gereefde marszeilskoelte: BF 5, single reefed topsails

gereefde onderzeilskoelte: BF 9, single reefed coarses

gestadig: steady

gestadige bovenbramzeilskoelte: IU, BF 2

gestadige bramzeilskoelte: IU, BF 3

gestadige koelte: IU, BF 5

harde wind: IU, BF 7

kleine koelte: IU, BF 1

koelte (incl. koelten, koeltie, koeltje, koeltjes): BF 2, but also used as a general qualifier for other terms where it carries the meaning 'breeze'.

labber (incl. labbere koelte, labberkoelte): BF 2

labber bramzeilskoelte: BF 2

leizeilskoelte, lijzeilskoelte: IU, BF 2, studding sail breeze

lichte bovenbramzeilskoelte: BF 2

lichte bramzeilskoelte: IU, BF 3

lichte koelte: BF 1

luchtje (incl. lugie, lugje, lugtje): see **koelte**

marszeilskoelte: BF 4, topsail breeze

onderzeilskoelte: BF 8

onegale, ongestadig: NDA, unsteady. Usually used as an adjectival qualifier

ongelijke bramzeilskoelte: IU, BF 3

ongestadige bramzeilskoelte: BF 3

ongestadige flauwe koelte: IU, BF 1

ongestadige gereefde marszeilskoelte: BF 5

ongestadige koelte: BF 2

ongestadige marszeilskoelte: BF 4

orcaan, orcaen, orkaan: IU, BF 12. Literally, a hurricane and again derived from the same Carib linguistic source as the English term.

passaat, passaatkoelte, passaatwind: IU, BF 4, Trade Wind. Unlike the English equivalent term this was rarely used, and confined to lighter winds.

rondlopende (or rondgaande) koelte: IU, BF 1, variable breeze

slappe bramzeilskoelte: BF 2

slappe koelte: BF 1

stijve bramzeilskoelte: BF 4

stijve gereefde marszeilskoelte: BF 6

stijve koelte: BF 6

stijve marszeilskoelte: BF 5

stil (incl. still, stille, stilleties, stilletjes, stilte, stiltetjes, stilties): BF 0

storm: IU, BF 10

swaere storm, zware storm: IU, BF 10

topzeilskoelte: IU, BF 4, topsail breeze

variable, variabele: BF 1

variabele koelte: IU, BF 1

zeer zware storm: IU, BF 11

zuchje (incl. zuchtje, zuggie, zugje): see **koelte**

INTRODUCTION TO FRENCH TERMS

A sample of 99 logbooks from the Archives Nationales, Marine, Service Hydrographique, included in the "Marine Subserie 4 JJ 7-26: Journaux de bord" were used in this part of the study. The results suggest that although a wide range of terms was in use during the study period, the vast majority of logbook entries fell into a relatively small number of descriptors. The five most commonly used wind force terms accounted for 62 per cent of all French logbook entries. Much of the proliferation of terms resulted from the frequent use of multiple adjectival qualifiers to the principal descriptor, once these had been removed, leaving only the 'base terms', the underlying vocabulary was more clearly distinguishable.

Contemporary texts provided much helpful guidance in the interpretation of the terms. The *Diccionario Marítimo Español* (O'Scanlan, 1831), although a Spanish item, contains a useful appendix with French – Spanish translations (see previous Spanish section). Also useful was the *Nuevo Diccionario Francés- Español y Español- Francés* (Salva, 1897) and the *Laroussse de la Langue Française*. Alexander Dalrymple's late eighteenth century publication *Practical Navigation* also contains a summary table

showing how English and French terms correspond, and is one of the earliest such attempts at direct translation. The latter is of interest as the table is based not only on contemporary logbooks but also on Dalrymple's correspondence with French mariners. Some of the terms cited by Dalrymple, including *vent peu* and *vent moyenne frais* (see Appendix II) did not, however, appear in the sample of logbooks used in this study. Fortunately, a large number of contemporary French and French-English maritime dictionaries have survived, and provided useful evidence for the meaning of different terms. Those by Bourde (1773), Lescallier (1783), Romme (1804, 1813) and Lecomte (1835) were of particular value. That by Pirrie (1895) although post-dating the study period was also useful. Falconer's *Universal Dictionary of the Marine* (1780) provides French translations of many of its terms, but contains also a valuable appendix of French terms and provides another opportunity for comparing contemporary terms in different languages.

In common with the Spanish terms, the analysis of French expressions has revealed a number of ambiguous expressions at the upper end of the wind force scale. Descriptions were encountered that clearly denote winds of notable strength, but it proved impossible to allocate them with confidence to any single point on the Beaufort scale. Such terms are denoted by BF>8 in the dictionary.

There is evidence, particularly from the many contemporary dictionaries, that the French marine vocabulary was undergoing an evolution in parallel with that taking place in English at that time. In particular, the term brisa (*Eng.* breeze), was not in widespread use in 1750, and was very narrowly defined (restricted to coastal land and sea breezes). Within twenty years, however, the term was being employed widely to cover a range of wind strengths at the lower end of the scale, and was applied irrespective of its suspected cause.

DICTIONARY OF FRENCH TERMS

a peu: IU, BF 5

affraîcheur: IU.

affraichi: BF 6

beacoup moins violent: IU, BF > 8

beacoup molli: IU, BF 1

beau: IU, BF 5

beau frais: BF 5

beau petit frais: BF 4

beaucoup de calme: BF 0

beaucoup de forces: BF > 8

beaucoup de vent: BF 7

belle brise: BF 4

bien petit frais: BF 4

bon frais: BF 5

bon frais an peu violent: BF 5

bon frais fraisant: BF 5

bon gros frais: IU, BF 7

bon petit frais: BF 4

bon vent: IU

bonne brise: BF 5

brise carabinée : BF 6

brise fiable : BF 2

brise folle: NDA, literally, baffling wind, and having no specific foce

brise forte: BF 7

brise fraîche : BF 5

brise ronde : NDA, translates as a 'steady breeze'

calme: BF 0

calme plat: BF 0

calme tout plat: BF 0

considerablement: IU, BF 8

coup de vent: BF 10

en tourmente: BF > 8

extrêmement fort: BF 10

extrêmement violent: BF 11

faible: BF 1

faible brise: BF 1

forcé: BF 8

fort: BF 7

forte: BF 7

fraîcheur: BF 1

fraîchir: BF 6

frais: BF 6

fraisant: IU, NDA

grand frais: BF 7

grand vent: BF 7

grande violence: BF 11

gros: BF 7

gros frais: BF 7

gros vent: BF 9

grosse brise: IU, BF 7

il a calmé: IU, BF 0

impetueux: BF > 8

joli frais: BF 4

joli petit frais: BF 4

jolie brise: BF 4

légère brise: BF 2

maniable : BF 4

mediocre: NDA

molli: IU, BF 2

mou: IU, BF 2

mousson : NDA, translates as the generic term 'monsoon'. It makes no specific reference to force, and its use is confined to vessels in the asiatic tropics.

ouragan: BF 12

petit: NDA

petit vent: IU, BF 5

petit air: BF 3

petit fraîcheur: BF 4

petit frais: IU, BF 4

petit temps: IU, BF 3

petit vent: BF 3

petite brise: BF 3

peu: IU, BF 5

porter les perroquets : BF 5. Contemporary duictionaries define this as a 'top sail gale'. See English section.

presque calme: BF 1

rafale (incl. raffalle): NDA, translates as 'squalls' (see also English section).

rafraîchi: IU, NDA

rafraîchissant: IU, NDA

soufflant impétueux: IU, BF 8

tempête: BF 10

tiphon (incl. tifon) : BF 12, derived from the Chinese term for 'great wind', and restricted to vessels in the asiatic tropics. See also English section.

tombé: IU, BF 0

vent alizé : NDA, translates as 'Trade Wind'. See also English section.

vent forcé : BF 8

vent frais: BF 6

vent moins impéteux : BF 6, contemporary dictionaries define this as a 'stiff gale'. See also English section.

vent mou : BF 2

ventand considerablement: BF > 8

violence: BF 11

violent: BF 11

violent ouragans: BF 12

SEA STATE DESCRIPTORS IN LOGBOOKS

Wind force terms followed a general 'code of practice' in all four national groups of logbooks examined here, and since 1906 the Beaufort Wind force scale has been specifically linked to the state of the sea (see Appendix I). Today marine observers are issued with official 'state of the sea cards' with which to compare and determine the nature of the observed conditions (Meteorological Office, 1983). The pictorial association between the two has, however, a much longer history. With notable prescience, Alexander Dalrymple (1789) used what he described as "...pictures of sea-pieces in my possession, to shew the different terms on the Scale, and teach the navigators, of all countries, the same language in describing winds." (p.36). It is perhaps, therefore, all the more remarkable that, with one exception, the description of sea state followed no Beaufort-like convention, indeed it was infrequently recorded in comparison with wind force. The one exception was that of the Spanish logbooks of the *Carrera de Indias*. Here is found a vocabulary unique in its concision and application. Once again, the over-qualification of 'base terms' and the occasional use of peculiar, non-standard descriptions needed to be addressed but, having done so, the following nine-point scheme emerged with notable clarity (see table below). This tradition continued, and as late as the second half of the nineteenth century when another, not altogether dissimilar, scale for Spanish navigators was proposed in 1881: *muy liana, llana, marejadilla, marejada, mar picada, muy picada, mar gruesa, mar gruesa y gruesísima*. It was just twenty five years later that George Simpson suggested the formal link between the Beaufort wind force and sea state that is still used today. The degree to which the eighteenth century Spanish system anticipated that of the twentieth century is remarkable, and for purposes of comparison the Douglas Sea Scale (the system currently in use, and also of nine points) is included in the following table.

Scale point†	Original Spanish term	English translation	Douglas sea scale
0	calma	calm	calm
1	liana	flat	smooth
2	bella	pleasant	slight
3	marejada	swell	-
4	picada	choppy	moderate
5	muy picada	very choppy	rough
6	gruesa	heavy sea	very rough
7	muy gruesa	very heavy sea	high
8	muy alta	high waves	very high
9	furiosa	stormy	precipitous
-	indeterminante	uncertain	confused

† this number system is used only to illustrate the order of the scale. No numbers were used in the original documents.

English officers, so assiduous in their observations of wind force, are notably reticent on the issue of sea state. Such observations as were made were usually confined to the incidence of swell and the direction from which it was driven. Only rarely was the sea state *sensu stricto* noted, and in many cases weeks or months might pass without any such reference. Dutch and French mariners seem likewise to have paid scant formal regard to the sea state.

SUMMARY OF WIND FORCE TERMS IN BEAUFORT SCALE ORDER

BEAUFORT FORCE 0: calm

ENGLISH	SPANISH	FRENCH	DUTCH
calm, flat calm, dead calm,	calma, calma muerte, calmo, debil, no ha habido, pacifico, sereno, sosegado,	beaucoup de calme, calme, calme plat, calme tout plat, il a calme, tombé	blackstill, bladstil, dood stil, doodstil, doodstilletjes, doodstilte, stil, still, stille, stilleties, stilletjes, stillies, stilte, stiltetjes, stilties

BEAUFORT FORCE 1: light airs

ENGLISH	SPANISH	FRENCH	DUTCH
inclinable to calm, light airs, small airs	aventolinado, blandura, ventolinas	beaucoup molli, faible, faible brise, presque calme, fraîcheur	al de zeilen bij, briesie, briesje, frisse koelte, flaauw, flauw, flauwtjes, flouw, flaauwe koelte, flauwe koelte, kleine koelte, lichte koelte, ongestadige flauwe koelte, rondlopende koelte, variable, variabele koelte

BEAUFORT FORCE 2: light breeze

ENGLISH	SPANISH	FRENCH	DUTCH
easy breezes, feint breeze, light breeze, light winds, little winds	abrisado, brisa, brisado, calmoso, de 6 y 7 millas, escaso, flojito, pardo, poco, suave, vacilante,	brise fiable, légère brise, molli, mou vent mou	bovenbramzeilskoelte, coeltie, coeltje, flauwe bovenbramzeilskoelte, gemene frisse bramzeilskoelte, gemene koelte, gestadige bovenbramzeilskoelte, koelte, koelten, koeltie, koeltje, koeltjes, labber, labbere koelte, labberkoelte, labber bramzeilskoelte, leizeilskoelte, lijzeilskoelte, lichte bovenbramzeilskoelte, luchtje, lugie, lugje, lugtje, ongestadige koelte, slappe koelte, zuchje, zuchtje, zuggie, zugje

BEAUFORT FORCE 3: gentle breeze

ENGLISH	SPANISH	FRENCH	DUTCH
easy gale, feint gale, gentle breeze, gentle gale, gentle trade, light gale	de 8 y 9 millas, endeble, flojo	petit air, petit temps, petit vent, petite brise	bramzeilskoelte, flauwe bramzeilskoelte, gemene bramzeilskoelte, gestadige bramzeilskoelte, lichte bramzeilskoelte, ongelijke bramzeilskoelte, ongestadige bramzeilskoelte

BEAUFORT FORCE 4: moderate breeze

ENGLISH	SPANISH	FRENCH	DUTCH
light monsoon, light trade, moderate, moderate breeze, pleasant breeze, pleasant wind, small gale	abonanzado, abonanzando, abonanzo, apacible, apaciguado, benigno, bonancible, bonanza, moderado	beau petit frais, belle brise, bien petit frais, bon petit frais, joli frais, joli petit frais, jolie brise, petit fraîcheur, petit frais maniable	frisse marszeilskoelte, gemene marszeilskoelte, marszeilskoelte, ongestadige marszeilskoelte, stijve bramzeilskoelte, topzeilskoelte

BEAUFORT FORCE 5: fresh breeze

ENGLISH	SPANISH	FRENCH	DUTCH
brisk trade, fine breeze, fine gale, fine trade, fresh breeze, moderate monsoon, moderate trade, pleasant gale, pleasant trade, steady breeze, top-gallant gale	fresquecito, fresquito,	a peu, beau, beau frais, bon frais, bon frais an peu violent, bon frais fraisant, bonne brise, brise fraîche, petit vent, peu, porter les perroquets	bovenmarszeilskoelte, dubbelgereefde bramzeilskoelte, enkelgereefde (marszeils)koelte, gereefde marszeilskoelte, gestadige koelte, ongestadige gereefde marszeilskoelte, passaat, passaatkoelte, passaatwind, stijve marszeilskoelte

BEAUFORT FORCE 6: strong breeze

ENGLISH	SPANISH	FRENCH	DUTCH
blows fresh, brisk gale, fresh trade, fresh wind, steady gale, steady trade, stiff breeze, strong breeze	de alta vela, de toda vela, de toda vela larga, durito, fresco, frescote, fuertecito, vivito	affraichi, brise carabinée, fraîchir, frais, vent frais, vent moins impéteux	dubbelgereefde marszeilskoelte, stijve gereefde marszeilskoelte, stijve koelte

BEAUFORT FORCE 7: near gale

ENGLISH	SPANISH	FRENCH	DUTCH
moderate gale, strong monsoon, strong trade	altivo, duro, frescachon, frescachonazo, fuerte, intenso, mucho, recio, vivo	beaucoup de vent, bon gros frais, brise fort, fort, forte, grand frais, grand vent, gros, gros frais, grosse brise	harde wind

BEAUFORT FORCE 8: gale

ENGLISH	SPANISH	FRENCH	DUTCH
fresh gale, strong wind	muchisimo, temporal	considerablement, force, soufflant impétueux, vent forcé	onderzeilskoelte

BEAUFORT FORCE 9: strong gale

*refers to those expression that can only be classified as force 9 or greater

ENGLISH	SPANISH	FRENCH	DUTCH
blows strong, heavy gale, strong gale, violent gale	alterados*, amenazante*, atrubonado*, borrascoso*, demasiado*, fuerza*, furia*, furioso*, impetuoso*, inaguantable*, insoportable*, insufrible*, intolerable*, rieguroso*, tempestad*, tempestuoso*, tormenta, tormentoso, turbonada*	beacoup moins violent*, beaucoup de forces*, en tourmente*, gros vent, impétueux*, ventand considerablement*	dicht gereefde marszeilskoelte, gereefde onderzeilskoelte

BEAUFORT FORCE 10: storm

ENGLISH	SPANISH	FRENCH	DUTCH
blows hard, hard gale, whole gale		coup de vent, extrêmement fort, tempête	dicht gereefde onderzeilskoelte, storm, swaere storm, zware storm

BEAUFORT FORCE 11: violent storm

ENGLISH	SPANISH	FRENCH	DUTCH
storm, tremendous gale, violent storm	fortisimo	extremêment violent, grande violence, violent, violence	zeer zware storm

BEAUFORT FORCE 12: hurricane

ENGLISH	SPANISH	FRENCH	DUTCH
hurricane, typhoon	ahuracanado, ferocidad extraordinario, fugadas huracanadas, huracan, huracanado, tormentoso como especie de huracan	ouragan, tifon, violent ouragan	orcaan, orcaen, orkaan

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APPENDIX I

THE BEAUFORT WIND FORCE AND WEATHER SCALES

There have been several versions of the Beaufort Scale. Francis Beaufort first proposed his scheme in 1806 when, on 13th January, he entered the following comments and notes in the logbook of the vessel of which he was then Captain, HMS *Woolwich*.[3] This scale employed no new terms and, indeed, was itself not wholly original and is a close copy of the scale proposed by Alexander Dalrymple (hydrographer to the English East India Company) in the late eighteenth century (see Appendix II).

"Hereafter I shall estimate the force of the wind according to the following scale as nothing can convey a more uncertain idea of wind and weather than the old expression of moderate and cloudy &c &c"

0	Calm	7	Gentle steady gale
1	Faint air just not calm	8	Moderate gale
2	Light airs	9	Brisk gale
3	Light breeze	10	Fresh gale
4	Gentle breeze	11	Hard gale
5	Moderate breeze	12	Hard gale with heavy gusts
6	Fresh breezes	13	Storm

Within eighteen months, Beaufort modified his scale and included, for the first time, a set of criteria. In his logbook for 14th September 1807, the following appears:

Scale of Winds

Or key to the wind column in this log

1	Light airs	That which just enables a ship to steer
2	Light breeze	That which will impel a man of war with all sail set by the wind 3 or 4 knots
3	Gentle breeze	That which will impel a man of war with all sail set by the wind 4 or 5 knots
4	Moderate breeze	That which will impel a man of war with all sail set by the wind 5 or 6 knots
5	Fresh breeze	That with which whole topsails, royals, staysails &c may be just carried full and by
6	Stiff breeze	That with which single reefed topsails, gallants, courses, jib and driver would be just carried by the wind, by a wholesome frigate when fairly pressed in chase
7	Moderate gale	That which the same vessel would just set 2nd reefed topsail and jib
8	Fresh gale	That which the same vessel could barely carry 3rd reefed topsails and courses
9	Strong gale	That which she would beat off a lee shore with reefed courses
10	A whole gale	That when she could show no other courses than storm staysails
11	Storm	That which would blow away any sails made in the usual way
12	Hurricane	Hurricane!

Beaufort continued to use this scheme and various development of it in all his logbooks, ruling additional columns into which the wind force number could be entered. The scale was finally adopted in December 1838 by the Admiralty for use in all Royal Navy logbooks, but even that had to be modified as ship design and the introduction of steam power imposed new demands on the scheme. The most recent form, together with the equivalent sea states, is given below, and is that to which the definitions in this volume are related.

[3] This logbook is in the care of the UK Meteorological Office Archives.

Force	term	Description of the state of the sea	Wind speed (knots)	range	Sea state	Wave height (m)
0	Calm	Sea like a mirror	0	<1	Calm	0
1	Light air	Ripples with the appearance of scales are formed, but without foam crests.	2	1-3	Smooth	0.1
2	Light breeze	Small wavelets, still short but more pronounced. Crests have a glassy appearance and do not break.	5	4-6	Smooth	0.2
3	Gentle breeze	Large wavelets. Crests begin to break. Foam of glassy appearance. Scattered white horses.	9	7-10	Slight	0.6
4	Moderate breeze	Small waves, becoming longer, fairly frequent white horses.	13	11-16	Moderate	1
5	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed. Chance of some spray.	19	17-21	Rough	2
6	Strong breeze	Large waves begin to form; white foam crests are more extensive everywhere. Probably some spray.	24	22-27	Very rough	3
7	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.	30	28-33	High	4
8	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.	37	34-40	Very high	5.5
9	Strong gale	High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.	44	41-47	Very high	7
10	Storm	Very high waves with long over-hanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of wind. On the whole the surface of the sea takes a white appearance. The 'tumbling' of the sea becomes heavy and shock-like. Visibility is affected	52	48-55	Phenomenal	9
11	Violent storm	Exceptionally high waves (small & medium sized ships might be lost to view for a time behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Every-where the edges of the wave crests are blown into froth. Visibility is affected.	60	56-63	Phenomenal	11.5
12	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected	64+			14

APPENDIX II

ALEXANDER DALRYMPLE'S WIND FORCE SCALE

The following table is a direct and unabridged copy from Alexander Dalrymple's *Practical Navigation* of 1789. It includes his own 'wind scale', which is of particular importance as it predates Francis Beaufort's scheme of 1806, and upon which the latter in heavily drawn. Indeed, the two were very much acquainted. Dalrymple acknowledges, in turn, the engineer John Smeaton's scale based on the study of the behaviour of a wind mill in Lincolnshire, eastern England (Smeaton, 1759). Of particular interest is Dalrymple's inclusion of a scale of comparative French terms in use at the time. For a fuller discussion of the origin of Beaufort's Scale and its development from earlier schemes see Wheeler and Wilkinson (in press).

TABLE OF COMPARISON OF WINDS, from Ship's Journals, with Mr. SMEATON'S Scale from Authorpe Mill, the Length of the Sails being 34 feet from the Center; or 68 feet diameter.

My Scale	Mr. Smeaton's Scale	and his description	French Terms
0 Calm	0 Calm	The Motion of the Air, not felt	0 Calme
1 Faint-Air, i.e. not quite calm	Scarce a Breeze	Do.....scarcely felt	1 Petit fraicheur, ou feible
2 Light-Air	Light Breeze not working	The direction of the wind sensible, but insufficient to move the Mill, or under 6 turns a minute	2 Fraicheur
3 Light -Breeze	1 Light working Breeze	Just sufficient to move the Mill 6 turns	3 Petit frais, ou petit brise
4 Gentle-Breeze	2 Breeze	Sufficient, to move the branches of trees, and Mill from 6 to 9 turns	4 Jolie brise?
5 Fresh-Breeze	3 Fresh Breeze	Move the boughs with some noise, Mill 9 to 13 turns	5 Jolie frais?
6 Gentle-Gale			6 Vent peu de frais
7 Moderate-Gale			7 Vent moyenne frais
8 Brisk-Gale	4 Fresh	Wind heard against solid objects and agitation of trees, Mill from 13 to 18	8 Vent frais
9 Fresh-Gale	5 Very fresh	Wind growing noisy, and considerable agitation of trees, Mill 18 to ¾ cloth	9 Bon frais
10 Strong-Gale	6 Hard	Wind troublesome, larger trees bend, ¾ to ¼ cloth	10 Grand frais
11 Hard-Gale	7 Very hard	Wind very loud and troublesome, large trees much agitated, Mill ¼ cloth to close struck	11 Vent fort
12 Storm	8 Storm	Wind exceeding loud, trees very much agitated and some broke, mill 25 to 30 turns without cloth	12 Tempeste

APPENDIX III

TRANSLATIONS OF PRESENT DAY BEAUFORT WIND FORCE TERMS

BF	ENGLISH	ESPAÑOL	FRANÇAIS	DUTCH
0	Calm	Calma	Calme	Stil
1	Light airs	Ventolina	Trés légère brise	Zwakke wind
2	Light breeze	Flojito	Légère brise	Zwakke wind
3	Gentle breeze	Flojo	Petite brise	Matige wind
4	Moderate breeze	Bonancible	Jolie brise	Matige wind
5	Fresh breeze	Fresquito	Bonne brise	Vrij krachtige wind
6	Strong breeze	Fresco	Vent frais	Krachtige wind
7	Near gale	Frescachón	Grand frais	Harde wind
8	Gale	Temporal	Coup de vent	Stormachtig
9	Strong gale	Temporal fuerte	Fort coup de vent	Storm
10	Storm	Temporal duro	Tempête	Zware storm
11	Violent storm	Temporal muy duro	Violent tempête	Zeer zware storm
12	Hurricane	Temporal huracanado	Ouragan	Orkaan

APPENDIX IV

SAIL PLAN AND SAIL NAMES OF A TYPICAL OCEAN-GOING VESSEL OF THE LATE EIGHTEENTH AND EARLY NINETEENTH CENTURIES

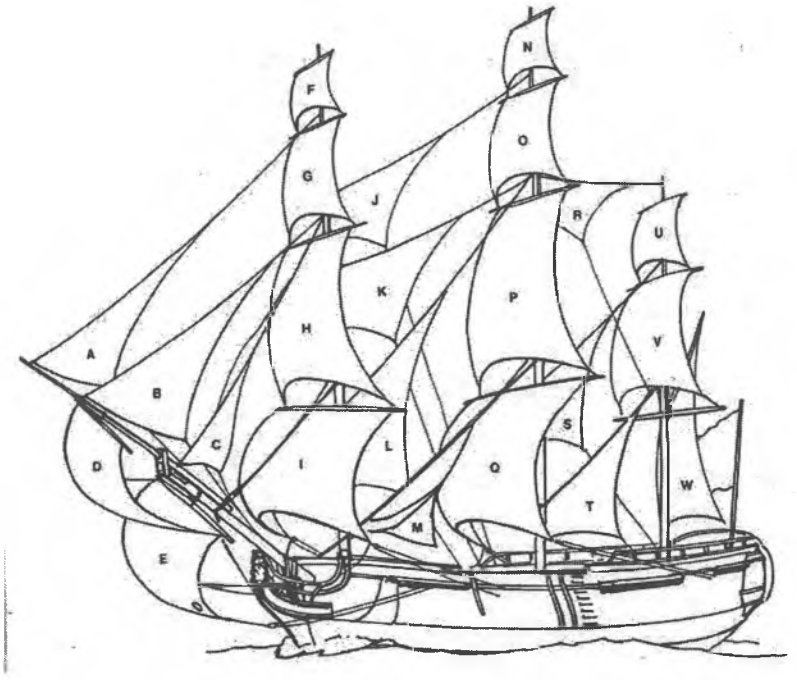


Figure 1. Sail plan of a typical late eighteenth century ship-of-the-line. Most of the logbooks used in the CLIWOC project would have been built to this, or a very similar, design. The key to the sail plan is provided in the following table in which the names of the various sails are given in each of the four languages used in the project.

drawing by Mark Myers RSMA, F/ASMA from Harland and Myers, *Seamanship in the Age of Sail,* (1984). Reproduced by kind permission of the authors.

KEY TO FIGURE 1

key letter	English description	Dutch description	French description	Spanish description
A	Flying jib	Buitenkluiver	Grand foc	Foque volante
B	Jib	Kluiver	Faux foc	Foque
C	Fore topmast staysail	Voorstengen-stagzeil	Petit foc	Contrafoque
D	Spritsail topsail	Bovenblinde	Contre-civadière	Sobrecebadera
E	Spritsail	Blinde	Civadière	Cebedera
F	Fore royal sail	Voorboven-bramzeil	Petit cacatois	Sobrejuanete
G	Fore topgallant sail	Voorbramzeil	Petit perroquet	Vela de juanete
H	Fore topsail	Voormarszeil	Petit hunier	Vela de velacho
I	Fore course or fore sail	Fok	Voile de mizaine	Vela de trinquete
J	Main topgallant staysail	Grootboven-bramstagzeil	Voile d'étai de grand perroquet	Vela de juanete mayor
K	Middle staysail	Grootbramstagzeil	Voile d'étai de de chouque	Estay mayor
L	Main topmast staysail	Grootstengen-stagzeil	Voile d'étai de hune	Vela de estay y gavia
M	Main staysail	Grootstagzeil	Grand voile d'étai de avant	Vela de estay mayor
N	Main royal	Grootboven-bramzeil	Grand cacatois	Sobrejuanete mayor
O	Main topgallant sail	Grootbramzeil	Grand perroquet	Vela penguito
P	Main topsail	Grootmarszeil	Grand hunter	Gavia
Q	Main course or mainsail	Grootzeil	Grand voile	Vela mayor
R	Mizzen topgallant staysail	Kruisbramvlieger	Voile d'étai de perruche	Vela penguito
S	Mizzen topmast staysail	Kruisstengenstagzeil	Diablotin	Vela de estay de mastelero de mesana
T	Mizzen staysail	Kruisstagzeil	Focd'artimon	Vela de estay de mesana
U	Mizzen topgallant sail	Kruisbramzeil	Perruche	Juanete de sobremesana
V	Mizzen topsail	Kruismarszeil	Perroquet de fougue	Sobremesana
W	Mizzen sail	Bezaan	Ourse d'artimon	Cangreja

7

Written Testimony

Christine
for the record

Subject: Re: Northern Waters Task Force Presntation

From: robert nick (yuukaq_nick@yahoo.com)

To: yuukaq_nick@yahoo.com;

Date: Sunday, October 9, 2011 7:08 PM

From: robert nick <yuukaq_nick@yahoo.com>
To: "Yuukaq_nick@yahoo.com" <Yuukaq_nick@yahoo.com>
Sent: Sunday, October 9, 2011 5:39 PM
Subject: Northern Waters Task Force Presentation

In the 1892 landmark case called "Illinois Central", the U.S. Supreme Court said that the government holds wildlife and navigable waterways in trust for the people so that they may fish, have a food supply, and meet other basic needs. This public trust doctrine is the oldest environmental principle of this great nation. Additionally, the U.S. E.P.A. is the arm of the federal government with the trust duty of protection towards Indian interests as its obligation since it began .This trust duty is embedded in federal law and predates statutory law by some 125 years. And this Indian trust doctrine is EPA's foremost obligation. And the governments public trust duty is to preserve the natural resources for all people today and future generations.

My paternal grandfather was a young man in 1892, when the U.S. Supreme Court ruled on this public trust doctrine. And the rule for him passed down throughout generations, was to preserve and protect the natural resources then and for future generations. His duty was to protect and teach the young men of keeping our environment pristine, thereby protecting natures trust asset for generations to come. To protect our land from pollutants, and not to discharge pollutants to the aquatic ecosystems. His knowledge was from traditional litanies of survival in this pristine wilderness rich in wild food supply. And throughout time we have learned that a government that fails to protect its natural resources sentences its people to hard times.

The EPA has charge of our natural trust. As governments are the only enduring institutions with control over human actions that affect natural resources, courts characterize it as the trustee of these resources. We have now learned that with every trust concept, the most important duty is protection, as natural trust lasts in perpetuity. And the amount of natural wealth passed to future generations depends entirely on how well the government trustees defend the trust.

The 3rd obligation of the EPA are the environmental statutes passed in the 1970's, to be used as tools to restore the natural trust. The two statutes are the Clean Air Act, and the Clean Water Act. Even with these governmental statutes, polluted water and degraded aquatic ecosystems threaten the viability of all living things. And million tons of air toxics have been emitted to outdoor air. We all now face an increased likelihood of cancer just by toxins in outdoor air. And the pollution that EPA and the state agencies have control over is ending up

in the traditional food supply of tribal people everywhere. We are in a moment of time where entire food groups are contaminated, where water everywhere is polluted and carries poisons, and global warming is threatening to destroy nearly all of Nature's trust

One hundred years ago, our grandparents, and parents probably never imagined that the destruction of our environments would come in the next generation...my generation. But here we are..experiencing the impoverishment of nature because of the consequences to society from actions taken by this generation of people. And the sad part is that we will not be here 100 years from now, when it will be too late to save what we still have.

Let me share a few thoughts of global warming...but let us hear what an Elder from Napaskiak told us years ago...long before I heard about El Nino, and global warming...."The fish in our rivers and lakes survive in median water temperature between warm and cold".So if the water temperature rises above the median, the fish will die.

Scientific data tells us that the recommended temperature for salmon spawning is 55 degrees Fahrenheit, and warmer temperatures cause diseases for fish and reduce availability of nutrients and oxygen. And based on historical weather data, Alaska's annual temperature has risen some 5 degrees, with winter temperature rising up to 10 degrees. And it is speculated that Arctic region could go up to 18 degrees Fahrenheit warmer by the year 2100. And we may have only 64% of our current snowpack by then.

Since the tributaries of the Kuskokwim and Yukon Rivers are the spawning habitats of all five species of salmon, let us briefly track their migration from spawning, out to the Bering Sea at six months, and their return to their natal streams seven years later to spawn and die. The chinook survives the six plus years in the rich plankton pastures of the Bering Sea. The Colder deep Bering Sea waters create a surfacing effect where the waters rich in nutrients rise to the surface where sunlight produces plankton growth. Every Spring, the melting ice pack leaves in its place this plankton that nourishes salmon, pollock, halibut, king crab, marine mammals, and 80 % of the seabird population.

Finally, those of us living in the wetlands of Western Alaska are seeing the forming of little ponds on the tundra in our villages. This I attribute to the melting of ice crystals below the surface of the tundra. Almost at every joint meeting of our local organizations, we are talking of the need to move to higher ground. In fact, our good Senator Hoffman did get a $50 thousand re-location feasibility study grant, but was vetoed by our short-lived Governor Sarah Palin. And our lakes and rivers are getting shallower in the dryer summer months.

In closing, there has been many scientific notations on causes of climate change, and the one that stands out is the greenhouse gases in the atmosphere caused by the industrial revolution of the twentieth century. Therefore man needs to decrease the amount of heat trapping gases in our atmosphere, as the accumulation of these gases are increasing the protective blanket around the earth. And this is causing the warming of earth's temperature. The leading greenhouse gas is carbon dioxide, and as an industrialized nation, the U.S. accounts for more than 20% of the world's greenhouse gas emissions. We do this by heating our homes, generating electricity, powering our cars, sno-machines, and outboards. And this carbon pollution and other gases we emit today, 2011, will stay in the atmosphere until our grandchildren become adults.

So, we need to change how we produce and consume energy today, as scientists predict even more devastating consequences for the earth.

Only, "WE" hold the solutions to protect our environment, our natural food sources, our health, our economy, our community, our planet, and our very existence on it.

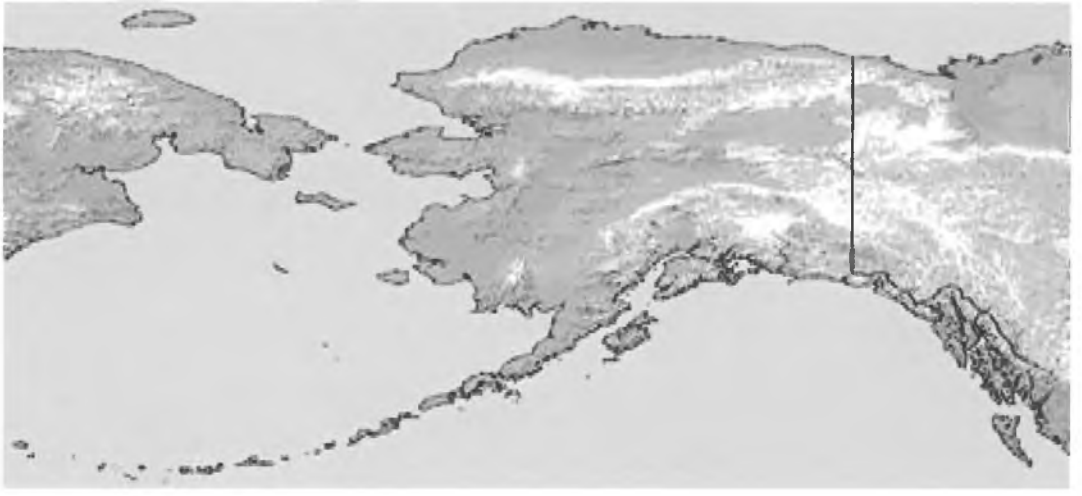
8

Draft Recommendation of the Northern Waters Task Force

Alaska State Legislature
Alaska Northern Waters Task Force
January, 2012 Report

The Northern Waters Task Force would like to thank the many communities and people throughout the state that welcomed us and took the time to help us better understand their communities and the Arctic issues facing them. Additionally, we would like to thank the many presenters who addressed the task force on their areas of expertise. Without hesitation, and often paying their own way, presenters flew thousands of miles to share their information with us. Their guidance was invaluable when making our final recommendations.

Statement from a Wales resident: From here we can see into tomorrow
(Looking from Wales toward Russia)



Introduction:

Does the resource-rich Arctic contain the next Prudhoe Bay?

Diminishing sea ice and worldwide need for natural resources has brought increased interest in the Arctic region. The Arctic's future will be dynamic, bringing both opportunities and challenges through mineral extraction, oil & gas development, fisheries, tourism, marine shipping, cultural protection, and other activities. Besides the eight Arctic nations, other countries are eyeing the resource rich area as a future economic bonanza including the European Union, China, Japan and South Korea. [1] For Alaska, the economic opportunities over the long term could be huge. The wealth of the pipeline could someday be replaced by the wealth of our ocean.

The Arctic is experiencing rapid change on many different fronts: environmental, social, economic, cultural and climatic. The Arctic is warming at twice the rate of the rest of the planet resulting in the loss of perennial sea ice. Recent predictions see an ice-free Arctic summer within 30 to 40 years resulting in new transportation routes.[2] Since record keeping began around 1880, the years spanning 2005-2010 were the warmest yet measured in the Arctic [3]

The Arctic itself covers more than a sixth of the Earth's total land mass not including the vast Arctic Ocean. Eight countries have territory north of the Arctic Circle; Canada, Russia, Norway, Denmark (Greenland), Finland, Sweden, Iceland, and the United States. By virtue of Alaska, the United States is an Arctic country. Five of the Arctic countries are on the Arctic coast. Seven of the eight Arctic countries have indigenous populations with more than 30 different groups inhabiting the region. The indigenous inhabitants have a unique and vast knowledge of the areas they have lived in for thousands of years and are dependent on a healthy Arctic ecosystem to meet their subsistence needs and to sustain their cultural heritage. Moreover, the Beaufort and Chukchi Seas are among the most diverse ecosystems in the world. One-tenth of the world's polar bears, one hundred known fish species, millions of shorebirds, seabirds, and waterfowl, and numerous unique marine mammals call these oceans home. Many of these species are found nowhere else in the world.

Many decisions about the Arctic's future are rapidly moving ahead seemingly without much input from Alaskans. The recent and rapid changes in the Arctic are presenting local, state, federal, and international communities with serious new challenges and require a review of fundamental policies in the areas of habitat management, resource development, marine navigation, economic development and national security. Numerous international, federal and state Arctic initiatives are planned for the near future, and a joint federal-state commission on Northern Waters issues is being considered. Immediate attention from state and federal leaders is crucial to maintain America's and Alaska's interests in the region. Decisions on these Arctic related issues could significantly impact Alaskans and indigenous populations. For these reasons, the Alaska State Legislature passed House Concurrent Resolution 22

[1] China and South Korea have increased their research in the area, are constructing several ice breakers and established a permanent research station at Svalbard.

[2] Snow, Water Ice and Permafrost in the Arctic, Executive Summary 2011. This report focuses on the impacts of a changing climate on snow, ice, and frost conditions in the Arctic over the last ten years. The work is directed by the Arctic Council and carried out by 200 of the world's leading Arctic researchers.

[3] Id.

which created the Northern Waters Task Force (NWTF). The task force set out to examine the changes in the Arctic and to speak with people in the local communities about the changes they were seeing and how they would like to participate in the many decisions being made. To carry out its mission, the task force has held hearings and taken public testimony in impacted communities, listened to many experts from a broad swath of organizations, and toured first-hand impacted areas and potential future infrastructure sites.

As Alaskans and Americans we need to refocus our attention on what needs to be done in the Arctic and better prepare for the changes and challenges ahead. This report reflects our deliberations and recommendations on Arctic issues affecting Alaska. The recommendations are in the following six areas:

- ***Arctic Governance***
- ***Arctic Planning & Infrastructure Investment***
- ***Oil & Gas Development***
- ***Arctic Fisheries***
- ***Marine Transportation***
- ***Arctic Research***

DRAFT

MEMBERSHIP AND DUITES OF THE TASK FORCE:

The Alaska State Legislature created the Alaska Northern Waters Task Force (ANWTF) in 2010 to assess development of state and federal northern waters. The Alaska Northern Waters Task Force is comprised of legislators, leaders from Arctic communities, and representatives of key federal and state agencies. Members of the task force are as follows: Representative Reggie Joule, Chair; Senator Bert Stedman, Vice-Chair; Representative Bob Herron; Senator Lyman Hoffman; Dept. of Environmental Conservation Commissioner Larry Hartig; North Slope Borough Mayor Edward Itta; Unalaska City Manager Chris Hladick; Nome Mayor Denise Michels; NANA Corp. Vice-President Chuck Green; and Alaska Marine Conservation Council Chair Dave Kubiak. Alternate members of the task force include Senator Donald Olson; Representative Bryce Edgmon; Richard Glenn from Arctic Slope Regional Corporation and Cora Campbell, Commissioner of the Department of Fish & Game. The United States Coast Guard served as the federal liaison and was represented by Rear Admiral Christopher Colvin until May 19, 2011. Upon Rear Admiral Colvin's departure, Rear Admiral Thomas Ostebo served as the federal liaison for the reminder of the term.

The duties of the task force are as follows:

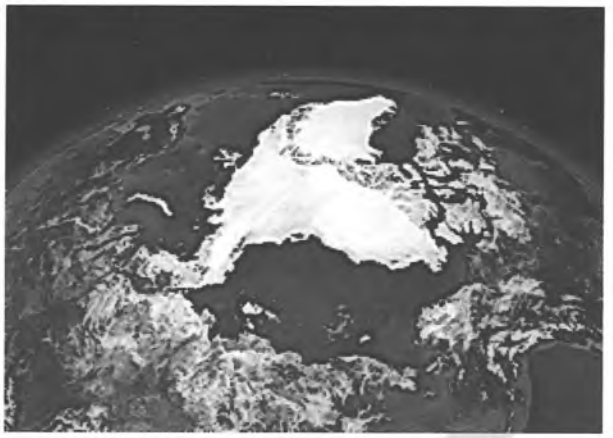
(1) Assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) Facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) Identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) Conduct hearings in the Arctic & Sub-Arctic regions of Alaska to fulfill its purpose.

The task force must provide final recommendations to the Legislature by January 30, 2012. The full text of House Concurrent Resolution 22 which formed the Northern Waters Task Force can be found at attachment B.



(NASA image from 2007shows Arctic summer sea ice. Reuters)

Hearings Schedule:

The task force held meetings around the state as follows:

- Anchorage October 1, 2010
- Barrow December 2 and 3rd in conjunction with PNWER and the Arctic Caucus
- Juneau March 14th, 2011
- Kotzebue July 6-7th
- Nome and Wales July 8-9th
- Unalaska August 24th
- Bethel October 10th
- Anchorage October 11th
- Anchorage December
- Anchorage hearing in conjunction with Alaska Federation of Natives, public testimony only October 19th

Many members of the task force also participated in the Arctic Imperative in Girdwood on June 19-21st; Yellowknife Arctic Caucus August 17-19th in the Northwest Territories, Canada; and the Norway Policy Tour, August 27th-Septemebr 4th in Oslo.

(The agendas for each of the meetings can be found at Attachment C)

DRAFT

ARCTIC GOVERNANCE:

Introduction:

A new generation of economic development is upon us. Development of the resource rich Arctic, while maintaining sustainable communities and preserving the unique Arctic environment, will require unprecedented cooperation between Arctic nations. This level of cooperation will require a paradigm shift in how Arctic nations think about their territories, land and water boundaries. Migrating fish stocks, oil spills, and ship wrecks will not respect territorial boundaries. Each Arctic nation needs to recognize that how they develop their resources can impact not only themselves but their neighbors in a very substantial way. Proactively working together the Arctic Nations have an unheard of opportunity to create an Arctic with self-sustaining growth and development while respecting the Arctic's fragile environment and unique cultures of its inhabitants.

International and Federal Involvement:

The NWTF Recommends that the Alaska State Legislature and the State of Alaska Should Urge the United States to ratify the United Nations Convention on the Law of the Sea:

The NWTF strongly encourages the United States to ratify the Laws of the Sea Convention. International cooperation in the Arctic must be strengthened with the force of international law. Public testimony and comments from international representatives indicated that there is a general consensus that the legal framework is already in place to resolve Arctic disputes. One of the mechanisms to resolve disputes is the Law of the Sea Convention. For the process to work all members need to ratify the Convention yet the United States has so far failed to do so. The United States is the only major maritime power that is not a party to the Convention. 161 nations, and the European Union, have joined the Law of the Sea Convention. Ratification of the Law of the Sea Treaty by the United States is vital for our country to legitimize its Extended Continental Shelf claims. The Law of the Sea Convention provides a mechanism for the United States to perfect rights to resources (oil and mining) over one of the world's largest continental shelves. Under the convention, nations can submit a claim to submerged lands if they demonstrate that their continental margin extends beyond the 200-mile limit. In this way nations can claim additional submerged lands and gain access to additional oil and gas reserves. This benefits our country's economic and national security interests. Ratifying the Laws of the Sea will secure rights to ocean and seabed resources; ensure open sea lanes for maritime commerce; and promote access to lay submarine cables and pipelines. The U.S military, national security and business interests support ratifying the convention. By failing to act the United States misses an opportunity to help shape future ocean policies, loses the opportunity to improve their strategic position in the Arctic, and fails to take advantage of the economic opportunities afforded under the convention. The United States should ratify the Law of the Sea as quickly as possible.

The NWTF Supports the Development of a comprehensive United States Arctic strategy:

Develop a comprehensive Untied States Arctic strategy, as many other Arctic countries have

done, including an investment plan to fund the initiatives identified as priorities.

The federal government recently tasked the U.S. Arctic Research Commission and the Navy to co-lead an interagency effort to prepare a strategic action plan for the "Changing Conditions in the Arctic." The State of Alaska and local communities should take an active role in the planning process, and the Commission should conduct thorough outreach to share information and gain insight from Alaskans.

The NWTF Recommends that the State Support and Encourage Greater International Cooperation, Collaboration and Leadership through the Arctic Council and Inuit Circumpolar Council-Alaska:

There is a need for an on-going international Arctic community that proactively works on Arctic issues. This group should consist of a broad sector of individuals and provide for all voices to be heard. The ongoing cooperation between the United States, Canada and other Arctic nations in research, seafloor mapping, vessel tracking and other issues is encouraging but more is needed. The Arctic international community needs to cooperatively work toward formal agreements in the areas of shipping, fishing, environmental protection, and resource development.

The Arctic Council is an intergovernmental and multinational group formed in 1996 that has begun to address this need. Its members include the governments of Canada, Denmark (including the Faroe Islands and Greenland), Finland, Iceland, the Russian Federation, Norway, Sweden, and the United States of America. The permanent participants of the Arctic Council are as follows: Aleut International Association (AIA), Arctic Athabaskan Council (AAC), Gwich'in Council International (GCI), Inuit Circumpolar Council (ICC), Russian Association of Indigenous Peoples of the North (RAIPON), and the Saami Council. The Council's work is supported by six active working groups that monitor the Arctic, conduct research, and prepare scientific reports with recommendations for the council and other international bodies. Sweden currently chairs the Arctic Council until 2013 when Canada will assume the chairmanship.

Recently the Arctic Council[4] helped formalize a Search and Rescue agreement that details emergency responses in Arctic regions. In May 2011, the Arctic Council set up a task force to begin developing an agreement for preventing and managing potential oil spills in the Arctic. These agreements will hopefully serve as blueprints for future agreements. The Arctic Council could possibly serve as the starting point of a broader international group that works on Arctic issues and other international cooperative agreements.

The Arctic Council has been on the forefront of the changing Arctic encouraging Arctic nations to recognize issues and collaboratively working with others to solve them, most notably with

[4] The Arctic Council is an intergovernmental and multinational group formed in 1996. Its members include the governments of Canada, Denmark (including the Faroe Islands and Greenland), Finland, Iceland, the Russian Federation, Norway, Sweden, and the United States of America. The permanent participants of the Arctic Council are as follows: Aleut International Association (AIA), Arctic Athabaskan Council (AAC), Gwich'in Council International (GCI), Inuit Circumpolar Council (ICC), Russian Association of Indigenous Peoples of the North (RAIPON), and the Saami Council. The Council's work is supported by six active working groups. Sweden currently chairs the Arctic Council until 2013 then Canada will assume the chairmanship.

Arctic indigenous people's organizations. Their work has been beneficial to all Arctic nations and is the only high-level forum where the Arctic indigenous peoples are actively involved as participants. Currently, the Arctic Council's work is limited to environmental protection and sustainable development. The United States, other Arctic nations, and the Arctic Council should review whether the mandate of the Arctic Council should be broadened and whether it should be transformed into a more formal international organization. The Arctic Council should consider adding additional participants or increasing the number of observer participants to the existing council.

The Task Force recommends the state support the efforts of the Inuit Circumpolar Council-Alaska.[5] As part of any Arctic governance structure, indigenous populations and the preservation and enhancement of their unique culture, history, and languages must be a priority. There is much to be gained from indigenous knowledge and understanding of the Arctic region. Every Arctic country that has adopted an Arctic strategy has made preservation of the indigenous populations a priority. ICC-Alaska provides a forum for Alaskan's indigenous populations needs to be represented. ICC should be recognized by any international group that works on Arctic issues and the State of Alaska should support ICC- Alaska in their efforts.

The NWTF recommends that the State of Alaska and Alaska's Congressional Delegation Consider Restructuring the Denali Commission

Restructure the Denali Commission as a joint federal/state body that focuses on Arctic issues and actively seeks funding for Arctic matters or expand the mission of the Denali Commission to include an Arctic component.

State & Local Involvement:

The NWTF Recommends that the State of Alaska Develop a comprehensive Alaskan Arctic Strategy:

Develop a comprehensive Alaska Arctic strategy, as many other Arctic countries have done, including an investment plan to fund the initiatives identified.

The NWTF recommends that the Alaska State Legislature Establish a Special Committee, an Oceans Commission, or continue the Northern Waters Task Force:

The Alaska State Legislature should either establish a second Northern Waters Task Force to monitor the Arctic or establish within the legislature a special committee on the Northern Waters or create an Oceans Commission through legislation. By continuing to monitor and participate in forums about the Arctic the Alaska State Legislature will be better able to make decisions that are in the state's best interest.

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[5] Founded in 1977 by the late Eben Hopson of Barrow, Alaska, the Inuit Circumpolar Council (ICC) has flourished and grown into a major international non-government organization representing approximately 150,000 Inuit of Alaska, Canada, Greenland, and Chukotka (Russia). The organization holds Consultative Status II at the United Nations.

The NWTF recommends that the Alaska State Legislature remain engaged with the Pacific North West Economic Region (PNWER's) Arctic Caucus:

Recently, PNWER formed an Arctic Caucus. PNWER is a public-private partnership and is a forum for collaborative bi-national planning. PNWER's membership includes the states of Alaska, Idaho, Montana, Oregon, Washington, and the Canadian provinces of Alberta, British Columbia, Saskatchewan, and the Yukon and Northwest Territories. PNWER encourages global competiveness while striving to maintain the environment. The Arctic Caucus is focusing on how the PNWER partners can work together on Arctic issues to further everyone's best interests and have already held several meetings. The Alaska State Legislature should continue to participate in the Arctic caucus and provide the needed funding to advance the joint objectives of the caucus and send Alaska representatives to the meetings.

The NWTF Recommends that the State of Alaska Establish a Regional Advisory Council or that the three Arctic Areas Form an Arctic Working Group:

The North Slope Borough, the Northwest Arctic Borough, the Bering Straits Region, and local tribes may want to consider forming an Arctic working group or an Arctic Citizens Council to formulate a joint agreement regarding their vision of the Arctic's future to strengthen the voice of the Arctic communities. (or maybe just a regional advisory council with a broader mix of people like the Prince William Sound or Cook Inlet?) From 2013 to 2017, the Arctic Council will be chaired by Canada and then the United States providing any organized group a unique opportunity to advance their objectives. The working group could additionally influence Arctic policy by having their members participate on state and federal boards and commissions that would further advance joint policies. A coalition of this magnitude could carry great weight in influencing policy and decision making at the state, federal, and international level and provide a clear voice for local residents.

The NWTF Recommends that the State of Alaska Re-Establish a Coastal Zone Management Program:

OIL & GAS DEVELOPMENT and RESEACRH:

Introduction:

A warming Arctic means new opportunities and challenges for oil and gas development and research. A 2008 US geological survey estimates that 13% of the earth's undiscovered oil reserves and 30% of the undiscovered gas reserves are in the Arctic.[6] To put that into perspective it is the equivalent of adding two Saudi Arabia's to the world's global reserves. The majority of the oil is predicted to be offshore. This equates to the following:

- 90 billion barrels of oil
- 1,700 trillion cubic feet of natural gas
- 44 billion barrels of natural gas liquids.

On top of that is an additional 240 billion barrels, or about 10% of the world's known petroleum reserves, that is already discovered. [7] The Chukchi and Beaufort Sea Areas off of Alaska's north coast rank behind the Gulf of Mexico for domestic resources. [8] However, there are substantial challenges and risks associated with developing in the Arctic. The Chukchi and Beaufort Seas are covered with ice for eight to nine months a year. Remote locations, high winds, reduced visibility from fog and darkness, freezing temperatures, sudden storms, and changing sea ice cover all limit exploration, drilling operations, oil spill response capability, and scientific research.

Just as we are looking at developing our resources so are other Arctic nations. With increased interest in developing offshore resources in the Arctic almost all Arctic nations have begun mapping the Arctic ocean floor beyond the 200 mile EEZ limit. Under UNCLOS, nations can submit a claim to submerged lands if they demonstrate that their continental margin extends beyond the 200-mile limit. In this way nations can claim additional submerged lands and gain access to additional oil and gas reserves. As previously stated, the NWTF cannot stress enough the importance of the United States government becoming a signatory to UNCLOS. By not being a signatory to UNCLOS the United States is losing out on the opportunity to access additional oil and gas reserves.

Although we have good data on some specific species that inhabit the Arctic we have little data on how the ecosystem functions as whole. Existing research has not been synthesized in a way that can guide informed decision making about drilling. In many areas, basic ecosystem data is lacking. Moreover, there is uncertainty about the combined impacts on the Arctic ecosystem of a changing climate and increased human activity. We do know that the Beaufort and Chukchi Seas are among the most diverse in the world. Many of the species found in the Arctic region

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[6] See USGS Cricum-Arctic Resource Appraisal website at http://energy.usgs.gov/arctic/.

[7] USGS Fact Sheet 2008-3049:Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle; at http://pubs.usgs.gov/fs/2008/3049/.

[8] Department of the Interior, "Estimated Undiscovered, Economically Recoverable Resources," http://www.doi.gov/whatwedo/energy/ocs/upload/UERR-map-2012-2017-80-NoYear-Note.pdf.

are found nowhere else. The Inupiat Eskimo who inhabit the area are dependent on a healthy Arctic ecosystem to meet their subsistence needs and to sustain their cultural heritage. These facts provide a back drop for the type of science that is needed in order to drill responsibly in the Arctic.

The NWTF Recommends that the State of Alaska and the United States Need to Establish A Comprehensive Research and Monitoring Plan:

To protect the Arctic ecosystem, a comprehensive research and monitoring plan needs to be in place before expanding drilling in U.S. Arctic waters. To this end the NWTF makes the following recommendations:

- Initiate an Arctic research collaboration effort and implementation plan that builds on the recommendations of the USGS Gap Analysis.

- Governments at the international, federal, state, and local level, as well as, industry, public agencies, and universities, need to work together to synthesize the research work that has already been completed. The parties then need to partner to complete a comprehensive science plan, that includes through and complete research and data collection on the Arctic marine environment. Using the information from the completed science gaps analysis by the USGS, the partners should work to complete the research that is needed to have a complete picture of the Arctic marine ecosystem. A process for identifying important ecological and subsistence areas to protect them from drilling should be part of the comprehensive science plan. Traditional knowledge should be used as part of the process to better understand the Arctic environment.

- After a comprehensive science plan has been conducted and the information synthesized, a long-term comprehensive monitoring program needs to be established to understand the impacts of drilling and oil spills on walrus, ice seals, bowhead whales, fish, birds, and other marine mammals that inhabit the Beaufort and Chukchi Seas.

- Encourage increased funding and support for international and other Arctic scientific research collaboration and greater transparency in funding of U.S. Arctic Research. The Arctic Research & Policy Act, as well as the legislation establishing the North Pacific Research Board and North Slope Science Initiative, establishes a process for much greater federal-state cooperation and budgeting than is now in place.

The research outlined above should assist in the decision making progress regarding oil and gas leasing, exploration and development, measuring and monitoring impacts from oil and gas development on the ecosystem, and damage assessment if an oil spill occurs.

The NWTF Recommends that the State of Alaska and the United States Need to Invest in Arctic Specific Oil Spill Response Capabilities and create a University Research Center:

In the event of an oil spill, the Arctic presents unique challenges faced nowhere else. Oil spill risk assessment and spill prevention and response technologies must account for Arctic conditions. Industry in cooperation with federal and state government must work together to reestablish leadership in Arctic and sub-Arctic oil spill research and development technology. A comprehensive research program to address oil spill containment and response issues in the Arctic should be established. As part of the research program, risk assessments need to be done which account for the types of spills that might occur and the resulting impacts. Better research and methods for tracking spilled oil and how it would react to Arctic conditions, particularly in ice needs to be conducted. Currently, the University of Alaska Fairbanks is proposing to establish a research center focused on oil spill prevention and preparedness in the Arctic. Experts across the University are currently engaged in numerous research projects related to Arctic oil spills and the center would help consolidate the effort. This center will allow UAF to partner with state and federal agencies, industry, and other academic institutions on their work.

The NWTF Recommends that the State of Alaska and the United States Need to Encourage the Adoption of an International Agreement for Oil and Gas:

Whether or not the United States advances offshore Arctic oil and gas exploration, other nations are proceeding with hydrocarbon development and oil spills are no respecters of international boundaries. The NWTF recommends that international standards related to Arctic oil and gas activities be established among all Arctic nations. Guidelines should include requirements for the design, construction, transportation, installation, operations, and removal of offshore structures. Both the Arctic Council and the International Standards Organizations have begun work in this direction and the NWTF supports these efforts and encourages the completion of the agreements before more development occurs. Additionally, an international agreement on oil spill response may be beneficial to all Arctic nations as well. Considering the level of risk these standards should demonstrate a level of performance never achieved before by the oil and gas industry.

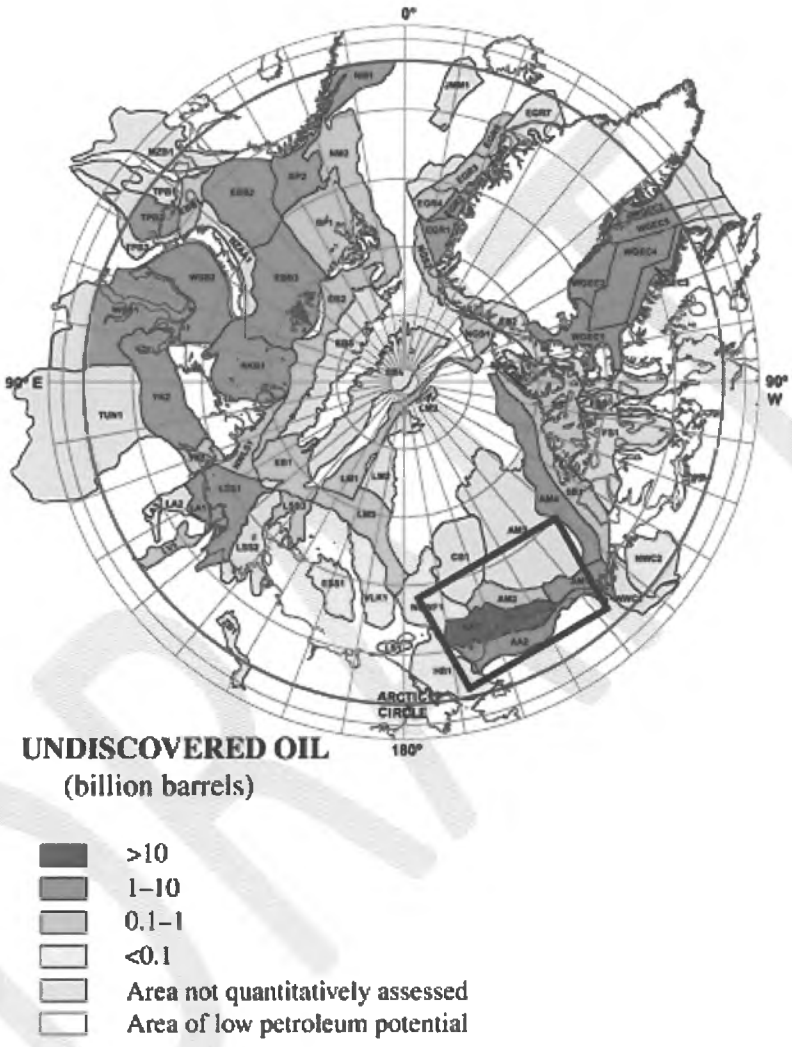
The NWTF Recommends that the State of Alaska Needs to Encourage Congress to Raise Liability Limits and to Fund Oil Spill in Ice Research:

The state and the legislature should encourage Congress to raise the liability limit for oil spills and increase the per incident pay out from the Oil Spill Liability Trust Fund. The state and the legislature should also encourage Congress to fund oil spill in ice research by appropriating the OPA 90 resources as originally intended.

The NWTF Recommends Increased Communication and Input from Alaskans:

Alaskans must have a seat at the table when Arctic policy and OCS development decisions are being made. The Task Force believes that successful communication, information sharing, and local input can only enhance the economic development opportunities of the Northern region.

Both the state and federal governments need to increase the lines of communications with Alaskans and the indigenous people. It was clear during the public hearing process that across the board Alaskans did not feel that they were being fairly represented and heard in the decision making process.



Assessment units of the Circum-Arctic Oil and Gas Assessment, color-coded according to the mean estimated undiscovered, technically recoverable oil resources. The black rectangle outlines the approximate location of the Alaska North Slope and Beaufort and Chukchi Seas OCS areas. Modified from Gautier and others (2009) by the U.S. Geological Services.

Marine Transportation:

Introduction:

Over the next ten to twenty years, the loss of perennial sea ice is expected to open Arctic waters, for at least part of the year, to new shipping routes. Maritime powers have been searching for a shorter route from the Atlantic to Asia for centuries. The melting Arctic raises the possibility of two shorter sea routes described below:

- The Northern Sea Route which runs along Russia's northern border from Murmansk to Providenya and could be used for trade between northeast Asia and northern Europe.

- The Northwest Passage which runs through the Canadian Arctic Islands and would could be used for trade between northeast Asia and North America.

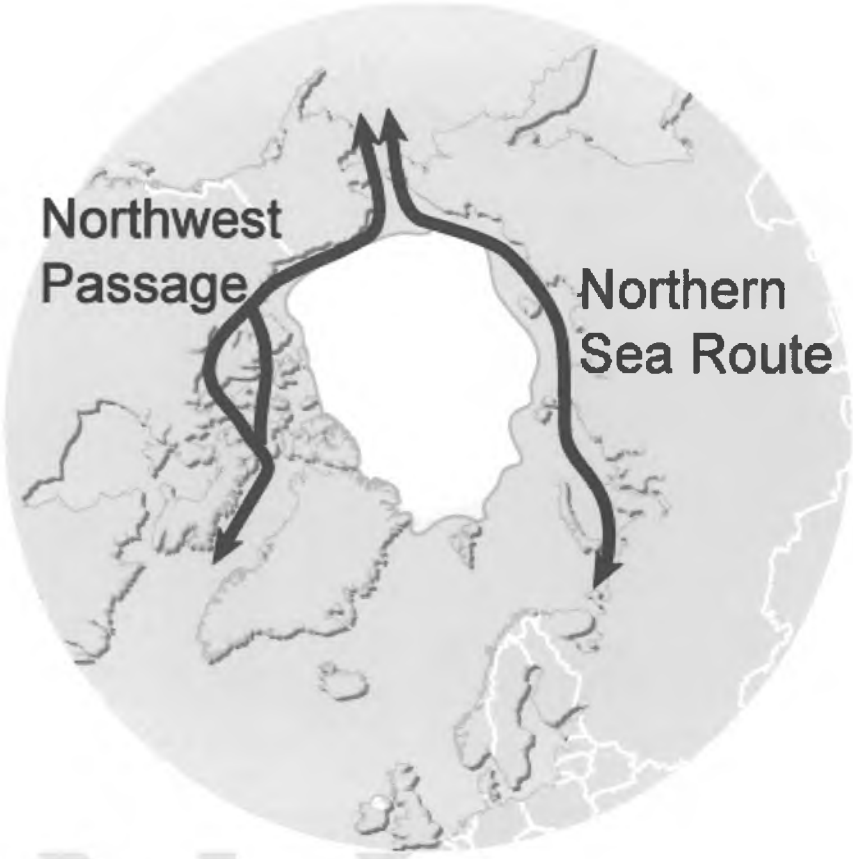
The economic benefits of these new routes could be significant. It has been estimated that ships sailing between East Asia and Western Europe could save more than 40% in transportation time and fuel costs by navigating the northern sea lanes north of Siberia rather than through the Suez Canal. Currently, most of the Arctic marine traffic is destinational delivering goods and supplies to the area or transporting minerals out. In 2006, it was estimated that some 6,000 vessels operated in the Arctic. Tourism as an economic engine is expanding rapidly in the region. In 2004, an estimated 1.2 million passengers visited the region but by 2007 the number of visitors had doubled.[9] With increased shipping come increased risks in vessel groundings, spills, collisions, pollutants, noise disturbances, and invasive species. With this information in mind the NWTF makes the following recommendations:

The NWTF Recommends that the State of Alaska Conduct A Shipping Risk Assessment for the Bering Straits:

The NWTF recommends that the State of Alaska conduct a shipping risk assessment of the Bering Straits by providing funding to the Department of Environmental Conservation to carry it out. The state should support efforts of the USCG Port Access Routing Study with a bilateral risk assessment of the increased shipping through the Bering Straits and options for international assets to respond to the risk (US assets staged or stored at Nome or Russian asset

[9] Arctic Council, 2009. **Arctic Marine Shipping Assessment 2009 Report**

staged or stored at Provdinya). This risk assessment could build on the findings of the Aleutian Island Risk Assessment and future findings of the Cook Inlet Risk Assessment.



Source: Hugo Ahlenius, UNEP/GRID-Arendol

The NWTF Recommends that the United States Works with the International Community to Finalize the Polar Code:

Maritime shipping is regulated through international treaties that establish standards for the safety and security of maritime operations. These standards are agreed upon through the International Maritime Organization (IMO), an agency of the United Nations.

Currently, Arctic ships are governed by the same requirements as any other open water ships. The IMO needs to finalize the Polar Code to supplement the international maritime and environmental conventions which already apply in the Arctic to support safe shipping and pollution prevention in the region. The Polar Code can provide for additional requirements on rescue equipment, firefighting, ice navigation, navigation in uninhabited areas, and consider requirements for Arctic ship construction, design, equipment, crew training and operations. The Polar Code is currently being drafted and the rules are expected to be in force by 2013-2014. The United States and Alaska should be actively involved in these discussions with the IMO to ensure that Alaska's unique geography and needs are met.

The IMO should consider measures or regulatory frameworks that will provide safety

mechanisms for the regions of the central Arctic ocean that are beyond coastal state jurisdiction.

The IMO should consider measures that strengthen passenger safety in Arctic taking into consideration the challenges of rescuing people in the region, including measures such as requiring voyages to be timed in such a way that at least one other vessel is in the area at all times.

Charts and other aids to navigation:

For safe shipping existing nautical charts will need to be updated. Additional navigation aids may be needed as well eg; buoys markers, ice atlases and charts. An assessment of navigational needs should be undertaken to identify priority actions and target locations most likely to present hazards in an effort to reduce the likelihood of accidents. Increased vessel monitoring and reporting may be needed as well for better enforcement in identified areas to be avoided and other traffic risk mitigation measures.

Charge (and support) the University of Alaska Fairbanks Scenarios Network for Alaska and Arctic Planning (SNAAP - http://www.snap.uaf.edu/) to develop specific and applicable data-driven models and scenarios that influence and inform future policy development, state investment, asset allocation, resource development, and community planning. SNAAP should be charged with developing both terrestrial and marine-focused scenarios. Marine scenarios should include ice dynamics and predictions, port development and access, marine mammal migration patterns, and the like. Terrestrial models should include predictions of landscape changes and the implications of such changes (melting permafrost, shifting and intensity of fire regimes, etc.) on the state's roads, airports, coastal ports, pipelines, and rural communities. Such models would inform future infrastructure development and management.

The NWTF Recommends that the Alaska State Legislature and the State of Alaska Continue to Support the Marine Exchange of Alaska:

Continue to support the Marine Exchange of Alaska, with expansion across the North Slope waters to Tuktoyaktuk, NWT, CA under a state-federal-international (US/Canada)-industry partnership. The idea of expansion into Canada was acknowledged as a worthwhile effort and endorsed as a project for the Arctic Caucus of PNWER.

The NWTF Recommends that the Alaska State legislature and the State of Alaska Continue to Support the AVTEC Maritime Training Center

Provide support to the AVTEC Maritime Training Center for improvements to the multi-pilot house marine simulator that will include training for ice navigation (both visual presentation and ice pressures on ship operations) . Support the development and approval of an "Ice Navigator" curriculum with the USCG that implements the recommendations of the Arctic Marine Shipping Assessment and is consistent with the future requirements of the IMO "Polar Code". AVTEC's Maritime Training Center is upgrading the multiple pilot house marine simulator to include ice operations. Through combined expertise of ocean engineers, ice-vessel operators, marine pilots and the programs instructors an ice navigator curriculum is being

developed. Continued support for this expanding program will enable Alaska to have an approved curriculum to train ice navigator with knowledge of working in the ice covered waters of Alaska and beyond as required by the U.S. and Canadian Coast Guards and under the guidance of the IMO Polar Code.

Adopt/Support the recommendations of the Aleutian Islands Risk Assessment

The Aleutian Island Risk Assessment completed Phase A under the guidance of Alaska DEC and the USCG, with findings posted at http://aleutiansriskassessment.com/. The study focused on the traffic predominately following the great circle route through the Aleutian Islands and Bering Sea. A stakeholder Advisory Panel developed recommendations that characterized risk reduction options into three categories: Risk Reduction Options recommended for immediate implementation; Options recommended for study in Phase B study; and those options considered but set aside.

The guiding principles applied to the analysis of these options were that prevention measures take priority over response measures and all measures should be realistic and practical.

The Options found to be practicable for immediate implementation include:

- Develop an enhanced vessel monitoring and reporting program;
- Enhance towing capabilities on Coast Guard cutters, and increase cutter presence in the Aleutians;
- Stage additional emergency towing systems in the Aleutians.

The Advisory Panel recommended four Options that require additional work or study in Phase B, prior to full implementation. These are:

- Increase rescue tug capability in the Aleutians
- Increase salvage and spill response capability in the Aleutians
- Determine the boundaries of IMO Particularly Sensitive Sea Areas, and develop recommendations for associated protective measures
- Strengthen the Aleutians Subarea Contingency Plan

This risk assessment highlighted the value of a multi-year stakeholder Advisory Panel reviewing the options and making recommendations. The NWTF recommends that the options for immediate implementation should be adopted and the Alaska State Legislature should provide funding for those objectives to be implemented. Efforts for Phase B should be continued to be addressed.

Agreed national borders
Possible shipping routes:
Northern sea route (Northeast Passage)
Northwest Passage
Summer sea-ice extent:
September 9th 2011
Average (1979-2000)
FINLAND
SWEDEN
RUSSIA
North Pole
NORWAY
ARCTIC OCEAN
GREENLAND (to DENMARK)
ALASKA (to US)
Beaufort Sea
ICELAND
CANADA

DRAFT

ARCTIC PLANNING & INFRASTRUCTURE INVESTMENT:

Immediate investment in Arctic infrastructure is a foremost priority for Alaska and the entire United States. Investment is needed to secure the well-being of Alaskans and other Arctic residents, responsibly develop resources, and facilitate and profit from new global transportation routes. Two significant events, The Arctic Council's Search & Rescue (SAR) agreement and the U.S. Coast Guard's Maritime Traffic Routing Study, will only further highlight the need for increased infrastructure investment. This investment in Arctic infrastructure will improve the safety, security, and reliability of transportation in the region – a goal established by the U.S. Arctic Policy signed in 2009.

The SAR agreement was signed by Secretary of State Hillary Clinton in Nuuk, Greenland on May 12, 2011 at the Arctic Council Ministerial Meeting. The SAR agreement commits the United States to search and rescue response in regions of the Arctic. Additionally, in coastal waters, the National Contingency Plan requires the U.S. Coast Guard to oversee oil spill planning and preparedness and to supervise any oil-spill response. All of these commitments require infrastructure. At present, the Coast Guard has very limited Arctic emergency response capabilities, no infrastructure on Alaska's North Slope to support its operations including an absence of housing for deployed personnel and support facilities, and only one operational Arctic icebreaker. Clearly, the Coast Guard has not been given the necessary tools to adequately carry out their directive.

The NWTF Recommends that the Alaska State Legislature Should Urge the United States to Forward base the U.S. Coast Guard:

The nearest Coast Guard base to the Arctic is in Kodiak 1,000 miles away from the drilling sites and Arctic shipping. A U.S. Coast Guard base decidedly nearer to the Arctic Ocean will be necessary in the near term. The Coast Guard needs a greater presence in the Arctic and should have bases in Kotzebue and Barrow and be given the requisite equipment needed to carry out their duties.

The NWTF Recommends that the Alaska State Legislature Should Encourage the United States to Fund Ice Breakers and Other Ice-capable Vessels:

The Coast Guard only has one operational icebreaker which presents a major challenge when it comes to operations in Arctic waters. Having ice-capable surface assets is vital for scientific research and the maintenance of sovereignty, as well as for the provision of emergency response assistance.

The NWTF supports funding the construction of at least one or preferably two new ice breakers for the U.S. Coast Guard, and supports planning for other necessary assets for search and rescue responsibilities, spill clean-up equipment and response vessels, and research. Search and rescue and oil spill response capacity need to be aligned with current disaster plans and coordinated

with emergency response organizations, including local community level organizations.

Navigation Aids:

Safe, secure and environmentally sound marine transportation will require infrastructure investment to support it. Short and long range navigation aids, high-risk area vessel-traffic management systems, iceberg and other sea condition warning systems, and improved communication technology are needed for safe navigation and shipping.

Of particular interest is having the Alaska Marine Exchange Automated Identification System (AIS) expanded across the northern waters beyond the Canadian border to Tuktoyuktuk. This will allow a clear record of transport across the US Arctic waters particularly for vessels either servicing the Canadian western Arctic communities or bound for transit through the Northwest Passage. As AIS provides a traffic monitoring service, it also provides a mechanism where a navigation watch with safety zones can aid navigation across the Arctic waters where permanent aids to navigation are difficult to power and maintain. To date, the Alaska Marine Exchange has developed through a joint state-federal-industry funding stream. The opportunity to extend into the Canadian Arctic has been discussed at the Pacific Northwest Economic Region at their Barrow Arctic Caucus meeting and deemed a priority. Insuring an adequate funding stream as a state-federal-international-industry partnership that meets both industry and government needs remains a priority. Completion of the AIS network across the western Arctic will allow for compliance under the International Maritime Organization (IMO) Polar Code (Guidance for Operating in Ice Covered (Polar) Waters (find correct title)).

Mapping:

Fund and expedite the mapping of the Chukchi and Beaufort Seas. Support NOAA in their efforts to fund the mapping of the Chukchi and Beaufort Seas with particular support for the coastal navigation routes (5-15 fathoms) and entrance routes to coastal villages. Encourage the expedited completion of priority areas in accordance with the 2011 National Hydrographic Survey Priorities.

Support the Statewide Digital Mapping Initiative to establish accurate horizontal and vertical control for the communities and significant land and water features adjoining the northern waters. From these surveys, accurately map existing infrastructure of the communities.

Support NOAA in their efforts to fund additional tidal observations to close the tidal datum gap in accordance with the 2008 NOAA Network Gap Analysis for NWLON. These increased observations will allow the joining of the digital mapping initiative vertical data with the Mean High Water and Mean Lower Low Water datum that determine ownership and jurisdiction of state, federal, native and private lands.

Ports and safe harbors:

The NWTF Recommends Funding the Institute of the North's Comparative Analysis of Port and Airport Infrastructure in Arctic Nations:

The Arctic Maritime and Aviation Transportation Infrastructure Initiative (Initiative) is a result of the work of the Arctic Council's Arctic Marine Shipping Assessment (AMSA) and the on-going work of a multi-agency (including DOT, FAA and Transport Canada) effort that sponsors the Arctic Aviation Initiative (AAI). It builds on and responds to past efforts and projects of two working groups within the Arctic Council – PAME's AMSA (2009) and the SDWG's Circumpolar Infrastructure Task Force (CITF), which acted as a platform for the Arctic Aviation Experts Workshop in 2005 and 2006. More directly, it follows on the strategic plan set forth at the 2010 Arctic Aviation Experts Conference (AAEC).

The Initiative seeks to address the infrastructure deficit – a lack of ports and airports that have adequate infrastructure and response capabilities (and in some nations a lack of ports in general) - by inventorying maritime and aviation assets in the Arctic that impact the region's ability to respond. This will be accomplished by developing guidance for a robust, effective transportation system in the North. By setting benchmarks for what capacity and capability should look like and establishing a current baseline of Arctic maritime and aviation transportation infrastructure, the Initiative will be able to produce a gap analysis that more efficiently facilitates the application of resources by federal, regional and local governments, as well as international bodies. In this, the intermodal approach helps to avoid duplication, leverages a multiplicity of efforts and provides efficiencies to infrastructure development in a region that often struggles with economies of scale.

As part of the scope of this Initiative, it is envisioned that a multi-year campaign take place. In the first year, a budget of $440,000 (see Annex 1) establishes a foundation to work from and begins the benchmarking process as well as gathering baseline data. Much of this has been done on the marine side by the AMSA, which will be updated and correlated with current and best aviation information. Baseline data will be fed into both a final guidance document and a revised version of the Institute of the North's Arctic Aviation Database, an updated form of which will be a deliverable from this effort; it will include port infrastructure and be renamed to reflect this expanded scope. The **Arctic Maritime and Aviation Infrastructure Database** will include a web-based, searchable map that illustrates the overlapping spheres of responsibility and capacity as well as perceived gaps in the system as a whole. Arctic nations' ability to respond will be coordinated, intentional and built upon a well-established understanding of both need and capability.

A second deliverable will be the **2012 Arctic Aviation Experts Conference**, which will review and assess the aviation portion of the guidance document. This is the only venue to date in the world dedicated to Arctic aviation and provides an invaluable service in connecting stakeholders from across the Arctic to one another and critical issues. A corresponding **2012 Arctic Port Response Infrastructure Conference** will take place to evaluate the maritime transportation portion of the final document. A draft version of the Guidance Document will then be delivered to the Arctic Council's SDWG for review and input.

In the second year of the project, the Guidance Document will be refined and finalized, with results of the Initiative disseminated and work groups identified to address individual projects identified in the final document. At the same time, the Arctic Maritime and Aviation Infrastructure Database will be launched and outreach conducted. Similar funding needs are anticipated for this phase (see budget, in Annex 1).

The NWTF Recommends continuing the analysis of ports and safe harbors in the Arctic Region:

Continue the analysis of options for port and safe harbor construction in the Arctic and assess the pros and cons of alternative locations, alternative types of ports, and seek out funding alternatives. Building on the findings of the 2008 & 2011 state-federal Alaska Regional Ports Workshops and the 2011 Arctic Ports Charette, convene an industry focused Alaska Arctic Ports Workshop that addresses the environmental conditions and engineering approaches to develop an Arctic deepwater port strategy for the following locations:

a. Nome-Teller port complex with expansion of the Nome causeway and breakwater, upgrade of the Nome-Teller road, and a seasonal landing/mooring facility off Teller in the Port Clarence bay.
b. Kotzebue Sound port complex for approaches to improve the materials handling at DeLong Mountain Terminal Port or construct the Kotzebue-Cape Blossom road and offshore causeway.
c. Other locations as identified in the previous workshops for supporting and lightering to river-bound traffic into the Yukon, Kuskokwim and other navigable waters, with particular reference to mooring buoys and localized community barge landing improvements.

Detailed description of each project follows.

Nome/Teller:

The Nome-Teller port complex provides an option for linking the established transportation infrastructure of Nome (air and medium draft port) with the large protected embayment of Port Clarence via the road to Teller. Expansion of the port of Nome for deep draft will require studies of the environmental impact of expanding the causeway >1200 feet to 35 feet of water and providing adequate protection from winds and waves during the ice free season. Operation of the port during the ice covered period will remain limited.
Support for deeper draft vessels <40 feet can be accommodated in Port Clarence with staging from Teller. The support could include an improved landing for lightering materials to and from the ship that were previously landed at Nome and transported to Teller. A second function of this protected embayment is as a "harbor of refuge" where vessels could be located under U.S. flag state control and in accordance with Alaska state laws for in voyage repairs, marine casualties, or for failure to comply with Arctic shipping requirements, including the IMO Polar Code.

A US Coast Guard deactivated runway and moth-balled facilities remain at the closed LORAN station on the Port Clarence spit. While these assets remain viable for re-activation, the transportation capacity between the 3000 foot runway at Teller, the 72 mile Teller Highway from Nome, the 6000 foot runways

at Nome and the 3000 foot causeway and breakwater at Nome appear to limit the value of investment in additional port capacity off the existing road system.

A study on the engineering approaches, the cost for improvements to the Nome-Teller port complex and the potential economic benefit merits consideration as a contender for a viable US Arctic Port with 35 feet of draft. Improvements to the community infrastructure as an Arctic operation hub should be factored in to this study.

The Kotzebue Sound port complex is an example where existing shallow draft ports could provide the foundation for improving the viability of mining activities and sustainability of the Northwest Arctic Borough communities. Presently the Delong Mountain Terminal Port provides a shallow draft lightering capability for the seasonal export of the Red Dog Mine ore concentrate. Studies have been conducted to developing a dredged channel and landing at the terminal, but found to not be cost effective and difficult to maintain. However, if additional mineral deposits are developed, either with Arctic coal or minerals from the Ambler district and west, the further development of this port merits review.

Across Kotzebue Sound is Cape Blossom, a potential deepwater port site for the hub community of Kotzebue. Presently, Kotzebue and its surrounding Northwest Arctic Borough communities depend on long distance lightering from offshore barges for re-supply with significant economic impact. Studies by the State of Alaska have shown that a road from Kotzebue to Cape Blossom and development of an extended length causeway of 7000 feet (?) (Harvey Smith for details) is feasible from an engineering perspective. Further studies will be needed to determine the actual cost effectiveness of this seasonally available deepwater port.

Support for a review of the port capabilities and lightering and storage options for fuel and supplies, as well as energy distribution and electricity generation should be considered.

The northern waters of Alaska also include the major river drainages of the Yukon, Kuskokwim, Noatak and Kobuk Rivers and Bristol Bay. Recognizing the communities on these river drainages receive a significant amount of re-supply by seasonal barge, the Denali Commission and U.S. Army Corps of Engineers completed a Statewide Barge Landing System Design study that defined different types of mooring and landing facilities for the northern waters area. The Phase 1 assessment was completed in 2009 and covered 111 communities on the Alaska Peninsula, the Yukon, Kuskokwim, and Kobuk Rivers, and the Bering, Chukchi and Beaufort Sea coasts and resulted in 36 priority projects. These approaches ranged from simple mooring points located above the river edge to barge ramps and jetties based on discussions with the local communities and the river operators. The study showed how efficiencies could be gained and environmental risks minimized with mooring of the tugs and barges during offloading. While initial projects showed the value and success of the approaches, the sources of federal funding have decreased significantly. Based on these findings, support for the construction of the priority community barge landings as designed is recommended.

Roads:

Convene a "Transportation Corridors to Resources" conference addressing access by road, rail or water to major natural resources, including mineral deposits that can be developed for the domestic and international market. Explore the options for public-private partnerships in capitalizing development of the resource deposits and providing a return on investment to the state and private sector. Provide a prioritized strategy for approaches to specific resource deposits and options for developing and moving to market.

Co-host (NWTF and the University of Alaska Fairbanks) a workshop:

Co-host a workshop the purpose of which would be to cross walk the 17 AMSA recommendations (developed to address issues throughout the Circumpolar North) with the specific needs of Alaskans discovered during the NWTF initiative. AMSA provides invaluable recommendations for the broad Arctic community and these recommendations would be helpful in guiding specific Alaska-focused recommendations toward actionable and helpful next steps. With AMSA as a framework, and covering broad-based issues from infrastructure and oil and gas development to inclusion and protection of indigenous communities, the NWTF-UAF workshop would produce specific, Alaska-based initiatives that may help to prepare communities for a dynamic, changing, and challenging future.

Implementation of AMSA for training of Ice Navigators:

Support the Alaska Vocational Technical Center Maritime Training Center and the U.S. Coast Guard in establishing a program for training of mariners as "Ice Navigators" to operate in ice covered waters. This is a recommendation from the Arctic Marine Shipping Assessment and is being incorporated into the International Maritime Organization Polar Code. AVTEC's Maritime Training Center is upgrading the multiple pilot house marine simulator to include ice operations. Through combined expertise of ocean engineers, ice-vessel operators, marine pilots and the programs instructors an ice navigator curriculum is being developed. Continued support for this expanding program will enable Alaska to have an approved curriculum to train ice navigator with knowledge of working in the ice covered waters of Alaska and beyond as required by the U.S. and Canadian Coast Guards and the International Maritime Organization.

The NWTF Recommends that the Alaska State legislature fund a Search and Rescue Coordination Center along the coast or provide funding to the Local Search and Rescue Efforts on the North Slope Borough and the Northwest Arctic Borough and Bering Straits:

Review and Consider Efforts to Expand Fiber Optic Cable Routes Across Northern Waters:

The retreat of sea ice and stability of the sea floor in the Arctic is creating interest in a potential

fiber optic cable route from London to Tokyo via the Canadian Northwest Passage and Alaska Arctic. Just as shipping routes are significantly shorter across the northern waters, so will be fiber optic cable routes. In 2010, Kodiak Kenai Cable Company developed an international consortium for the Arctic Link with landing at Prudhoe Bay. Similarly, within the United States, the company proposed the Northern Fiber Link, with branches at linking Kodiak with remote communities of Dutch Harbor, Nome, Kotzebue, and Barrow before linking back in to the Prudhoe Bay landing. While this proposal was unsuccessful in obtaining funding, valuable research was conducted into a viable Arctic cable route and the Arctic Cable Company was formed. On land, GCI's Terra SW is connecting coastal villages and communities to a fiber optic-microwave network. This network will explore expansion to include the communities of northwest Alaska. On the North Slope of Alaska, the Arctic National Broadband Network initiative proposed to develop broadband capability between Barrow and Nuiqsut. These efforts are exploring how both terrestrial and seabed fiber optic cable communications can be deployed across the Arctic and between sub-Arctic countries. Others will continue to explore the options of increasing broadband capacity via offshore cable routes that are shorter and more seasonally protected than those existing in the boreal, temperate and tropic oceans. Support for these studies should continue and opportunities considered in joining fiber optic cable venture that will land fiber optic links to the coastal hub communities and industry bases adjoining the northern waters.

The NWTF Recommends that the Alaska State Legislature Explore Models for an Arctic Infrastructure Development Authority or Recommend that the Legislature Work with the Arctic Caucus in PNWER to Explore Options by Providing Funding and Staff Support:

What can Alaska do to attract investors? Consider restructuring AIDEA and use PFD monies? How could Alaska cooperate with other Arctic countries to develop infrastructure?

(NOAA boat headed out to conduct research in the Arctic)

ARCTIC FISHERIES:

Introduction:

Alaska and the Arctic contain some of the world's largest and valuable fisheries. There are some 100 known species of fish in the Arctic Ocean. Scientists are discovering that a number of sub-Arctic species, such as Cod, Herring, and Pollock, are expanding their habitation further north as sea ice melts and the oceans warm.[10] At the same time, fish stocks are likely to be impacted by increased economic activity, ocean acidification, salinity and temperature changes in the ocean and loss of sea ice, these changes will require data collection and monitoring of fish stocks over a significant period of time. This shift in fish habitat creates potentially new commercial fishing opportunities for Arctic nations. For rural Alaskans this could present an economic opportunity for people living in remote areas of the state. The task force makes the following recommendations regarding Arctic fisheries.

Need for Comprehensive Research and Monitoring Plan:

On February 5, 2009, the North Pacific Fishery Management Council imposed a moratorium on fishing in Alaska's northern waters until more information is available so that any future commercial fishing operations can be sustainable. The current moratorium on Arctic fisheries in the U.S. Exclusive Economic Zone (EEZ) should not postpone Arctic fisheries research. For the last two years, there has been a lack of any significant research or data collection to justify the moratorium. There is a critical need to establish baseline data on fish stocks and to conduct other relevant research to inform future decision-making. Research in the following areas is recommended:

- Baseline assessment surveys to estimate biomass of potentially harvestable species
- Ecosystem studies to evaluate potential effects of fisheries on other species of marine mammals and seabirds which feed on the seafloor
- Species specific productivity parameters, rates of growth, recruitment and natural mortality, to estimate potential sustainable fishery yields
- Social and economic studies to evaluate benefits and costs to communities along the Arctic coast
- Dedicated funding to support fisheries research

[10] K. Arkema, S. Abramson and B. Dewsbury, 2006. "Marine ecosystem-based management: from characterization to implementation," Frontiers in Ecology and the Environment. 4: 525-532.

The NWTF Recommends that the State of Alaska and the United States Need to Expand the North Pacific Management Council for Local Input:

The North Pacific Management Council should be expanded to include a seat each for the North Slope Borough, Northwest Arctic Borough, Bering Straits, and the local tribes to ensure local input on decisions being made about the Arctic. The Governor currently appoints members to the Council which, in some people's views, hasn't led to the best representation of all Alaskan's views. However, there has been a recent push from Oregon and Washington to expand their presence on the council. With this in mind it may be better to work with the Governor to see if two or more of the seats can be site specific to the Arctic. Adding these specific seats would ensure local input about the Arctic and would guarantee a venue for local people to voice their concerns and be heard.

Expand the CDQ Program:

Alaska should explore the possibility of an additional CDQ harvest area in the Chukchi and Beaufort Seas as a way to harvest and protect the fisheries in the area. An expansion of the CDQ program requires a change in federal law. If fisheries are open in the Beaufort and Chukchi Seas as part of allocating the new quota there should be two new CDQ organizations formed to represent the communities in those areas. The State of Alaska and the Alaska State Legislature should work with Alaska's Congressional delegation in moving this priority forward.

The NWTF Recommends that the State of Alaska and the United States Need to Encourage the Adoption of an International Agreement for Fisheries:

The United States has meet with other countries regarding the management of Arctic fish stocks. The federal government should continue international discussions and take the necessary steps to negotiate an agreement with other Arctic nations to cooperatively research fish stocks, and sustainably manage migratory, transboundary, and straddling fish stocks. Northern fisheries are covered by international agreements in waters within the 200-mile limits of coastal nations. However, high Arctic waters beyond those limits, such as those of the Canada Basin west of the Arctic islands, are unregulated. The time to enter into an international cooperative agreement with other Arctic nations is before commercial fishing begins so it is appropriate to move forward with this initiative in the near future.

As part of any international agreement, the Arctic nations should consider establishing an international fisheries management organization for the Arctic. The state of Alaska, the North Slope Borough, Northwest Arctic Borough, Bering Straits, and/or the local tribes should be participants on any organization that is formed.

ARCTIC RESEARCH:

Rather than view research as the animal that is going to kill development it is time for Alaska to shift the paradigm and recognize that research will actually expedite and assist Alaska in developing its vast resources and gain an international reputation as a world leader. It is also an opportunity for Alaska to diversify its economy and grow a world class research university. Just recently BOEMRE awarded a $5.6 million dollar contract for Arctic research to a Texas University one of many research opportunities lost by Alaska.

Conduct a Survey of Alaska Native marine/subsistence use:

The Alaska Marine Shipping Assessment found that information on marine use by Arctic indigenous peoples is missing. Establish the *Alaska Indigenous Marine Use Survey Project*, directing state, and requesting federal resources to capture the varied and unique ways indigenous peoples use and rely upon marine-based resources. Some efforts have been made or are in progress, but more needs to be done to bring subsistence use information up to date. Much of the existing information lacks detail such as specifying the season, length, or range of the subsistence use making it difficult to identify potential conflicts with industry activities. Subsistence patterns, use patterns, and economic and social implications of potential conflict with other marine use stakeholders are examples of some of the issues to be surveyed and explored. Accurate and complete data will best help inform Arctic users on how to minimize impacts on subsistence and other community activities. Since the Beaufort and Chukchi Seas are the first areas that will see oil drilling in order to get baseline data, the NWTF recommends that the Alaska State Legislature fund grants to the North Slope Borough, the Northwest Arctic Boroughs, the Bering Straits, to conduct the research over the next two years.

Conduct a Survey of Impacts on Arctic communities and their inhabitants:

The NWTF recommends that the State of Alaska fund research on the social, economic, cultural and subsistence impacts that the changes in the Arctic are having on Arctic inhabitants. The research could be conducted by the University of Alaska, the Department of Health and Social Services, Alaska Native Tribal Health Consortium, or the Arctic Council within the next two years.

Support Alaska Based Arctic Research and Use of Traditional Knowledge:

Across a variety of areas additional research regarding the Arctic needs to be undertaken. The NWTF supports this research being conducted in Alaska in conjunction with the University of Alaska and should include the use of traditional knowledge. Arctic research provides a unique opportunity for the University of Alaska to expand and become a world leader in Arctic

research. It also provides an opportunity for the State of Alaska to benefit from the economic impact of the research and a potentially growing University system.

Every Arctic country that has formulated an Arctic strategy recognizes the importance of the Arctic indigenous peoples and their knowledge of the region they have inhabited for thousands of years. Likewise, in Alaska the use of traditional knowledge should be part of the scientific process to better understand the Arctic environment.

Improved sea ice nowcasts and forecasts and trajectories:

This requires coupling weather forecasts (atmospheric models) with currents and waves (ocean circulation models) with sea ice (sea ice models), and it currently is not being done. Improving these would give better warnings of onshore ice shoves (similar to what happened in Kotzebue last spring), and better real time forecasts not only of what sea ice conditions are today, but also what they will be tomorrow to better inform decision making by boat captains and subsistence hunters operating in mixed ice/open water conditions. This was the #1 recommendation coming out of a sea ice workshop last week attended by experts from the National Weather Service, National Ice Center, and National Snow and Ice Data Center. The big challenge with sea ice forecasting continues to be the need sea ice thickness, which isn't captured by satellites as well as extent is.

***Establishing routine surveys of key chemical, physical and biological parameters of the Bering and Chukchi Seas so that you can see change over time, especially in the next decade if oil and gas exploration continues and as the Arctic warms*:**

This will be one of the top priorities in the federal Strategic Action Plan for the Arctic – it's referred to as a Distributed Biological Observatory, and it consists of transects that run from shore across the continental shelf at various key areas of the Bering Sea, Bering Strait and Chukchi Sea to Pt Barrow. The surveys could be taken by scientific expeditions from the many nations that are sending ice breakers to the Arctic (a group of them have already agreed to do this) and by industry and government partners. We know conditions are changing, and we need to start the monitoring to measure that change. The Arctic is one of the regions that is potentially most susceptible to ocean acidification.

***Research and monitoring of marine mammal response to noise*:**

The Arctic is becoming a noisier place, and as shipping traffic increases and with the potential of oil and gas drilling, it will become even noisier. Many entities are studying this, but an overall coordinated plan needs to be developed and put in place.

Ocean circulation nowcast/forecast:

We need an operational model that assimilates real-time data to be used for search and rescue, to include in #1 above, and in the event of an oil spill. The pieces are there, but it is not in "operational" mode yet, still on a research basis.

***Biological hotspots in the Arctic*:**

Where are they? How important are they to the ecosystem? We know where a few area, but don't know enough about them to determine the role they play in ecosystem function.

***Integrated data management*:**

You can have all the data you need, but if it is not accessible or usable, then it has very little value. Integrating the data collected by state and federal agencies, academics, and industry is essential. Several entities are taking steps to make this happen. The Alaska Ocean Observing System is one; the North Slope Science Initiative is attempting this for the North Slope; and there are several efforts at the international level. These need to be encouraged, because they are the basis for multiple stakeholder data applications such as emergency response tools, nowcasts/forecasts of ocean and sea ice conditions, etc.

***A grand plan*:** There have been a lot of research plans done for the Bering Sea and the Arctic for various programs, but most end up being a laundry list of potential projects. We still don't have an overarching research plan for the Arctic that captures the current state of knowledge and is designed to meet multiple stakeholder needs, not just those of the research community.

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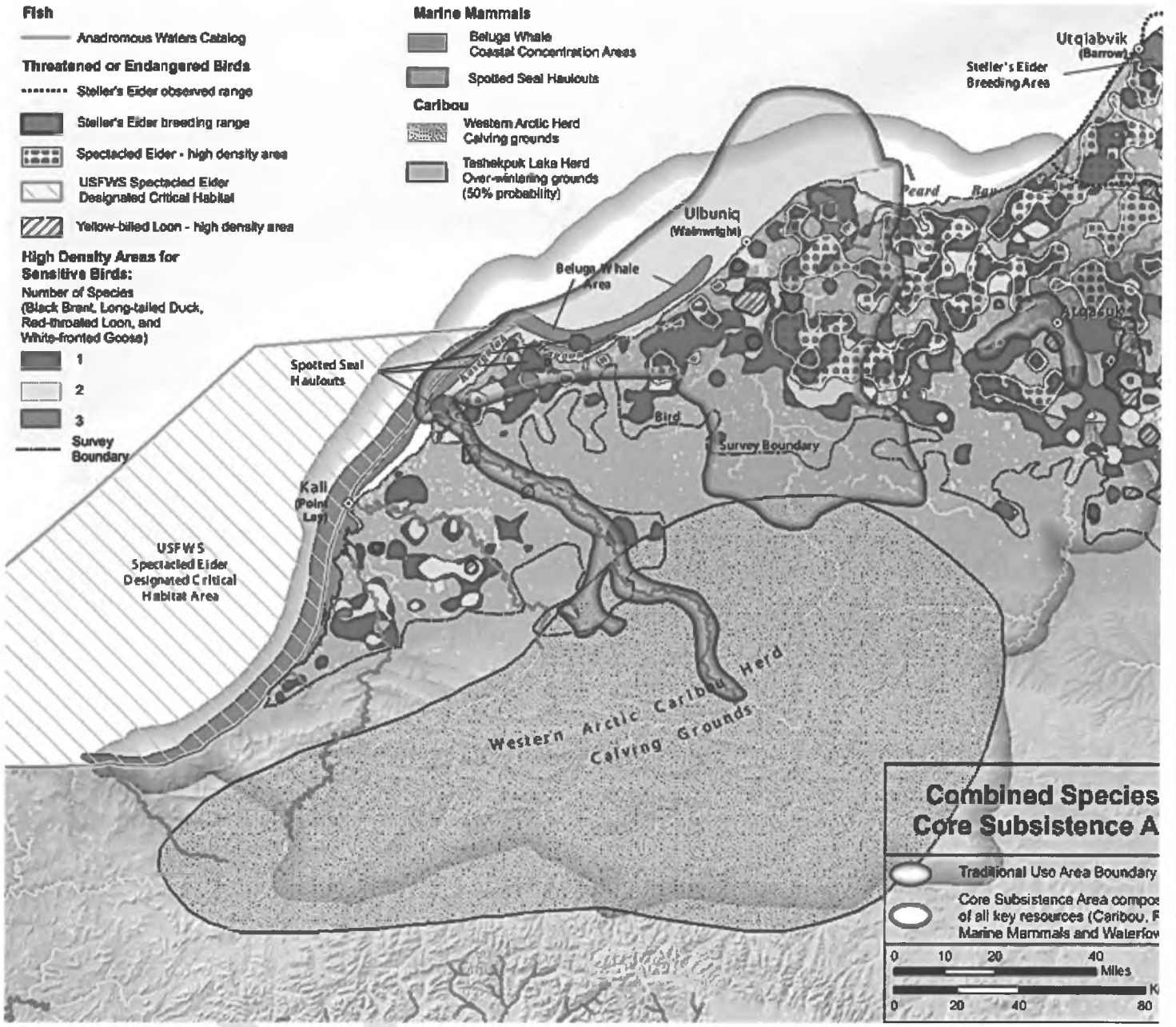

Combined sensitive species habitat areas and core subsistence areas for onshore Arctic Alaska. Modified from The Nature Conservancy and Wainwright Traditional Council (2008) by the U.S. Geological Survey.

CONCLUSIONS

A directed course of action that includes the recommendations of this report is needed for Alaska to be the valuable partner with the federal government on Arctic issues. The United States and Alaska (together and independently) should seek increased cooperation with other Arctic governments. Arctic residents should have full participation in deciding Arctic issues.

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ATTACHMENT A
ROSTER OF NORTHERN WATERS TASK FORCE MEMBERS:

LEGISLATIVE MEMBERS:

Representative Reggie Joule, District 40, Kotzebue, Chair

Email: representative_reggie_joule@legis.state.ak.us
Phone: 465-4833
Address: State Capitol Bldg. Room 410
Juneau, AK. 99801

Staff to task force: Christine Hess 465-4942 Christine_hess@legis.state.ak.us

Senator Bert Stedman, District A, Vice-Chair

Email: senator_bert_stedman@legis.state.ak.us
Phone:
465-3873
Address: State Capitol Bldg. Room 516
Juneau, AK. 99801

Representative Bob Herron, District 38 , Bethel

Email: representative_bob_herron@legis.state.ak.us
Phone: 545-0848
Address: Bethel LIO Box 886
Bethel, AK. 99559-0886

Representative Bryce Edgmon, District 39, Dillingham (alt.)

Email: representative_bryce_edgmon@legis.state.ak.us
Phone: 842-1729
Address: P.O. Box 84
Dillingham, AK. 99576

Senator Lyman Hoffman, District S, Bethel

Email: senator_lyman_hoffman@legis.state.ak.us
Phone: 465-4453
Address: State Capitol Bldg. Room 518
Juneau, AK. 99801

DRAFT

Senator Donald Olson, District T (alt.)

Email: senator_donny_olson@legis.state.ak.us
Phone: 465-3707
Address: State Capitol Bldg. Room 508
Juneau, AK. 99801

PUBLIC MEMBERS:

***Chris Hladick, City Manager, Unalaska*:**

Email: chladick@ci.unlaska.ak.us
Phone: 581-7733
Address: PO Box 584
Unalaska, AK. 99685

Larry Hartig, Commissioner, Department of Environmental Conservation:

Email: Larry.hartig@alaska.gov
Phone: 465-5065
Address: P.O. Box 111800
Juneau, AK. 99811-1800

Mayor Edward Itta, North Slope Borough

Email: Edward.Itta@north-slope.org or esitta@gci.net
Phone: 852-0455
Address: Mayor's Office
P.O. Box 69
Barrow, AK. 99723

Mayor Denise Michels, Nome

Email: mayor@ci.nome.ak.us
Phone: 443-4251
Address: City of Nome
P.O. Box 281
Nome, AK. 99762

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Chuck Greene, Vice President NANA Development Corporation

Email: Chuck.Greene@nana.com
Phone: 442-3301
Address: P.O. Box 49
Kotzebue, AK. 99752

Dave Kubiak, Alaska Marine Conservation Council

Email: mythos1@starband.net
Phone: 277-5357 (Anch) /486-2553 (Kodiak)
Address: Box 193
Kodiak, AK, 99615

Cora Campbell, Governor's Office, Special Assistant (State alt.)

Email: cora.campbell@alaska.gov
Phone: 465-3938
Address: 1840 Wickersham Ave.,
Juneau, AK. 99801

Richard Glenn, Arctic Slope Regional Corporation, Executive Vice-President Lands and Natural Resources

Email: rglann@asrc.com
Phone: 852-9428
Address: ASRC
Box 129
Barrow, AK. 99723

FEDERAL LIASION:

Rear Admiral Colvin, Commander, 17th Coast Guard District, Federal Liaison until May 19, 2011 replaced by Rear Admiral Ostebo

Phone: 463-2029
Email: christopher.c.colvin@uscg.mil
Address: United States Coast Guard
17th CG District
Commander (D)
P.O. Box 5517
Juneau, AK. 99502-5517

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Rear Admiral Ostebo replaced Rear Admiral Colvin on May 19, 2011

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ATTACHMENT B HOUSE CONCURRENT RESOLUTION 22:

HCR022c -1- CSHCR 22(FIN)
New Text Underlined [DELETED TEXT BRACKETED]
26-LS1622\W

CS FOR HOUSE CONCURRENT RESOLUTION NO. 22(FIN)
IN THE LEGISLATURE OF THE STATE OF ALASKA
TWENTY-SIXTH LEGISLATURE - SECOND SESSION
BY THE HOUSE FINANCE COMMITTEE
Offered: 4/9/10
Referred: Rules
Sponsor(s): HOUSE COMMUNITY AND REGIONAL AFFAIRS COMMITTEE

A RESOLUTION

Establishing and relating to the Alaska Northern Waters Task Force.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS Alaska is the only Arctic state in the nation; and

WHEREAS recent warming trends have resulted in the depletion of Arctic perennial sea ice by nine percent a decade; and

WHEREAS, according to the National Aeronautics and Space Administration, the rate of depletion is accelerating because of the interaction among the ice, oceans, and atmosphere; and

WHEREAS rapidly retreating sea ice is altering fish and wildlife habitats and affecting the accessibility and viability of certain species, on which many local communities rely for nutritional and cultural purposes; and

WHEREAS reduced sea ice is affecting polar route navigation by opening oceans previously frozen year-round; and

WHEREAS the new accessibility of the Northern waters is resulting in increased marine transportation, access to resources, tourism, fisheries, and the presence of United States government agencies in the North; and

26-LS1622\W

WHEREAS the waters of Northern Alaska are of national security and strategic importance to the United States and the State of Alaska; and

WHEREAS, because of national security concerns, the United States Coast Guard is increasing its presence in the North and has plans to build new infrastructure to support its heightened activity, including housing and office facilities and possibly a deep water port; and

WHEREAS Northern Alaska contains important mineral and other resources both in state waters and on the outer continental shelf; and

WHEREAS commercial activities, including resource development, and the revenue they generate for the state may be significantly affected by the changing Arctic waters; and

WHEREAS those changes will affect local communities, businesses, the state, and the natural resources on which they rely; and

WHEREAS there is no comprehensive state plan for Alaska's Northern waters; and

WHEREAS various federal agencies and international bodies are working together to form a commission to address the changing ocean patterns and the opportunities and problems that may arise as a result of those changing patterns; and

WHEREAS the State of Alaska should be involved in the process of forming the commission; and

WHEREAS a comprehensive plan to address the warming ocean, including the economic, ecological, and security effects, will benefit the state and its residents;

BE IT RESOLVED by the Alaska State Legislature that the Alaska Northern Waters Task Force is created in the legislative branch and shall consist of 11 members as follows:

(1) two senators appointed by the President of the Senate;

(2) two representatives appointed by the Speaker of the House of Representatives; and

(3) seven members appointed jointly by the President of the Senate and the Speaker of the House of Representatives, as follows:

(A) five public members, three of whom reside in coastal areas of the state;

(B) one member representing the executive branch of state government;

(C) one member representing the federal government; and be it

FURTHER RESOLVED that a vacancy on the task force shall be filled in the manner of the original appointment; and be it

FURTHER RESOLVED that the legislators on the task force shall select a chair from among themselves and the chair may assign staff to provide support to the task force; and be it

FURTHER RESOLVED that the public members, and, if the member does not receive reimbursement for expenses from the federal government, the federal government member of the task force may receive per diem and travel expenses authorized for boards and commissions under AS 39.20.180; and be it

FURTHER RESOLVED that the task force may meet during and between legislative sessions and the duties of the task force include the following:

(1) assess and facilitate creation of a state and federal commission responsible for overseeing the development of state and federal northern ocean waters;

(2) facilitate regional coordination, cooperation, and outreach regarding the creation of the commission to keep local stakeholders informed and to incorporate their input into the process;

(3) identify and coordinate efforts of mutual concern for federal, state, and local agencies, as well as international interests in the creation of the commission; and

(4) conduct hearings in the Northern region of the state to fulfill its purpose; and be it

FURTHER RESOLVED that the task force shall provide recommendations regarding the formation of the commission and shall deliver a preliminary report of its findings to the legislature by January 20, 2012, and deliver a final report to the legislature on January 30, 2012, together with legislative proposals for consideration; and be it

FURTHER RESOLVED that the task force shall be available for legislative hearings regarding its final report and recommendations; and be it

FURTHER RESOLVED that the continuation or termination of the task force shall be reevaluated during the Second Regular Session of the Twenty-Seventh Alaska State Legislature.

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ATTACHMENT C HEARING SCHEDULES:

NORTHERN WATERS TASK FORCE AGENDA

October 1, 2010 8 am to 5 pm
Anchorage Legislative Office
Anchorage, Alaska

1. Welcome and organization 8-8:45 a.m.

   Introduce members
   Overview of task force and task force mission
   Travel and accounting procedures
   Discussion of possible schedules for future hearings and sites:

   - Alaska Federation of Natives (Oct. 20-23rd)
   - Nov. 14-17th Kotzebue and Nome
   - Dec. 1-2 Barrow with PNWER
   - End of January Bethel
   - Possible Unalaska date?
   - Topics for hearing

   15 min. break

2. Introduction and overview 9-9:15 a.m.

   Presenter: Molly McCammon, Director
   Alaska Ocean Observing Systems

3. Science of the warming waters and federal policy update 9:15-10 a.m.

   Presenter: Dr. Kate Moran, Senior Policy Analyst
   Whitehouse Office of Science and Technology Policy
   By video conference

   15 min. break

4. Overview from the National Oceanic and Atmospheric Administration 10:15 to 11 a.m.

   Presenters: Laura K. Furgione, National Oceanic and Atmospheric Administration (NOAA) Deputy Assistant Administrator for Weather Services and Deputy Director of the National Weather Service (NWS).

   Dr. Douglas DeMaster, NOAA's Science and Research Director, Alaska Fisheries Science Center

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Amy Holman, NOAA's Alaska Regional Coordinator

5. Overview of the State of Alaska's and the state/federal executive roundtable activities regarding the Arctic 11-11:45 a.m.

   Presenter: Mr. Larry Hartig, Commissioner, Department of Environmental Conservation

   15 min break to get lunch which will be served there
   International Lunchtime Panel 12 to 1 p.m.:
   Presenters:
   Cheryl Rosa, Deputy Director, United States Arctic Research Commission
   Jennifer Loten, Canadian Consul, Canadian Consulate
   Mayor Edward Itta, Former President, Inuit Circumpolar Consul

6. Overview from the United States Coast Guard on marine shipping and Coast Guard activities in the Arctic 1:15 to 2 p.m.

   Presenters: Rear Admiral Christopher Colvin, USCG and Capt. Carl Uchytil

7. Overview from the United States Arctic Research Commission 2-2:45 pm

   Presenter: Cheryl Rosa, Deputy Director of USARC and Anchorage Director

   15 min. break

8. Oil and gas presentation regarding exploration in the Arctic 3-3:45 p.m.

   Presenters:

   Marilyn Crockett
   Executive Director
   Alaska Oil & Gas Association

   Cam Toohey, Government Affairs Manager
   Shell Exploration & Production Company, Alaska

   Jason Brune
   Executive Director
   Resource Development Council

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Northern Waters Task Force Agenda
March 14th
Noon to 2 p.m.
State Capitol Building Room 106
Teleconference 1-855-463-5009

1. Topics for Consideration at Hearings

Arctic Governance

- What is the federal government doing?
  - -Office of Science and Technology Policy
  - -National Ocean Council/Regional Planning Bodies
  - -Coastal and Marine Spatial Planning
  - -NOAA
  - -USARC
- Laws of the Sea
- Boundaries and extended continental shelf issues
- What is the State of Alaska doing?
- What are local communities doing?
  - -Important Ecological Areas
- What is happening internationally? International agreements for research, shipping, search and rescue, oil and gas activities and spill response
- Arctic Council and ICC Updates
- What does multi-jurisdictional cooperation in the Arctic look like? How does the state participate? How do local people participate?

(Possible speakers: Bering Sea Partnership, Barry Briscoe, Environmental Law Institute, NOAA, Alaska Ocean Observing Systems, Arctic Council, ICC, US Coast Guard, Institute of the North, US State Department, Office of Science and Technology, Council on Environmental Quality, Ocean and Coastal Policy, Mark Robbins, Oceana, Aspen Institute, Charles Ehler)

---Participation in the Arctic Imperative event at Alyeska in June may cover some of the above topics

Oil and Gas Development and Research

- Proposed 5 year development schedule
- Current oil spill response capabilities and technology and research needed in this area
- What are Coast Guard, industries, states, and local capabilities to respond to an oil spill?
- Research needed to provide understanding of Arctic environment, ecosystems and environmental conditions, baseline data, and oil spill impacts on environment
- Possible oversight needed at the local, state, federal and international level

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(Possible speakers: Shell, Conoco, Fran Ulmer, Pew Research, Oil Spill Recovery institute, US Arctic Program, Oceans' North, Alaska Clean Seas, Aleutian Island Risk Assessment, Prince William Sound Advisory Council, Alaska Eskimo Whaling Commission, North Slope Borough, Northwest Arctic Borough, Barrents Sea Plan, Norway)

Arctic Infrastructure Investment and Long Term Planning

- What investments need to be made
- Who should make the investments
- What research/planning needs to still take place

(Possible speakers: US Coast Guard, Navy, Department of Transportation)

Arctic Fisheries

- NPFMC Fishing moratorium
- International agreement to manage migratory, transboundary, and straddling fish stocks in the Arctic Ocean and possible future international fisheries management organization
- Need for eco-system research and baseline data collection to inform future decision making

(Possible speakers: National Marine Fisheries Service on recent fish stock study, North Pacific Fisheries Management Council)

Marine Transportation

- Commercial shipping
- Vessel monitoring and tracking
- International search and rescue capabilities and agreements with other countries for search and rescue
- What are the Coast Guards, State of Alaska, and local capabilities for search and rescue?
- Regulation of shipping, international shipping rules and agreements
- Navigation aids, maritime communication, ports, and other infrastructure needed
- National Security
- Invasive Species

(Possible speakers: US Coast Guard, Pacific environment, Marine Exchange of Alaska, Crowley, Aleutians Island Risk Assessment, Protection of Arctic Marine Environment (PAME), Alaska Marine Shipping Assessment, Saint Lawrence Seaway, Department of Transportation)

Research

- What science is needed? How does research inform management decisions?
- Gap analysis of what science is missing and coordination of research
- Climate Change impacts on communities

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- Endangered Species Act

(Possible speakers: USGS, USARC, NOAA, Walrus commission, Alaska Eskimo Whaling Commission, North Slope Borough Wildlife Department, Beluga commission. Alaska Native Tribal Health Consortium, Aspen Institute, ESA speaker, Office of Polar Programs, National Science Foundation)

2. Subcommittees

Discuss possibility of subcommittees to work on coordinating the meetings

3. Hearing Schedule

- Bethel
- International Forum Girdwood NWTF invited June 20-21st
- Kotzebue and Nome: July 5-7th in conjunction with Trade Fair
- Unalaska: August 24-26th with the legislative fly-in
- Final Recommendations Meeting: September/October in Anchorage

4. Preliminary Recommendations

Discuss preliminary recommendations

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Arctic Imperative Summit Agenda
Girdwood, Alaska June 19th -21st

SUNDAY June 19th, 2011

4:00 p.m. -8:00 p.m. Welcome Reception & Dinner
5:00 p.m. -6:15 p.m. Reception Columbia Patio and Ballroom
6:30 Dinner
Columbia Ballroom
6:45 p.m. -6:50 p.m. Alice Rogoff, Publisher, Alaska Dispatch
6:50 p.m. -7:05 p.m. The Honorable Lisa Murkowski, U.S. Senator,
7:05 p.m. -7:20 p.m. The Honorable Mead Treadwell, Lieutenant Governor, State of Alaska
7:20 p.m. -7:35 p.m. Rex Rock, President and CEO, Arctic Slope Regional Corporation
Mayor's Panel:
7:35 p.m. -7:40 p.m. The Honorable Robert Harcharek, Mayor, City of Barrow
7:40 p.m. -7:45 p.m. The Honorable Eugene Smith, Mayor, City of Kotzebue
7:45 p.m. -7:50 p.m. The Honorable Denise Michels, Mayor, City of Nome
8:00 p.m. -9:00 p.m. Dessert & Evening Entertainment
Glacier Express

MONDAY June 20th, 2011

KAHILITNA COURT
The Arctic Matters
8:00 a.m. -8:05 a.m. Alice Rogoff, Publisher, Alaska Dispatch
8:05 a.m. -8:20 a.m. **Video Messages**
8:20 a.m. -8:35 a.m. The Honorable Sean Parnell, Governor, State of Alaska *invited
8:35 a.m. -8:50 a.m. The Honorable Olafur Ragnar Grimsson, President of Iceland
THEME: Arctic International Affairs
8:55: a.m. -9:00 a.m. Moderator: Lt. Governor Mead Treadwell, State of Alaska
9:00 a.m. -9:15 a.m. Richard Haass, President, Council on Foreign Relations
9:15 a.m. -9:30 a.m. David Balton, Deputy Assistant Secretary for Oceans and Fisheries, United States Department of State
9:30 a.m. -9:45 a.m. Denis Stevens, Consulate General of Canada, Seattle
9:45 a.m. -10:00 a.m. Peter Taksoe-Jensen, Danish Ambassador to the United States
10:00 a.m. -10:15 a.m. Pontus Melander, Minister-Counselor, Embassy of Sweden
10:15 a.m. -10:30 a.m. John B. Bellinger, III, Partner, Arnold & Porter LLP
10:30 a.m.-10:50 a.m. BREAK
THEME: Investment
10:50 a.m. -10:55 a.m. Moderator: Dan Sullivan, Commissioner, Department of Natural Resources
10:55 a.m. -11:10 a.m. David Rubenstein, Managing Director, Carlyle Group
11:10 a.m. -11:20 a.m. ***
11:20 a.m. -11:30 a.m. Ethan Berkowitz, Arctic Cable Company*pending
11:30 a.m. -11:50 a.m. DIALOGUE

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THEME: National Security
LUNCH: Columbia Ball Room
12:10 p.m.-12:30 p.m. General Joseph Ralston (Ret.), Former Supreme Allied Commander of NATO
12:30 p.m. -12:45 p.m. Brigadier General Robert Chekan,
Deputy Director of the Strategy, Policy, and Plans Directorate,
United States Northern Command
12:45 p.m. -1:00 p.m. Rear Admiral Christopher C. Colvin, Deputy Commander, Pacific Area
United States Coast Guard
1:00 p.m.-1:20 p.m. DIALOGUE
1:20 p.m. -1:50 p.m. BREAK
THEME: Resources
KAHIHTNA COURT
1:50 p.m. -1:55 p.m. MODERATOR: Drue Pearce, Senior Policy Advisor, Crowell Morning
1:55 p.m.-2:10 p.m. Robert Blaauw, Senior Advisor, Shell Global Arctic Theme
2:10 p.m.-2:25 p.m. Jimmy Stotts, Chair, ICC Alaska
2:25 p.m. -2:40 p.m. Marie Greene, President and CEO, NANA Regional Corporation
2:40 p.m. -2:55 p.m. Dan Sullivan, Commissioner, Department of Natural Resources, State of Alaska
2:55 p.m. -3:05 p.m. BREAK
3:05 p.m. -3:20 p.m. Admiral Thomas Barrett, USCG (Ret.), President, Alyeska Pipeline Services Co.
3:20 p.m. -3:35 p.m. Geoffrey Haddad, Vice President, Exploration and Land, Conoco Phillips
3:35 p.m. -4:50 p.m. Pete Slaiby, Vice President, Shell Alaska
4:50 p.m. -5:30 p.m. DIALOGUE
5:30 p.m. -6:30 p.m. BREAK
6:30 p.m. BANQUET- Columbia Ball Room
6:45 p.m. -7:15 p.m. Artur Chilingarov, Deputy Chairman, State Duma of the Russian Federation
President of Non-commercial Partnership of the Coordination of
Northern Sea Route Usages
7:15 p.m.-7:30 p.m. George Noongwook, Vice Chair, Alaska Eskimo Whaling Commission
7:30 p.m.-7:45 p.m. ***

TUESDAY June 21st, 2011

KAHILTNA COURT
8:00 a.m. -8:05 a.m. Susan Bell, Commissioner, Department of Community, Commerce, and Economic Development
8:05 a.m. -8:10 a.m. Harvey Brooks, Deputy Minister, Yukon Economic Development
THEME: Shipping, Port Development, Ice Breakers
8:10 a.m. -8:15 a.m. Moderator: Scott Borgerson, Managing Director, CargoMetrics Inc.
8:15 a.m. -8:30 a.m. Lawson W. Brigham, Distinguished Professor of Geography & Arctic Policy
University of Alaska Fairbanks;
Chair, Arctic Marine Shipping Assessment of the Arctic Council (2005-09)
8:30 a.m. -8:40 a.m. Stephen Carmel, Senior Vice President, Marine Services, Maersk Line, Ltd.
8:40 a.m. -8:50 a.m. Ross MacDonald, Transport Canada
8:50 a.m. -9:00 a.m. Simon P. Lisiecki, Former Vice President, Government & Industry, BP Shipping

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9:00 a.m. -9:10 a.m. Michael Terminal, Edison Chouest Offshore
9:10 a.m. -9:30 a.m. BREAK
9:30 a.m. -9:40 a.m. Thomas Mack, President, Aleut Corporation
9:40 a.m. -9:50 a.m. Matt Ganley, Vice President, Lands, Bering Straits Native Corporation
9:50 a.m. -10:00 a.m. Robert Keith, Chairman of the Board, Kawerak Inc.
10:00 a.m. -10:10 a.m. The Honorable Dora Akingka, Mayor, City of Diomede
10:10 a.m. -10:20 a.m. The Honorable Ellen Richards, President of the Native Village of Wales
10:20 a.m. - 11:00 a.m. DIALOGUE
LUNCH: Tent
12:10 p.m. -12:30 p.m. Kenneth Rogoff, Professor of Economics, Harvard University
12:30 p.m. -12:45 p.m. The Honorable Lesil McGuire, Alaska State Senator;
President, Pacific Northwest Economic Region
THEME: Arctic Science and Traditional Knowledge
KAHILTNA COURT
1:00 p.m-1:15 p.m. MODERATOR: Fran Ulmer, Chair, United States Arctic Research Commission
1:15 p.m.- 1:30 p.m. Danielle Labonte, Director General, Indian and Northern Affairs Canada
1:30 p.m. -1:45 p.m. Crocker Snow, Director, Murrow Center for Public Diplomacy
1:45 p.m. -2:00 p.m. Vera Metcalf, Director, Eskimo Walrus Commission
2:00 p.m. -2:30 p.m. DIALOGUE
2:30 p.m. -2:45 p.m. BREAK
THEME: Arctic Policy/Governance
2:45 p.m. -2:50 p.m. MODERATOR: David Monsma, Executive Director,
Energy and Environment Program, Aspen Institute
2:50 p.m. -3:05 p.m. The Honorable Bill Sheffield, Former Governor of Alaska
Director, Port of Anchorage
3:05 p.m. -3:20 p.m. The Honorable Reggie Joule, Alaska House of Representatives;
Chair, Alaska State Legislature NWTF
3:20 p.m.-3:35 p.m. The Honorable Frank Murkowski, Former Governor and Senator of Alaska
3:35 p.m. -3:50 p.m. John Miller, Author
3:50 p.m. -4:05 p.m. Harold Heinze, CEO, Alaska Natural Gas Development Authority
4:05 p.m. -4:20 p.m. Carter Roberts, President and CEO, World Wildlife Fund United States
4:20 p.m. -4:35 p.m. The Honorable Edward Itta, Mayor, North Slope Borough
4:35 p.m. -5:05 p.m. DIALOGUE
5:30 p.m. -6:30 p.m. RECEPTION -Tent-Closing Remarks

WEDNESDAY June 23rd, 2011
ARCTIC TOUR (OPTIONAL)
*order subject to change depending on protocol of confirmed speakers
*Details on investor roundtables and entertainment will be published in the Summit program

DRAFT

Alaska Northern Waters Task Force (ANWTF)
Agenda for Kotzebue and Nome Meetings: July 6-9, 2011

KOTZEBUE:

July 6th, Wednesday – Kotzebue Field Tour

- **8:00 am Bering Air Terminal to depart for tour**
- **Tour of Red Dog Mine and Port Site**
- **Group lunch at Red Dog**
- **Return to Kotzebue between 2 to 3 p.m.**
- **Wind mill and city tour (3 to 4 do radio show)**
- **6:00 p.m. Group dinner at NANA Board Room, presentations by:**
  - **NANA Regional Corporation on possible resource development opportunities and**
  - **City of Kotzebue/Cape Blossom group on deep water port sites**

July 7th[th], Thursday, Northwest Arctic Borough Assembly Chambers

Presenters on the following resource development topics:

- **8:30 to 9 a.m. UAF Workshop Findings: Arctic Marine Shipping Assessment Presentation: Mike Sfraga, University of Alaska Fairbanks, Vice-Chancellor**
- **9 to 9:30 a.m. Presentation by Shell on Arctic off shore development plans: Colleen McCarthy, Communications Manager, Shell Oil and Wayne Leighty, Commercial Regulatory Analyst, Shell Oil**

  9:30 to 10 a.m. Presentation by Tom Okleasik, Planning Director, Northwest Arctic Borough, Subsistence mapping

  -15 minute break-
- **10:15 to 11:15 a.m. Presentation on oil spill response capabilities and cooperative agreements with other Arctic nations:**
  - **Department of Environmental Conservation, Larry Dietrick, Director of Division of Spill Prevention and Response**
  - **U.S. Coast Guard, Captain Adam Shaw**

Lunch break from 11:30 to 1 p.m.

- **1:15 to 2 p.m. PEW Environment Group/Marilyn Heiman, Director Pew Environment Group, U.S. Arctic Program**
- **2 to 3 p.m. Lessons Learned Deep Water Horizon: Fran Ulmer, Chair, U.S. Arctic Research Commission**

DRAFT

- **3:30-5:30 Presentation by Rep. Joule on Northern Waters Task Force followed by public testimony on Northern Waters Issues**

NOME:

July 8th, Friday, Old St. Joes

Presenters on the following Arctic infrastructure and research topics:

- **9 to 9:30 a.m. Nome update, impacts of recent changes on local community: Mayor Denise Michels**
- **9:30 to 10:30 a.m. Discussion of possible future deep water port sites in the Northern region, state and federal perspectives:**
  - **Department of Transportation, Michael Lukshin, Engineer**
  - **US Army Corps of Engineers, Stephen Boardman, District Chief, Civil Project Management Branch**

--15 min. break--

- **10:45 to 11:15 a.m. Bering Straits Port Access and Route Study presentation: Captain Adam Shaw, U.S. Coast Guard**
- **11:15 to 11:45 a.m. Land Conservation Cooperation Project: Polly Wheeler, Coordinator, Northwestern Interior Forest Landscape Conservation Cooperative, U.S. fish and Wildlife**

Lunch break from 11:45 to 1:00 p.m.

- **1 to 1:30 p.m. Discussion of vessel tracking in the Arctic: Marine Exchange of Alaska, Ed Page, U.S. Coast Guard (Ret), Executive Director, Marine Exchange of Alaska**
- **1:30 to 2 p.m. Navigational and search and rescue aides needed for the Arctic: U.S. Coast Guard, Captain Adam Shaw**
- **2. to 2:45 p.m. Arctic research presentation: Dr. Kathleen Crane, PhD, Arctic Research Program, NOAA Co Chair of the Arctic Council's Circumpolar Biodiversity Marine Monitoring Program, CAFF**
- **2:45 to 3:15 p.m. Inuit Circumpolar Council, Jimmy Stotts, President**

--15 min. break--

- **3:30-5:30 Presentation by Rep. Joule on Northern Waters Task Force followed by public Testimony on Northern Waters Issues**

July 9th, Saturday, Nome field tours

- **9 am Bering Air Terminal to depart for tour**
- **Morning flight to Wales for community visit**
- **Fly over of Little Diomede, Bering Strait choke point, shoal area off the Wales coast, and possible future deep water port site at Port Clarence**

LUNCH ON OWN

- **Tour of Nome port facilities and gold suction dredging**
- **Tour of rock quarry**

Alaska Northern Waters Task Force (ANWTF)
Agenda for Unalaska: August 24, 2011
Grand Aleutians Hotel

August 24th, Wednesday, Grand Aleutians Hotel

Presenters on the following Arctic fishing and shipping topics:

- **8:30 to 9 a.m. Presentation by U.S. Coast Guard on Arctic Summer Operations: Rear Admiral Ostebo, United States Coast Guard 17th District**
- **9 to 9:30 a.m. Presentation by City of Unalaska on Aleutian Islands Risk Assessment, emergency towing systems, and the mooring buoy project: Shirley Marquardt, Mayor of Unalaska**
- **9:30 to 10 a.m. Presentation by Alaska Marine Pilots on pilotage in Arctic waters: Captain Carter Whalen, Alaska Marine Pilots**

-15 minute break-

- **10:15 to 10:45 a.m. Presentation on Arctic salvage operations: Dan Magone, Owner Magone Salvage**
- **10:45 to 11:30 a.m. Presentation by U.S. Coast Guard on United Nations Convention on Law of the Seas: Rear Admiral Kenny, Judge Advocate General and Chief Counsel, U.S. Coast Guard**

Lunch break from 11:30 to 1 p.m.

- **1:00 to 1:30 p.m. Presentation on the Arctic's Future: Senator Lisa Murkowski**
- **1:30 to 2 p.m. Presentation on Bering Sea Fisheries: Frank Kelty, Natural Resource Analyst, City of Unalaska**
- **2 to 3:00 p.m. Presentation on Development and Implementation of an Arctic Fishery Management Plan: Steve MacLean, North Pacific Fisheries Management Council, Protected Species Coordinator and Fisheries Analyst**
- **3 to 3:30 p.m. Presentation on Arctic fisheries research: University of Alaska, Gordon Kruse, President's Professor of Fisheries, School of Fisheries Division**
- **3:30 to 4 p.m. Presentation on invasive species and border control: Jeffrey J. Lisius, Assistant Port Director Trade**
- **4:00-5:30 p.m. Presentation by Rep. Edgmon on Northern Waters Task Force followed by public testimony on Northern Waters Issues**

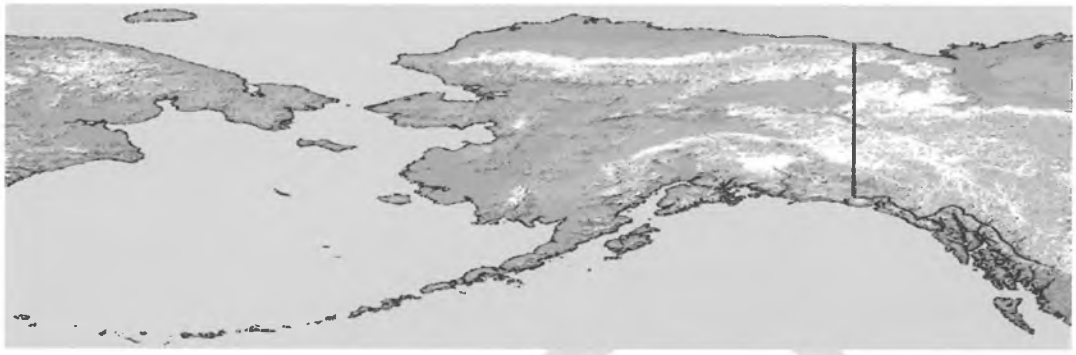
Legislative Fly-In August 25-27th

Alaska Northern Waters Task Force

October 10, 2011 (Monday)
Bethel, AK – YKHC Board Room

- Arctic Research
- Climate Change & Erosion

Monday, October 10	**Alaska Northern Waters Task Force**
10:00 – 10:05am	**Introduction from ANWTF Chair Reggie Joule**
10:05 – 10:45am	**Mike Coffey, DOT, Maintenance and Operations Chief** Climate Change and Alaska's Public Infrastructure
10:45 – 11:00am	**BREAK**
11:00 – 11:45am	**Mike Brubaker, ANTHC, Director, Community Environmental Health** Climate Change: Challenges to existing community infrastructure and design for future sustainability
11:45 – 12:00pm	**BREAK**
12:00 – 1:15pm	**Local Knowledge Elders Panel**
1:15 – 1:45pm	**Pizza Lunch Provided**
1:45 – 2:30pm	**Tim Andrew, AVCP, Natural Resource Manager**
2:30 – 3:15pm	**Steve Street, AVCP, Director of Cultural & Environmental Sciences** Shoreline Erosion: A Crisis for Historic Preservation
3:15 – 3:30pm	**BREAK**
3:30 – 5:00pm	**Public Testimony (Any topic related to the ANWTF)**
5:00pm	**Meeting Adjourned**



Alaska Northern Waters Task Force

October 11, 2011
Anchorage, AK – Anchorage LIO Conference Room
Topic: Current Arctic Research and Research Gaps

Tuesday, October 11	**Alaska Northern Waters Task Force**
8:30am	**Call to Order & Introductions**
8:45 – 9:30am	**Molly McCammom, AOOS** *Summary of Major Arctic Research*
9:30am – 10:30am	**Panel Presentation & Discussion** **Melanie Smith, Audubon Alaska** *Arctic Marine Data Synthesis and Research Gaps* **Leslie Holland-Bartels, USGS** *Research Gaps*
10:30am – 11:15am	**Billy Connor, UA Transportation Center** *Permafrost Issues in Alaska Relating to Transportation and Construction*
11:15am – 11:25am	**Break**
11:30am – 12:00pm	**Kristen Shake, UAF School of Fisheries & Ocean Sciences** *Ocean Acidification*
12:00pm – 12:45pm	**Lunch: Provided (ANC LIO Conference Room)** **Bill Schnabel, UAF Water and Environmental Research Center** *"Coastal Communities and Climate Change" video provided by Marine Advisory Program*
12:45pm -1:00pm	**Cpt. Pater Garay,** *AK Marine Pilots*

1:00pm – 1:30pm	**Nils Andreassen** *Institute of the North*
1:30pm – 4:00pm	**Discussion and Decisions on Final Recommendations**
4:00	**Meeting Adjourned**

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ATTACHMENT D: DEFINITION OF THE ARCTIC:

Arctic Boundary as Defined by the Arctic Research and Policy Act (ARPA)

All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi seas; and the Aleutian chain.

THE FOLLOWING DOCUMENT

HAS NOT BEEN FILMED BUT IS

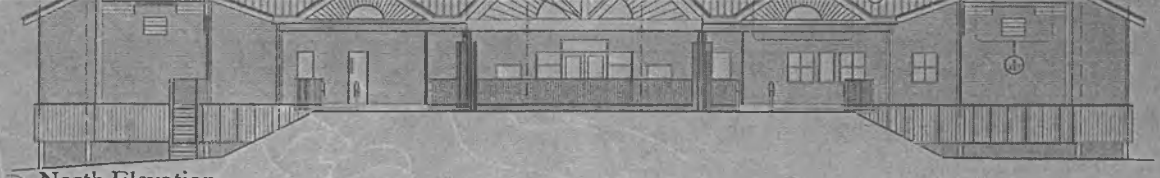
AVAILABLE IN THE ORIGINAL FILE

the Messenger Quarterly
YUKON-KUSKOKWIM HEALTH CORPORATION
YKHC
Volume XVI No. 9 • Sept. 15, 2011

Vision from dream to reality

Construction of regional assisted living home begins

The groundbreaking ceremony for Bethel's Long Term Care Facility was held August 22. From left: YKHC Vice President for Support Services Greg McIntyre, President/CEO Gene Peltola, Rep. Bob Herron, Senator Lyman Hoffman, YKHC Board Chair Ray Alstrom, Board Vice Chair Bill Kristiovich. Story on page 4.



North Elevation

INSIDE: SLT, p. 3 • Circumpolar Meet, p. 6 • McCann @ 10, p. 8, • Sudan Gala, p 12

Anchorage Meeting, Oct. 11, 2011

<TARGET><BILL></BILL><SUBJECT>Anchorage Meeting, October 11, 2011</SUBJECT><COMM>ANW27</COMM></TARGET>

NWTF Meeting

Anchorage

Oct. 11th

1 Northern Water Task Force Anchorage Agenda

2 Overview of Research & Monitoring in the Arctic
AOOS – Molly McCammon

3 Evaluation of Science Needs on OCS Energy Development
USGS - Leslie Holland-Bartels

4 Arctic Marine Data Synthesis & Research Gaps
Audubon AK – Melanie Smith

5 Alaska Marine Pilots Testimony
AK Marine Pilots - Cpt. Garay

6 Arctic Infrastructure & Advocacy
Institute of the North – Nils Andreassen

7 The Relationship Between Permafrost & Infrastructure
UA Transpo Center – Billy Connor

8

AVERY® READY INDEX®

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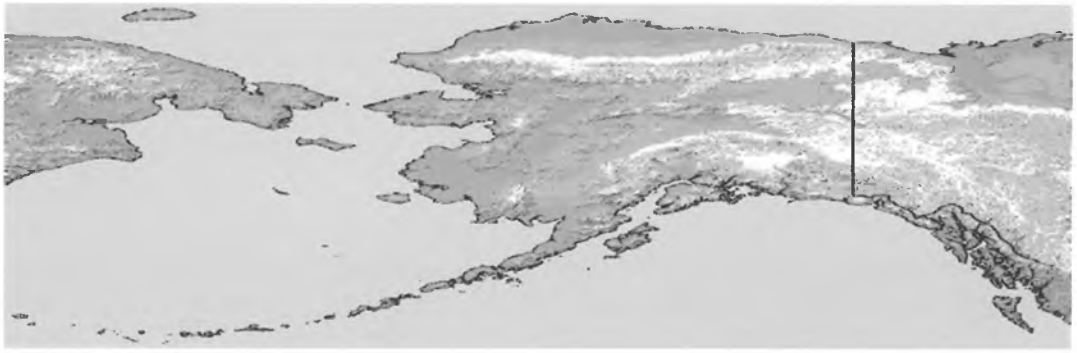
Agenda



Alaska Northern Waters Task Force

October 11, 2011
Anchorage, AK – Anchorage LIO Conference Room
Topic: Current Arctic Research and Research Gaps

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1:30pm – 4:00pm	**Discussion and Decisions on Final Recommendations**
4:00	**Meeting Adjourned**

2

Overview of Research and Monitoring in the Arctic

Overview of research and monitoring in the Arctic

Northern Waters Task Force

October 11, 2011

Molly McCammon, Executive Director

Alaska Ocean Observing System

www.aoos.org

AOOS

Alaska Ocean Observing System

1 year ago: gave talk to NWTF on "Why Care about the Arctic"

- U.S. is an Arctic nation
- Alaska IS the U.S. Arctic
- Arctic Ocean is least studied in world
- Arctic affects global climate
- Home to indigenous populations
- Rich in oil & gas, fisheries
- Biodiverse

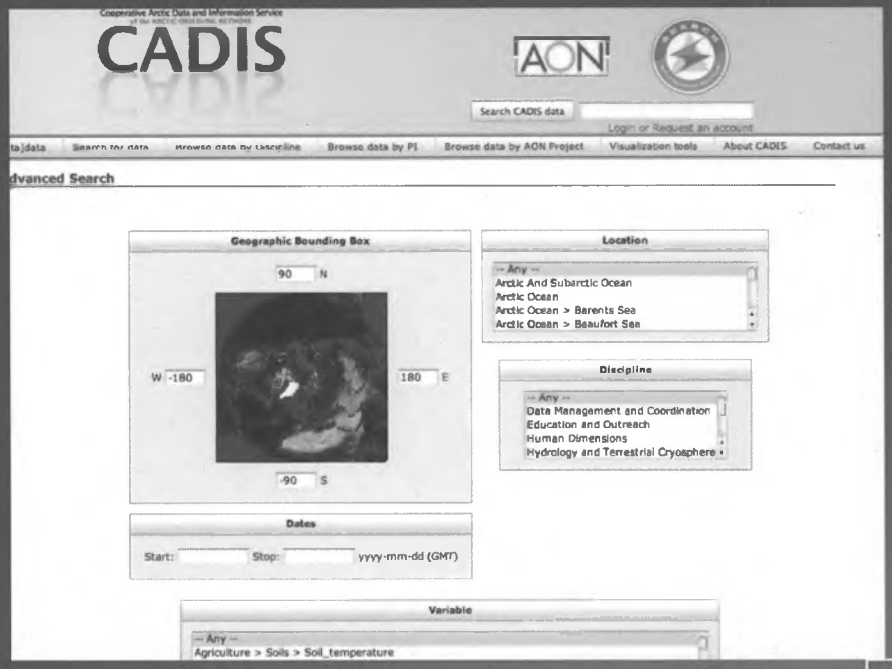
cont.

- Ground zero for climate change
- National security issues
- Opportunities for increased tourism, resource use, shipping
- Concerns for coastal communities, subsistence users, endangered species, ocean acidification

In past year, NWTF has

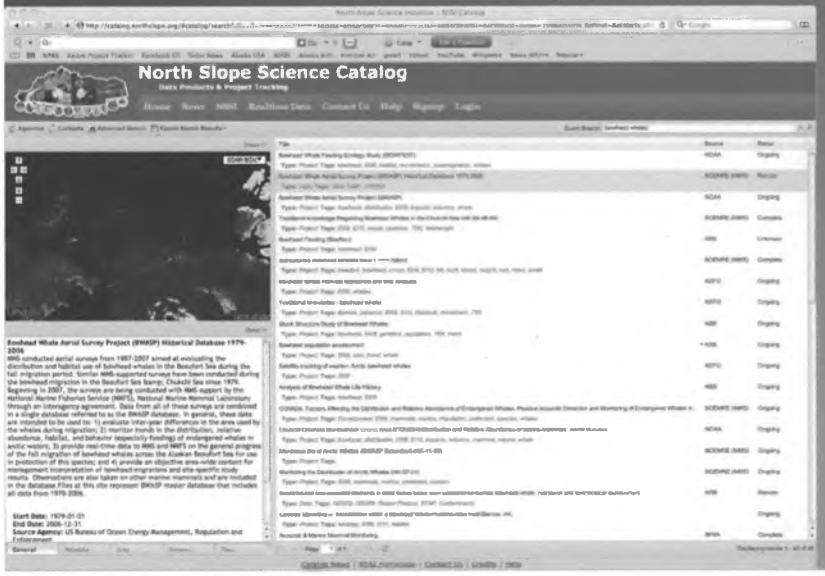
- Held meetings in Nome, Kotzebue, Unalaska, Bethel, Anchorage
- Visited other rural coastal communities
- Heard from dozens of Alaskans, scientists, agency experts

Arctic Research & Monitoring: a mix of players



Where do you go for information?

3 major data portals:
NSSI, AOOS & ACADIS



AOOS Arctic Assets Map

ARCTIC SCIENCE SUMMARY

2. APOA and AOGA Nearly 400 studies in Prudhoe Bay and Beaufort Sea, all related to potential impacts from oil and gas developments. Both biological and physical aspects. Start of assessment of acoustic impact on marine life and effectiveness of mitigation.

15. UW Sound Measurements. Sound and propagation characteristics of various industrial activities have been documented over the years. The measurment protocol and equipment has evolved over the years. No standardized methodology for these type of measurements exists.

23. SBI cruise is an example of change from single cruises to large multi-year, multi-disciplinary environmental programs in the Arctic.

31. Environmental Studies Program from CPAI, Shell and Statoil is unique in the sense that oceanographic and biological data are collected in a structural integrated manner, allowing

1. WEBSEC Characterization of oceanographic and biological data summer/fall season. Chukchi Sea (1970) and Beaufort Sea (1971-1972). Resulted in comprehensive list of species sampled.

3-13, 15-17, 19. OCSEAP Result from various disciplines are reported in a Synthesis Report in 1978: 'Beaufort/Chukchi Interim Synthesis Report'. No integrated analyses across disciplines were conducted. Access to Report through BOEMRE's website.

9. Bird Colony Surveys. Radio transmitters placed on birds from these colonies starting in 1994 (by USGS)document ed areas of the OCS were utilized by these colonies

8. Beaufort Sea ice studies confirmed that critical life processes of most Arctic invertebrates and vertebrates take place during the relatively calm

24. RUSALCA is a multi-year, multi-disciplinary program utilizing scientists from the US and Russia to collect benchmark information about Arctic processes.

Research Programs*

1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

1. Western Beaufort Sea Ecological Cruises (WEBSEC)
Beaufort Sea

2. Oil and Gas Industry Research Programs (coordinated through APOA and AOGA)
Beaufort Sea. Start of assessment of acoustic impact on marine life and effectiveness of mitigation

3. Long term study of Black Guillemot Colony, Cooper Island, Beaufort Sea (OCSEAP, UAF)
OCSEAP — Beaufort Sea. After OCSEAP continuing annual monitoring of Black Guillemot nesting colonies by Dr. Divoky (UAF) in relation to climate change

4. Arctic Fish Habitat Use Beaufort Sea (OCSEAP, ADFG, NOAA, BOEMRE, Industry)
Beaufort Sea. Fish studies conducted by ADFG (1974), BOEMRE (1980) and ARCO, CPAI & BP (1976-present)

5. Bearded Seal History and Ecology (OCSEAP)
Beaufort Sea & N-Pacific

6. Ice Edge Ecosystem Productivity, plankton focus (OCSEAP)

7a. Ice-seal and other Marine Mammal Surveys, Chukchi Sea (OCSEAP, ADFG, USFWS, USGS)
Chukchi and Bering Sea. Ice-seal feeding and ecology studies. Aerial surveys ringed seals, and ongoing studies (e.g. see 7b, 7c)

7b. Ice Seal Satellite tracking studies (ADFG, Kotzebue hunters)
Chukchi Sea. Fieldwork with native hunte

7c. Walrus satellite and radio tracking, population surveys (ADFG, USGS, Russians, Chukchi hunters)
Chukchi Sea

8. Beaufort Sea Icebreaker Studies (OCSEAP), continuation of WEBSEC
Beaufort Sea

9. Bird Colony surveys Cape Lisburne & Cape Thompson (OCSEAP, USFWS, USGS)
Chukchi Sea (OCSEAP) — USFWS — USGS

10. Beaufort Sea Barrier Island - Lagoon Ecosystem Process Study (OCSEAP)
Beaufort Sea

11. Bowhead Whale Migration, Distribution and Abundance. Aerial surveys (OCSEAP, BOEMRE, NMML)
Bering, Chukchi, Beaufort Seas Aerial Survey (OCSEAP) — Beaufort Sea. Bowhead Whale Aerial Survey Program (BWASP), conducted by BOEMRE and NMML.

12. Foodweb and Nutrient Dynamics Nearshore Alaskan Beaufort Sea Waters (OCSEAP)
Beaufort Sea

13. Toxicity of Oil-Well Drilling Muds to Alaskan Larval Shrimp and Crabs (OCSEAP)

14. Polar Bear Research, Southern Beaufort population (USFWS, USGS)
Beaufort Sea. Mark-Recapture surveys. Aerial surveys. Effect of climate change on population

15a. UW Sound Measurement and Localisation from Prudhoe Bay Region (OCSEAP)
Beaufort Sea. Started as OCSEAP. UW sound measurements of man-made sounds is ongoing and mainly conducted by Industry (e.g. 15b, 15c, 15d)

15b. UW Sound and Marine mammal Monitoring Expl. Drilling and Icebreaker Operations (Industry)
Beaufort Sea. A total of 30 wells were drilled during this period

15c. UW Sound and Marine Mammal Monitoring Seismic/Shallow Hazard Surveys, Beaufort Sea (Industry)
Beaufort Sea — Beaufort Sea

15d. UW Sound and Marine Mammal Monitoring Northstar Island (Industry)
Beaufort Sea. Information on bowhead deflection related to offshore production.

16. Chukchi Sea Coastal Studies, Habitat mapping related to oil spill response (OCSEAP)
Chukchi Sea

17. Winter Ecology of Under Ice Benthos (OCSEAP)
Beaufort Sea

18. Migratory Bird Management Surveys (USFWS)
Chukchi and Beaufort Sea. Aerial population surveys of various sea ducks and waterfowl.

19. Oil-Ice-Sediment Interactions during Freeze-up and Break-up (OCSEAP)

20. UW Sound and Marine mammal Monitoring Expl. Drilling and Icebreaker Operations (Industry)
Chukchi Sea. Five wells were drilled

21. ANIMIDA and c-ANIMIDA Program (BOEMRE)
Beaufort Sea

22. Beluga Movements and Satellite tagging Studies (NSB, ABWC, NMFS)
Chukchi and Beaufort Seas

23. Western Shelf Basins Interactions Project (SBI) - funded by NSF, ONR, USCG
Chukchi Sea

24. Russian-American Long-Term Census of the Arctic (RUSALCA)
Chukchi Sea

25. Bowhead Whale Tagging Study (ADFG, AEWC, BOEMRE)
Chukchi & Beaufort Seas

26. Bowhead Whale Feeding Ecology Study (BOWFEST)
Beaufort Sea, Barrow

27. Acoustic Monitoring of Bowhead Calls, Beaufort Sea (Shell)
Beaufort Sea

28. UW Sound and Marine Mammal Monitoring Seismic and Shallow Hazard Surveys (Industry)
Chukchi Sea

29. Polar Bear surveys Chukchi Sea population (USFWS, USGS)
Chukchi Sea

30. COMIDA Bowhead Whale Abundance and Distribution, Chukchi Sea (BOEMRE, NMML)
Chukchi Sea

31. Environmental Studies Program Chukchi Sea (CPAI, Shell, Statoil)
Chukchi Sea

32. COMIDA studies, Chukchi Sea (BOEMRE)

33. CHAOZ Acoustic, Oceanography, and Zooplankton Study (NMML, NOAA)

34. Bearded Seal Movement, Habitat use and Foraging behavior Study (NSB, NOAA)

Color Legend:

- Beaufort Sea Studies
- Chukchi Sea Studies
- Studies applying both to the Beaufort and Chukchi Sea
- Area of survey unknown

Sources: Websites of BOEMRE, NMFS, ADFG, USFWS, AOFG, NSB, and Shell 2010; Science of the U.S. Arctic Outer Continental Shelf, Vol.1

Note: This summary includes main research programs and is not intended as a comprehensive list of all studies that were or are being conducted.

ARCTIC SCIENCE SUMMARY

	Research Programs:	Research Disciplines	Location	Season
1	Western Beaufort Sea Ecological Cruises (WITSEC)	Physical Oceanography, Chemical, Plankton, Benthos, Fish	Beaufort Sea (Chukchi, 1975)	Summer / Fall
2	Oil and Gas Industry Research Programs (coordinated through APOA and AOGA)	Physical Oceanography, Ice Dynamics, Oil in water, Underwater Sound, Marine Mammals, Birds	Beaufort Sea	Winter / Summer
3	Long-term study of Black Guillemot Colony (OCSEAP, UAF)	Seabird	Beaufort Sea, Cooper Island	Summer
4	Arctic Fish Habitat Use Beaufort Sea (OCSEAP, ADFG, NOAA, BOEMRE Industry)	Marine Fish	Beaufort Sea, nearshore areas	Summer
5	Bearded Seal History and Ecology (OCSEAP)	Marine Mammals	Beaufort Sea and North Pacific	??
6	Ice Edge Ecosystem Productivity, plankton focus (OCSEAP)	Plankton, focusing on ice edge system	Beaufort Sea?, Chukchi Sea?	Spring?
7a	Ice seal and other Marine Mammal Surveys, Chukchi Sea (OCSEAP, ADFG, USFWS, USGS)	Marine Mammals	Chukchi and Bering Sea	Spring / Summer
7b	Ice Seal Satellite tracking studies (ADFG, Kotzebue hunters)	Marine Mammals	Chukchi Sea	Spring / Summer
7c	Walrus radio tracking (USGS, hunters Chukchi villages)	Marine Mammals	Chukchi Sea	Spring / Summer
8	Beaufort Sea Icebreaker Studies (OCSEAP), Phyto/Zooplankton, continuation of WITSEC	Phytoplankton, Zooplankton	Beaufort Sea	Summer / Fall
9	Bird Colony surveys Cape Lisburne & Thompson (OCSEAP, USFWS, USGS)	Seabirds	Chukchi Sea	Spring
10	Beaufort Sea Barrier Island - Lagoon Ecosystem Process Study (OCSEAP)	Zooplankton, Benthos, Fish, Seabirds, Marine mammals	Beaufort Sea	Summer / Fall
11	Bowhead Whale Migration, Distribution and Abundance (OCSEAP, BOEMRE, NMML)	Marine mammals, specifically bowhead whale	Beaufort Sea	Summer / Fall
12	Foodweb and Nutrient Dynamics Nearshore Alaskan Beaufort Sea Waters (OCSEAP)	Ice-algae, phytoplankton production	Beaufort Sea	??
13	Toxicity of Oil/Well Drilling Muds to Alaskan Larval Shrimp and Crabs (OCSEAP)	Shrimp and Crab larva	NA	NA
14	Polar Bear Research, Southern Beaufort population (USFWS, USGS)	Marine Mammals	Beaufort Sea	Spring / Summer
15a	UW Sound Measurement and Localization from Prudhoe Bay Region (OCSEAP)	Acoustic	Beaufort Sea	Winter / Spring / Summer
15b	UW Sound and Marine mammal Monitoring Exp. Drilling and Icebreaker Operations (Industry)	Marine Mammals, Acoustic	Beaufort Sea	Summer / Fall
15c	UW Sound and Marine Mammal Monitoring Seismic Surveys, Beaufort Sea (Industry)	Marine Mammals, Acoustic	Beaufort Sea	Summer / Fall
15d	UW Sound and Marine Mammal Monitoring Northstar Island (Industry)	Marine Mammals, Acoustic	Beaufort Sea	Winter/ Spring / Summer
16	Chukchi Sea Coastal Studies, Habitat mapping related to oil spill response (OCSEAP)	Physical and Biological description of northern Chukchi Sea coastline	Chukchi Sea	
17	Winter Ecology of Under Ice Beluga (OCSEAP)	Invertebrates, vertebrates under ice	Beaufort Sea	Winter?
18	Migratory Bird Management Surveys (USFWS)	Sea ducks	Chukchi and Beaufort Sea	Spring?
19	Oil-Ice-Sediment Interactions during Freeze-up and Breakup (OCSEAP)	Interactions of oil, ice and suspended particulate matter	NA	NA
20	UW Sound and Marine mammal Monitoring Exp. Drilling and Icebreaker Operations (Industry)	Marine Mammals, Acoustic	Chukchi Sea	Spring / Summer
21	ANIMIDA and c-ANIMIDA Program (BOEMRE)	Soil and Biota Chemistry, Contaminants, Biological effects Pollutants, Marine Mammals, Whaling	Beaufort Sea	Spring / Summer
22	Beluga Movements and Satellite tagging Studies (NSB, AEWC, NMFS)	Marine Mammals	Chukchi and Beaufort Sea	Spring
23	Western Shelf Basins Interactions Project (SBI) - funded by NSF, ONR, USCG	Physical Oceanography, Marine mammal acoustics (passive), Zooplankton acoustics (active)	Chukchi Sea	Spring / Summer
24	Russian-American long-term Census of the Arctic (RUSALCA)	Physical Oceanography, Plankton, Marine mammals (opportunistic)	Chukchi and Bering Seas	Summer
25	Bowhead Whale tagging Study (ADFG, AEWC, BOEMRE)	Marine Mammals, bowhead whales	Chukchi and Beaufort Sea	Spring
26	Bowhead Whale feeding Ecology Study (BOWFEST)	Oceanography, Zooplankton, Seabeds, Marine Mammals, Acoustic	Beaufort Sea, Barrow area	Summer / Fall
27	Acoustic Monitoring of Bowhead Calls, Beaufort Sea (Shell)	Marine Mammals, Acoustic	Beaufort Sea	Summer / Fall
28	UW Sound and Marine Mammal Monitoring Seismic and Shallow Hazard Surveys (Industry)	Marine Mammals, Acoustic	Chukchi Sea	Summer / Fall
29	Polar Bear surveys Chukchi Sea population (USFWS, USGS)	Marine Mammals	Chukchi Sea	Summer / Fall
30	COMIDA Bowhead Whale Abundance and Distribution, Chukchi Sea (BOEMRE, NMML)	Marine mammals, specifically bowhead whale	Chukchi Sea	Summer / Fall
31	Environmental Studies Program Chukchi Sea (CPAI, Shell, Statoil)	Oceanography, Chemistry, Ocean acidification, Plankton, Benthos, Seabirds, Marine Mammals, Acoustic	Chukchi Sea	Summer / Fall
32	COMIDA studies, Chukchi Sea (BOEMRE)	Benthic, Soil and Biota Chemistry, Opportunistic Seabird and Marine Mammal	Chukchi Sea	Summer / Fall
33	CHAOZ Acoustic, Oceanography, and Zooplankton Study (NMML, NOAA)	Oceanography, Zooplankton, Acoustic	Chukchi Sea	Summer
34	Bearded Seal Movement, Habitat use and Foraging behavior Study (NSB, NOAA)	Marine Mammals	Chukchi Sea	Summer

Color Legend:

- Beaufort Sea Studies
- Chukchi Sea Studies
- Studies applying both to the Beaufort and Chukchi Sea
- Area of survey unknown

Sources: Websites of BOEMRE, NMFS, ADFG, USFWS, AOGA, AOA and Shell 2010, Initiation of the U.S. Arctic Outer Continental Shelf, Vol I

Note: This summary includes main research programs and is not intended as a comprehensive list of all studies that were or are being conducted.

Primary funding sources

- National Science Foundation*
- BOEM(RE), former MMS*
- Industry: Shell, CP, Statoil, BP*
- Other federal agencies: USGS, NOAA, EPA, USFWS
- State agencies: ADF&G, ADEC
- North Pacific Research Board
- Other (e.g., North Slope Borough, AOOS, NGOs)

Federal research commitment to Arctic: estimated at $400m/year (includes satellites)

Primary coordination/collaboration entities…many w/stakeholder advice

- North Slope Science Initiative
- Alaska Ocean Observing System
- North Pacific Research Board
- US Arctic Research Commission/Interagency Arctic Research and Policy Committee (IARPC)
- DOI LCCs, DOI Climate Center, NOAA Climate Service
- AK Climate Change Executive Roundtable
- ACCAP
- Co-management groups: whaling, walrus, beluga
- North Pacific Fishery Management Council
- AK Marine Ecosystem Forum
- ARCUS

International Groups

- Arctic Council
- Sustained Arctic Observing Network (SAON)
- Arctic Marine Assessment Program (AMAP)
- Internatl Arctic Science Committee (IASC)
- North Pacific Marine Science Organization (PICES)
- Pacific Arctic Group (PAG)

National Science Foundation

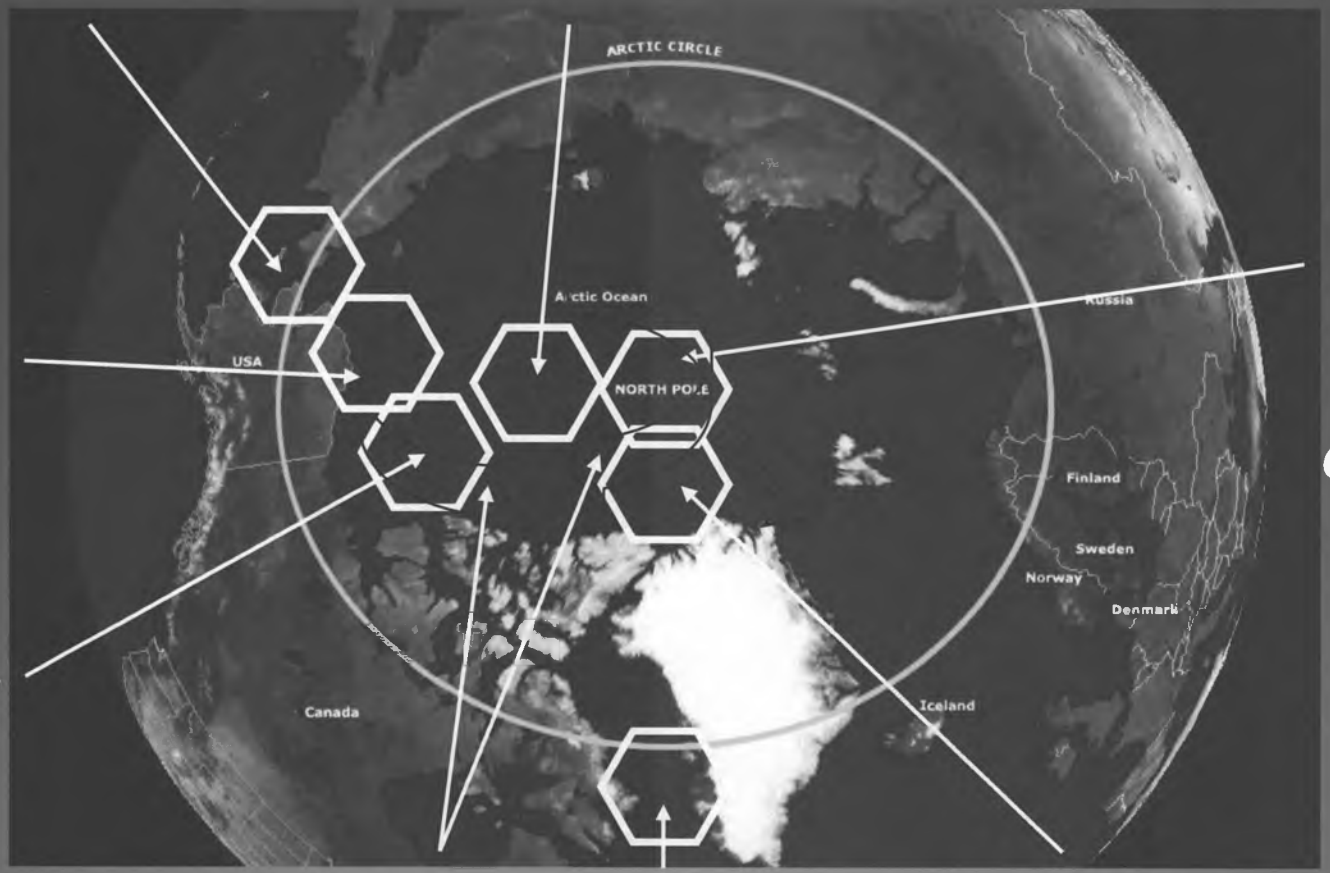
- Largest federal funder
- Focus: central Arctic basin for climate & sea ice
- Main interagency umbrella program: SEARCH:

  observe, understand, respond to change
- Added Arctic Observing Network (AON – 40 projects) during IPY: ice-tethered profilers, ice mass balance buoys, ocean flux buoys, No Pole observatory, Beaufort Gyre
- BEST, Arctic System Science Program & Synthesis (of Arctic processes), Shelf-Basin Investigations (Healy cruises to study warming of Arctic), & Study of Northern AK Coastal Systems (coastal zone)
- Arctic Report Card, Sea Ice Outlook
- Supported by ARCUS

Physical & Chemical Oceanography; Sea Ice

Bering Strait

Aerial Hydrographic Surveys



Seasonal Ice Zone

North Pole Environ-mental Observatory

Beaufort Gyre Observatory & Deepest Waters

Ice-Tethered Profilers & Ice Dynamics and Weather Buoys

Davis Strait

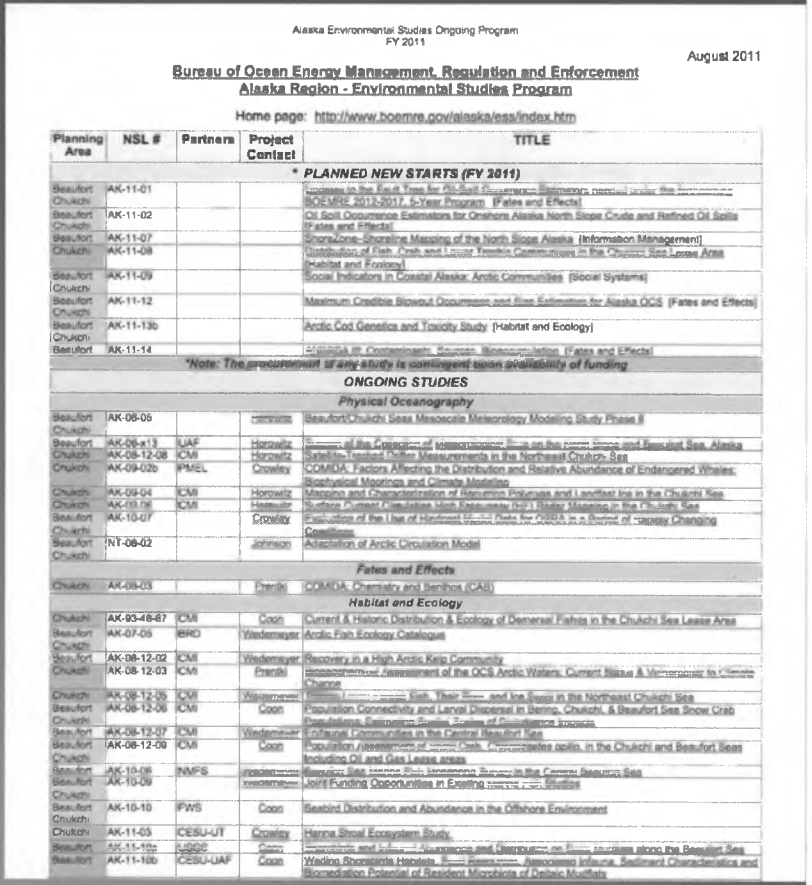
Switchyard & Seasonal Ice Zone

More recently….

- Beaufort/Chukchi nearshore oceans
- Bering Sea Sub-Network
- Western Arctic mooring: with OA sensors
- More IABP buoys in nearshore waters….
- SIZONET : nearshore radars, webcams, local observers

BOEM(RE)

- 2007-2009, leveraged $30m studies in Chukchi: about $10-15m a year
- Studies focus on info needed to assess potential environmental problems w/O&G activities
- Ocean circulation, baseline chemistry, physics & biology, habitat, fate & effects of oil, protected species, subsistence
- Identified need for more synthesis: physics & marine mammal synthesis underway



Alaska Environmental Studies Ongoing Program
FY 2011

August 2011

Bureau of Ocean Energy Management, Regulation and Enforcement
Alaska Region - Environmental Studies Program

Home page: http://www.boemre.gov/alaska/ess/index.htm

Planning Area	NSL #	Partners	Project Contact	TITLE
				* *PLANNED NEW STARTS (FY 2011)*
Beaufort Chukchi	AK-11-01			[illegible] BOEMRE 2012-2017, 5-Year Program [Fates and Effects]
Beaufort Chukchi	AK-11-02			Oil Spill Occurrence Estimators for Onshore Alaska North Slope Crude and Refined Oil Spills [Fates and Effects]
Beaufort	AK-11-07			ShoreZone- Shoreline Mapping of the North Slope Alaska [Information Management]
Chukchi	AK-11-08			[illegible] [Habitat and Ecology]
Beaufort Chukchi	AK-11-09			Social Indicators in Coastal Alaska: Arctic Communities [Social Systems]
Beaufort Chukchi	AK-11-12			Maximum Credible Blowout Occurrence and Size Estimation for Alaska OCS [Fates and Effects]
Beaufort Chukchi	AK-11-13b			Arctic Cod Genetics and Toxicity Study [Habitat and Ecology]
Beaufort	AK-11-14			[illegible] [Fates and Effects]
				Note: The procurement of any study is contingent upon availability of funding
				ONGOING STUDIES
				Physical Oceanography
Beaufort Chukchi	AK-06-06		Hansen	Beaufort/Chukchi Seas Mesoscale Meteorology Modeling Study Phase II
Beaufort	AK-06-x13	UAF	Horowitz	[illegible]
Chukchi	AK-08-12-08	ICMI	Horowitz	Satellite-Tracked Drifter Measurements in the Northeast Chukchi Sea
Chukchi	AK-09-02b	PMEL	Crowley	COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales; Biophysical Moorings and Climate Modeling
Chukchi	AK-09-04	ICMI	Horowitz	Mapping and Characterization of Ravinnin Polynyas and Landfast Ice in the Chukchi Sea
Chukchi	AK-09-06	ICMI	Hannahs	[illegible]
Beaufort Chukchi	AK-10-07		Crowley	[illegible]
Beaufort Chukchi	NT-08-02		Johnson	Adaptation of Arctic Circulation Model
				Fates and Effects
Chukchi	AK-08-03		Prentki	COMIDA: Chemistry and Benthos (CAB)
				Habitat and Ecology
Chukchi	AK-93-48-87	ICMI	Coon	Current & Historic Distribution & Ecology of Demersal Fishes in the Chukchi Sea Lease Area
Beaufort Chukchi	AK-07-05	BRD	Wiedemeyer	Arctic Fish Ecology Catalogues
Beaufort	AK-08-12-02	ICMI	Wiedemeyer	Recovery in a High Arctic Kelp Community
Chukchi	AK-08-12-03	ICMI	Prentki	[illegible]
Chukchi	AK-08-12-05	ICMI	Wiedemeyer	[illegible]
Beaufort Chukchi	AK-08-12-06	ICMI	Coon	Population Connectivity and Larval Dispersal in Bering, Chukchi, & Beaufort Sea Snow Crab
Beaufort	AK-08-12-07	ICMI	Wiedemeyer	Epifaunal Communities in the Central Beaufort Sea
Beaufort Chukchi	AK-08-12-09	ICMI	Coon	Population [illegible]
Beaufort	AK-10-06	NMFS	[illegible]	[illegible]
Beaufort Chukchi	AK-10-09		[illegible]	Joint Funding Opportunities in Existing [illegible]
Beaufort Chukchi	AK-10-10	FWS	Coon	Seabird Distribution and Abundance in the Offshore Environment
Chukchi	AK-11-05	CESU-UT	Crowley	Hanna Shoal Ecosystem Study
Beaufort	AK-11-10c	USGS	Coon	[illegible]
Beaufort	AK-11-10b	CESU-UAF	Coon	Wading Shorebirds Habitats [illegible] Assessing Influence, Sediment Characteristics and Bioremediation Potential of Resident Microbiota of Deltaic Mudflats

Industry

- Offshore work: primarily Shell, ConocoPhillips, & Statoil, some BP
- $20-40m a year, including ship time
- Joint environmental studies in Chukchi
- Individual companies: weather buoys & sea ice SAR images: to aid research & exploration vessels
- Shell: $4-5m/yr to NSB for science studies
- Joint Industry Program (JIP): industry cooperative to fund studies important to entire international industry (cleanup of oil in ice)

Joint Industry Studies

- Jt Environmental studies focusing on lease areas, permit requirements, & baseline data
- Work covers: birds, mammals & fish, zooplankton, ocean chemistry & physics
- Significant work on bottom sediments, also effects of noise on marine mammals

Other federal agencies

- NOAA: RUSALCA w/NSF & Russia: since 2004, Bering Strait moorings & cruises; DBO; climate; weather & sea ice forecasting; Sea Ice Outlook for Walrus Hunters; Arctic website; satellites; unmanned aircraft
- USGS: coastal erosion, freshwater fish, polar bears, Regional Climate Center
- USFWS: LCCs about $2 m each (5 in AK), also sea otters, walrus & sea birds w/USGS
- Navy: sea ice in Chukchi, Natl Ice Center (w/Coast Guard & NOAA)
- NASA: satellites; National Snow & Ice Data Center (w/NSF & NOAA)
- Army Corps: CRREL (Cold Regions Research Lab) & coastal erosion
- DOE: atmosphere
- EPA: water quality

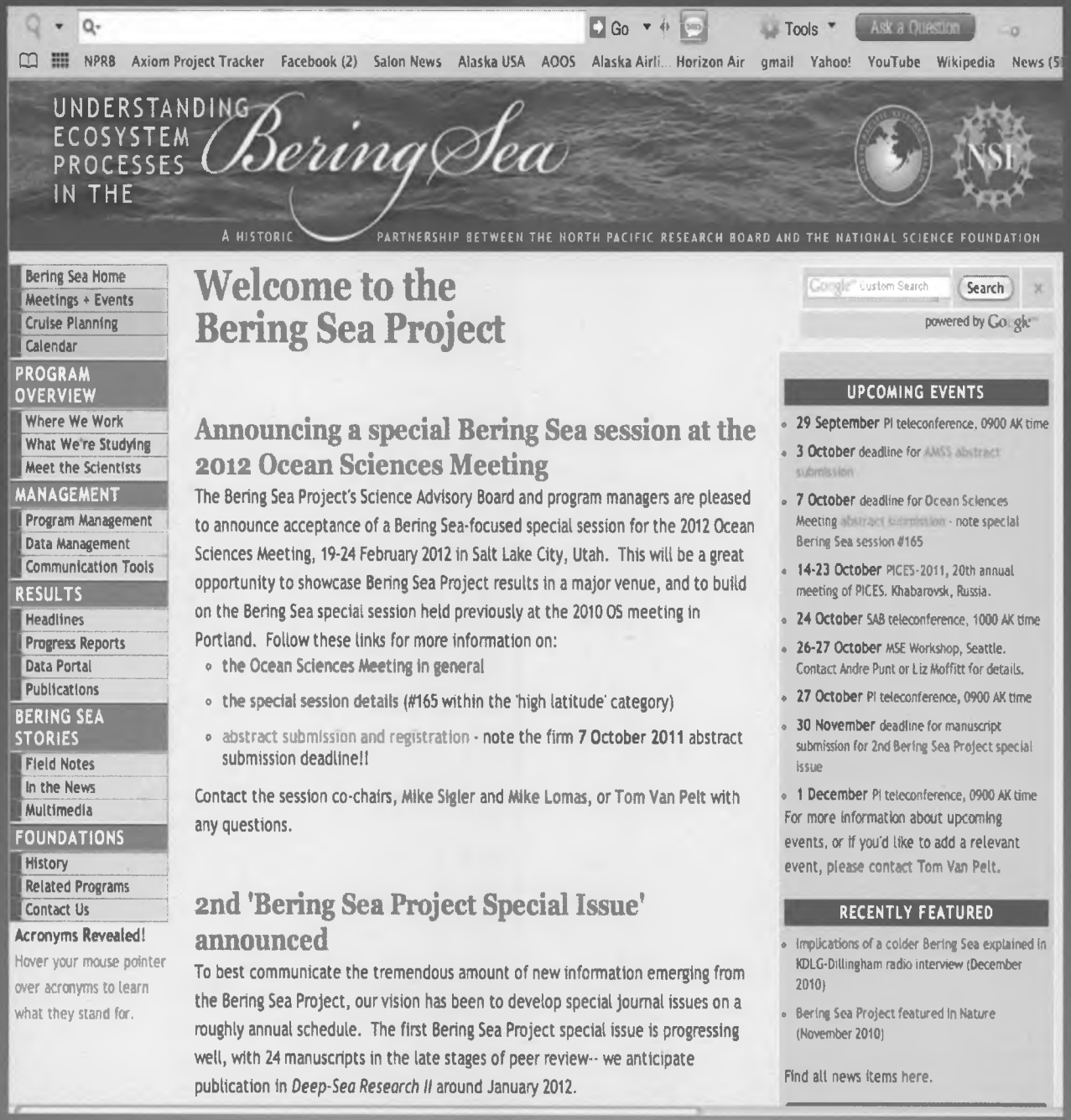
North Pacific Research Board

- 2007-2012: $52m joint study in Bering Sea w/NSF
- FY 11: $400k in data rescue, Arctic cod, algal toxins in marine mammals
- FY 12 RFP: $400k for specific work in Arctic cod, fish, fish habitat, lower trophic levels & primary production, walrus, belugas & ice seals; additional $400k to non-specific Arctic
- FY 12 RFP w/NSF: $1.5m for synthesis & gap analysis (industry funded)

Product will help inform joint NPRB/NSF/plus others major integrated research program beginning 2014

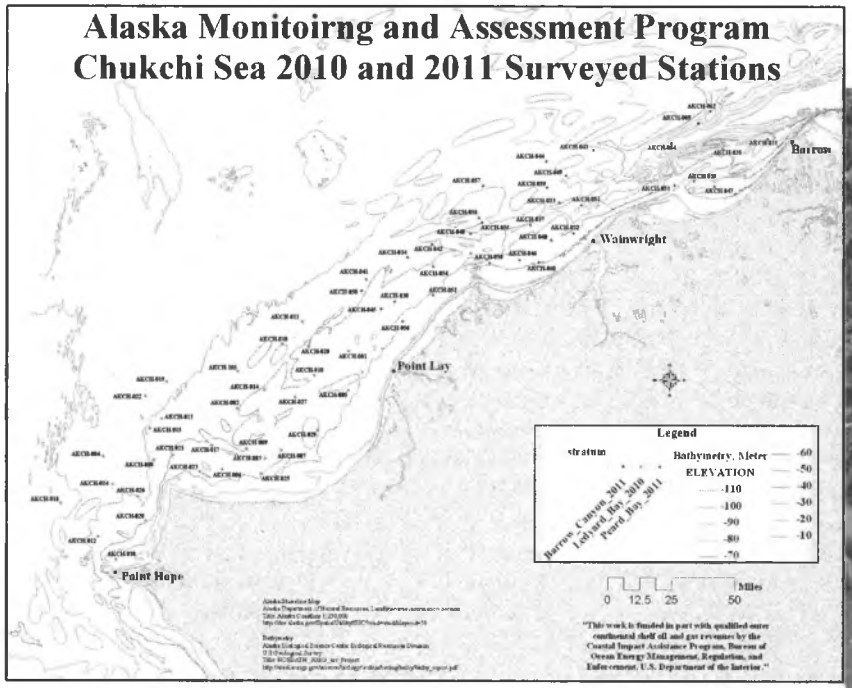
NPRB Arctic funding commitment planned: $3m min

(plus staff time)


Go
Tools
Ask a Question
NPRB
Axiom Project Tracker
Facebook (2)
Salon News
Alaska USA
AOOS
Alaska Airli...
Horizon Air
gmail
Yahoo!
YouTube
Wikipedia
UNDERSTANDING ECOSYSTEM PROCESSES IN THE Bering Sea
A HISTORIC PARTNERSHIP BETWEEN THE NORTH PACIFIC RESEARCH BOARD AND THE NATIONAL SCIENCE FOUNDATION
NSF
Bering Sea Home
Meetings + Events
Cruise Planning
Calendar
PROGRAM OVERVIEW
Where We Work
What We're Studying
Meet the Scientists
MANAGEMENT
Program Management
Data Management
Communication Tools
RESULTS
Headlines
Progress Reports
Data Portal
Publications
BERING SEA STORIES
Field Notes
In the News
Multimedia
FOUNDATIONS
History
Related Programs
Contact Us
Acronyms Revealed!
Hover your mouse pointer over acronyms to learn what they stand for.
Welcome to the Bering Sea Project
Search
powered by Google
Announcing a special Bering Sea session at the 2012 Ocean Sciences Meeting
The Bering Sea Project's Science Advisory Board and program managers are pleased to announce acceptance of a Bering Sea-focused special session for the 2012 Ocean Sciences Meeting, 19-24 February 2012 in Salt Lake City, Utah. This will be a great opportunity to showcase Bering Sea Project results in a major venue, and to build on the Bering Sea special session held previously at the 2010 OS meeting in Portland. Follow these links for more information on:
the Ocean Sciences Meeting in general
the special session details (#165 within the 'high latitude' category)
abstract submission and registration - note the firm 7 October 2011 abstract submission deadline!!
Contact the session co-chairs, Mike Sigler and Mike Lomas, or Tom Van Pelt with any questions.
2nd 'Bering Sea Project Special Issue' announced
To best communicate the tremendous amount of new information emerging from the Bering Sea Project, our vision has been to develop special journal issues on a roughly annual schedule. The first Bering Sea Project special issue is progressing well, with 24 manuscripts in the late stages of peer review-- we anticipate publication in Deep-Sea Research II around January 2012.
UPCOMING EVENTS
29 September PI teleconference, 0900 AK time
3 October deadline for AMSS abstract submission
7 October deadline for Ocean Sciences Meeting abstract submission - note special Bering Sea session #165
14-23 October PICES-2011, 20th annual meeting of PICES. Khabarovsk, Russia.
24 October SAB teleconference, 1000 AK time
26-27 October MSE Workshop, Seattle. Contact Andre Punt or Liz Moffitt for details.
27 October PI teleconference, 0900 AK time
30 November deadline for manuscript submission for 2nd Bering Sea Project special issue
1 December PI teleconference, 0900 AK time
For more information about upcoming events, or if you'd like to add a relevant event, please contact Tom Van Pelt.
RECENTLY FEATURED
Implications of a colder Bering Sea explained in KDLG-Dillingham radio interview (December 2010)
Bering Sea Project featured in Nature (November 2010)
Find all news items here.

State of Alaska

- ADF&G bowhead & gray whale tagging
- ADEC: $2.1m 2010-2011 Chukchi & Beaufort water quality monitoring project, AKMAP funded by CIAP



Others

- North Slope Borough – mostly spring work on bowheads, agreement w/Shell for $4-5m a year science work identified as important by communities
- AOOS: contribute to equipment purchases; data integration & visualization; Arctic assets map, ship coordination; sea ice atlas; coordination & facilitation, 10 year buildout for long term obs

Recommendations

- Improved sea ice nowcasts/forecasts & trajectories
- Baseline surveys of key physical, chemical & biological parameters – monitor change over time
- Marine mammal response to noise – research
- Develop ocean circulation nowcast/forecasts
- ID & monitor biological hotspots: Hannah Shoal, Ledyard Bay, Barrow Canyon, Boulder Patch in Prudhoe Bay
- Integrate & visualize data
- Develop a grand plan

USARC: establishes research goals & sets research policy

IARPC: adopts goals, creates research plan

White House: OMB/OSTP

Congress: authorizers & appropriators

USARC comments on budget to Congress

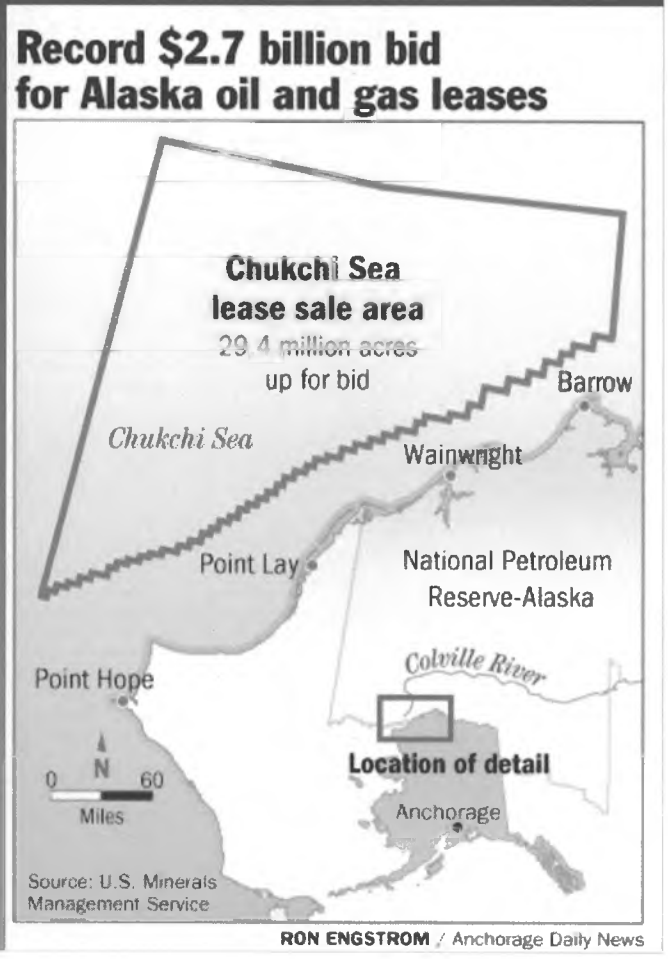
Industry/NOAA Data Sharing MOA

- Signed in August by NOAA & 3 companies: Shell, Statoil & ConocoPhillips
- Umbrella agreement committing industry to sharing data with government and public
- 1st priority: met ocean data in real-time to assist weather forecasting & sea ice images for forecasting
- 2nd priority: non-real time data: hydrographic & bathymetry surveys for charting, habitat mapping; modeling & environmental studies
- Potential use of AOOS Data Portal for public access

CMSP Proposal

- State concerns w/CMSP
- Focus on identifying needs for additional data layers for decision support: human uses,

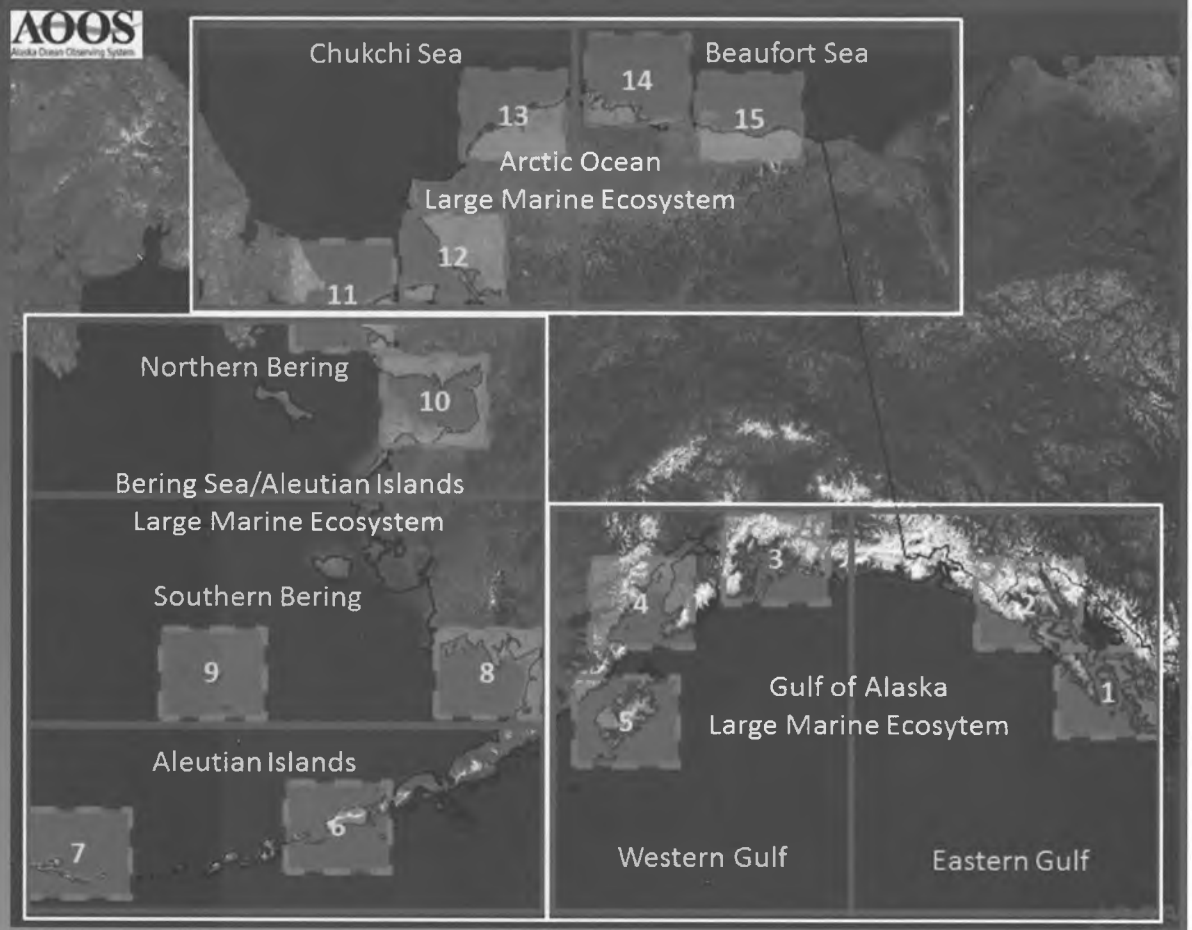
  20 year climate scenarios
- What info do stakeholders need?
- 1 year, $760k
- Partners: AOOS, UA, TNC



10 year AOOS build out

4 themes:
- Marine operations
- Coastal Hazards
- Climate trends
- Ecosystems/fisheries & water quality

3 Large Marine Ecosystems
7 Sub-regions
15 (or more) Areas



Other Activities

- US Arctic Observing Coordination Mtg, March 2012
- Sea Ice Forecasting Workshops
- NPRB/NSF synthesis & proposed ecosystem studies
- Sikuliaq launch 20123-14
- Coast Guard study of Bering Strait
- NOAA Arctic Vision & Strategy
- AK Sea Grant workshop in Bering Strait
- Natl Ocean Policy: Arctic Strategic Action Plan

Conclusions

- A lot of research and monitoring going on in the Arctic
- Nobody knows it all, nor is there 1 place to find it all
- There's probably some duplication, but everyone is trying to avoid that with $$ so tight
- A lot of new data has been collected, but not all of it has been synthesized in a way that furthers our big picture understanding of the Arctic
- We can do better

3

Evaluation of Science Needs on OCS Energy Development

An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska

Leslie Holland-Bartels
USGS Arctic OCS Team
October 11, 2011

Northern WaterTask Force
Anchorage AK

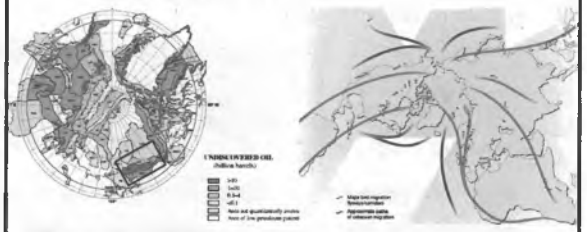
Context: March 31 Energy Policy Announcement

Development: "…expand development and production throughout the Gulf of Mexico, including resource-rich areas of the Eastern Gulf of Mexico…"

Exploration: "…expand oil and gas exploration in frontier areas, such as the Arctic Ocean and areas in the Atlantic Ocean, to gather the information necessary to develop resources in the right places and the right ways."

Conservation: "…calls for the protection of special areas like Bristol Bay in Alaska…national treasure[s] that we must protect for future generations."

USGS



High Energy Potential | High Ecological Value

USGS

What this was not

- Prioritize research for permitting decisions
- Review and report on all research that exists

We were asked to

- Gain a better understanding of the breadth of perspective across major vested parties: Give the Secretary more context to the divergent perspectives brought to him
- Examine the literature and ongoing work and give the Secretary an independent flavor of the available science and potential useful future effort in specific focal areas that he had received significant public comment on

USGS

USGS Arctic OCS Study – Assignment

An initial, independent evaluation of science needs to understand the resilience of Arctic coastal and marine ecosystems to Outer Continental Shelf resource extraction activities – Chukchi and Beaufort Seas.

Key Topics of Focus:

Marine Mammals and Seismic Activities: Effect of seismic exploration activities (sound) on marine mammals;

Oil Spill Response: Research needs to allow for an effective and reliable oil spill response in ice-covered regions; and

Cumulative Impacts: Cumulative impacts of development, infrastructure, and maintenance activities;

Climate Change Considerations: How the likely effects of climate change will either mitigate or compound the impacts from energy development in the Arctic environment.

USGS

USGS Arctic OCS Study – Process

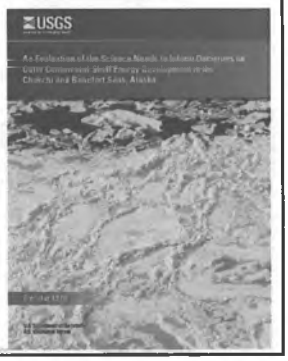
- Reviewed >400 scientific publications, workshop findings, science policy documents, and web sites.
- Met with >40 individuals and organizations that have research or science assessments on the issue topics.
- Conducted a series of structured information sessions with key vested parties: Prototype "Disparate Stakeholder Analysis" with Northslope community, oil industry, State, Federal, and nonregulatory interests to clarify points of disention and what, if any, science could improve consensus building.
- Held a special session at the Alaska Marine Science Symposium to gather final thoughts on specific science gaps.

USGS

USGS Arctic OCS Study – Products

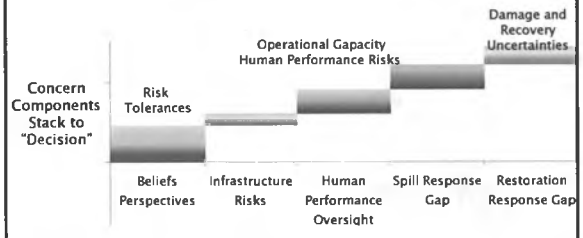
Resulting findings:

•USGS Circular 1370:
•http://pubs.usgs.gov/circ/1370



USGS

Full Cycle View: Stakeholder reach their "decisions" and see GAPs differently



USGS

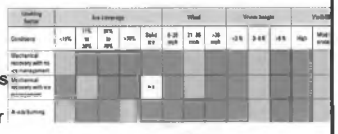
Oil Spill Risk, Response, and Impact: examples

- Develop centralized information to house rapidly emerging science and technical information: Big Challenge
- Better understand physical oceanography, meteorology to refine oil spill trajectory and other models
- Support and enhance decision support and ocean observing systems improve preparedness by highlighting data and operational needs (ERMA, AOOS)
- Better understand oil-in-ice weathering -- response and ecosystem exposure
- Evaluate standardized testing procedures and results cross-comparability for mechanical containment (eg wave tanks); develop collaborative protocols
- Further develop mechanical recovery systems that work under ice
- Develop system able to make short-term ice dynamics forecasts
- Improve understanding of effectiveness of *in situ* burning and enhance information -- emissions and residue characterization and improved plume modeling

USGS

Information for Effective Oil Spill Risk Assessment, Preparedness, and Response advancing, but significant challenges remain

- *Exxon Valdez* and Deepwater Horizon Oil Spills demonstrate that a suite of spill response tools must be available and effective, and change over time of spill
  - Significant question exists about the Response Gap for the Arctic; this is exacerbated by expected climate change factors. No authoritative analysis of the recent or forecasted Response Gap exists. (Expert Consultation response)

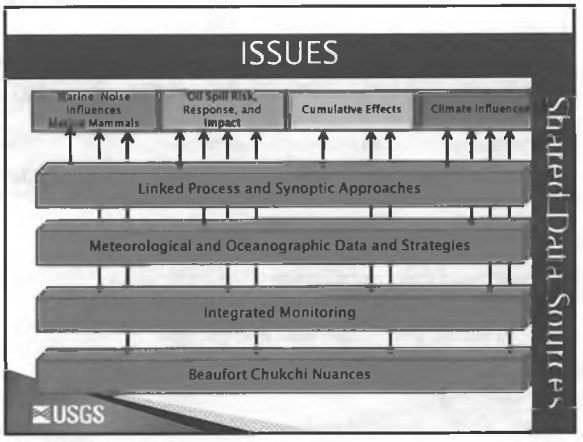


From Nuka Research and Planning Group, LCC and Pearson Consulting, LCC (2010, tables 6-1, 6-2); USGS Table 5-4

Commission authoritative assessment of "Response Gap" now/future climate

USGS

ISSUES



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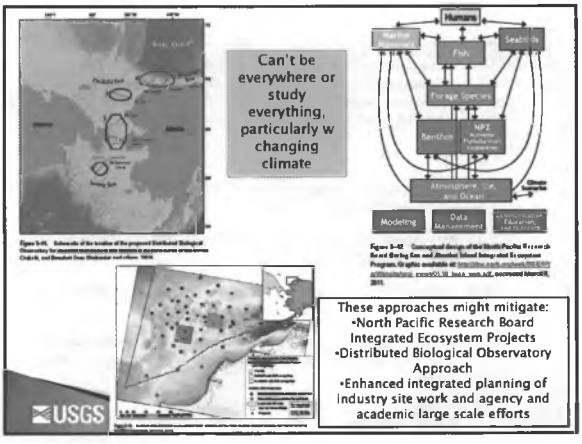
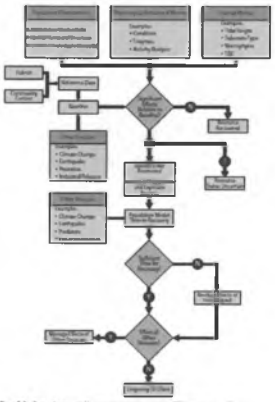


USGS

What do you really need "ahead" to assess impact if a spill were to happen?



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Big Picture View

- The Arctic science and resource community is a model of collaboration. Found an open and energized desire to understand different views on development and to find means to move forward. Thus, the development of integrated monitoring efforts and collaborative science efforts across governmental, industry, and nongovernmental entities can be accomplished. However, we believe focused attention is required to envision and implement such a fully collaborative environment.
- Found many excellent examples of thoughtful analyses of science and technology needs to inform oil and gas development decisions in the Arctic. Our recommendations and findings add to those already in the literature. To move forward, we strongly recommend that a collaborative implementation process be put in place, but it needs to include appropriate measures of accountability for all responsible parties/entities. In our many discussions, we heard that managers, responders, scientists, and community members are willing to engage in discussing information needs, but they have a growing expectation that those needs are considered and, if appropriate, addressed in a visible and traceable manner.

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14

Big Picture View

- Structured Decision Making (SDM) approaches bring vested and interested stakeholders into the decision process in a transparent and documented way. The process allows for learning and adaptation, which are critical concepts in a frontier and changing environment like the Arctic and we encourage its use.
- Oil and gas development decision making occurs within the broader context of Arctic issues. A collaborative and comprehensive Arctic science planning process would bring great value to the decisions required to proceed with development of oil and gas and other strategic assets in the Arctic in a changing climate environment. Such a science plan and its implementation must be informed by an SDM-like process and the syntheses of information we discussed earlier.

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4

Arctic Marine Data Synthesis & Research Gaps

Arctic Marine Data Synthesis and Research Gaps

Melanie A. Smith, Audubon Alaska

Northern Waters Task Force Meeting

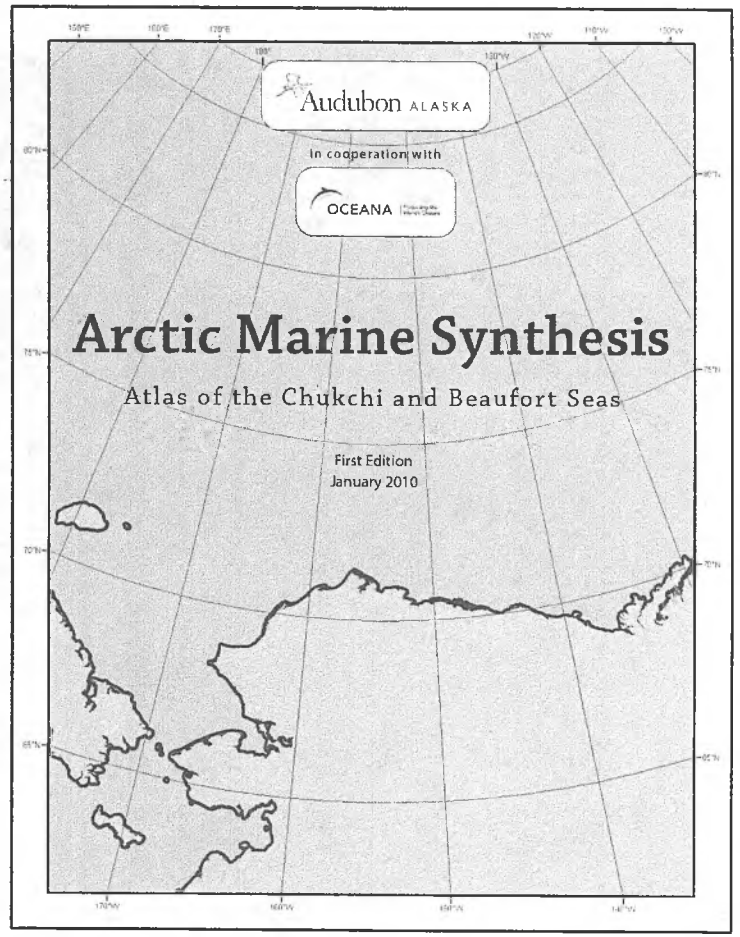
October 11, 2011

Audubon ALASKA

Understanding Marine Ecology through Maps...

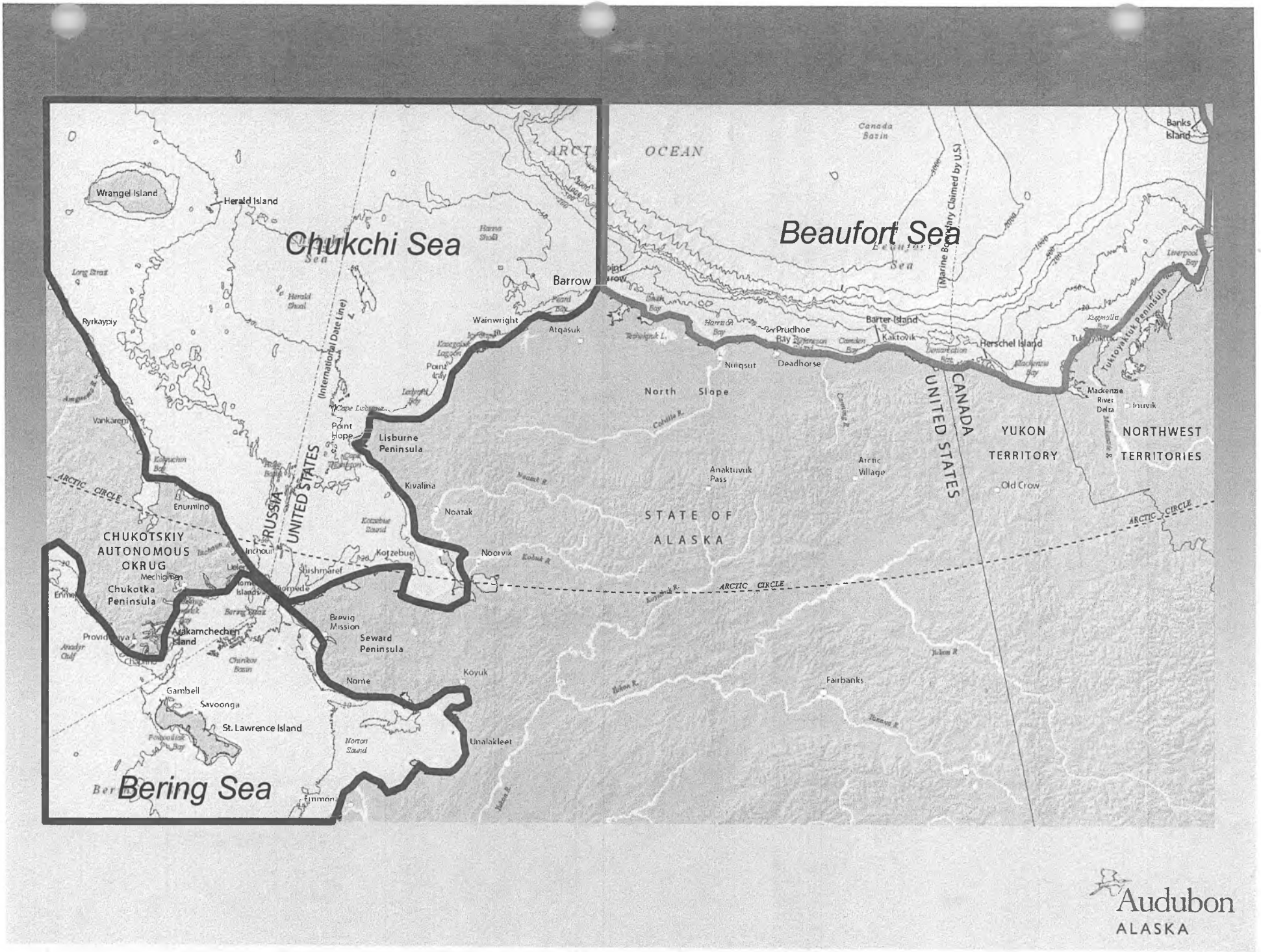
Arctic Marine Synthesis

- Physical Oceanography
- Water Column & Benthic Life
- Fish
- Birds
- Mammals
- Human Influences



Physical oceanography
Water Column & Benthic Life
Fish
Birds
Mammals
People

Audubon ALASKA



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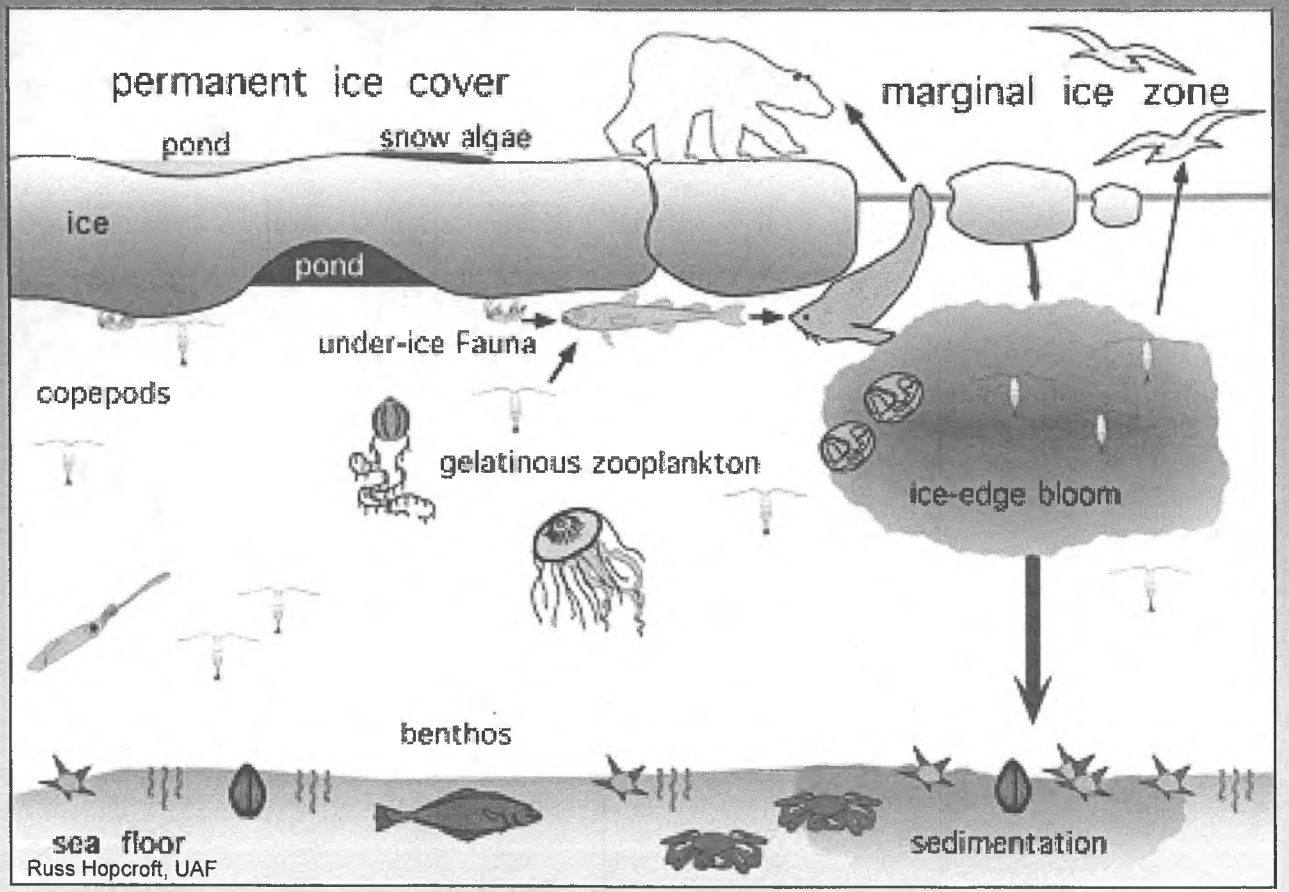
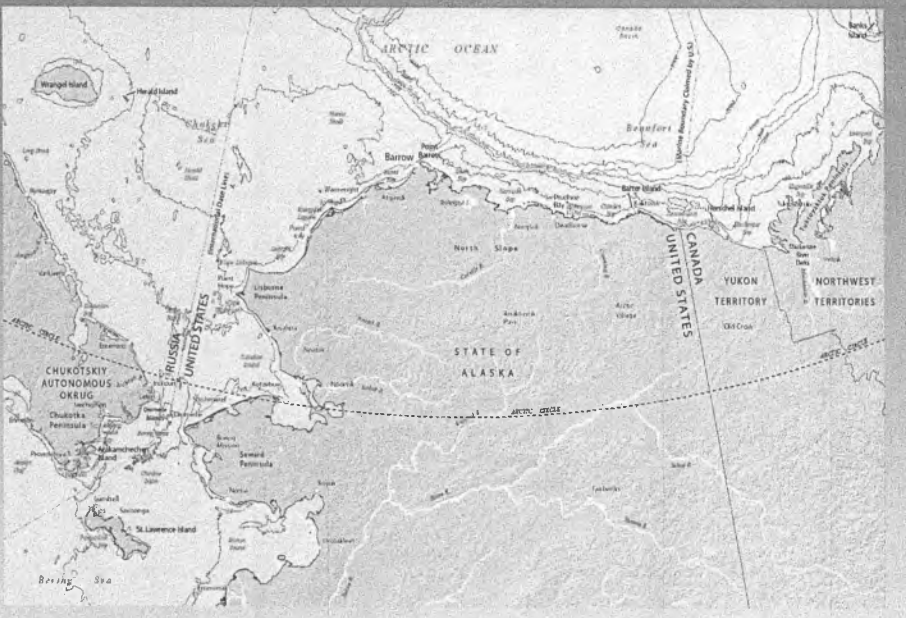
Arctic Marine Ecosystem



Audubon
ALASKA

Data Sources

- The atlas integrates
  - OCSEAP
  - NOAA environmental atlas
  - Environmental Sensitivity Index
  - Peer-reviewed literature
  - Agency studies (USFWS, MMS, USGS)


ARCTIC OCEAN
Wrangel Island
Herald Island
Barrow
Point Barrow
Barrow Island
Beaufort Sea
North Slope
Arctic Village
Lisburne Peninsula
Anaktuvuk Pass
Kaktovik
Barter Island
Kendrick Island
Oldman Island
Oldman Creek
Gubik Gas Field
Umiat
Colville River
Colville Delta
Kuparuk Oil Field
Prudhoe Bay
Deadhorse
Sagavanirktok River
Franklin Bluffs
Galbraith Lake
Toolik Lake
Atigun Pass
Chandler Lake
Wiseman
Coldfoot
Arctic Circle
Arctic Village
Old Crow
Porcupine River
Porcupine Caribou Herd
Dempster Highway
Eagle Plain
Ogilvie Mountains
Tombstone Mountain
Tombstone Territorial Park
Klondike Goldfields
Dawson
Yukon River
Fort McPherson
Peel River
Mackenzie River
Mackenzie Delta
Inuvik
Aklavik
Richardson Mountains
Arctic Red River
Tsiigehtchic
Fort Good Hope
Norman Wells
Great Bear Lake
Great Slave Lake
Yellowknife
Fort Simpson
Fort Liard
Nahanni National Park
Nahanni Range
Mackenzie Mountains
Liard River
Fort Nelson
Fort St. John
Dawson Creek
Alaska Highway
Whitehorse
Watson Lake
Teslin
Teslin Lake
Atlin
Atlin Lake
Skagway
Haines
Haines Junction
Kluane Lake
Kluane National Park
Mount Logan
Mount Saint Elias
Wrangell Mountains
Wrangell-Saint Elias National Park
Glacier Bay National Park
Glacier Bay
Juneau
Prince Rupert
Queen Charlotte Islands
Queen Charlotte Sound
Hecate Strait
Dixon Entrance
Ketchikan
Prince of Wales Island
Alexander Archipelago
Chatham Strait
Admiralty Island
Baranof Island
Sitka
Chichagof Island
Cross Sound
Icy Strait
Gulf of Alaska
Kodiak Island
Kodiak
Afognak Island
Shelikof Strait
Cook Inlet
Kenai Peninsula
Kenai
Homer
Kachemak Bay
Anchorage
Matanuska-Susitna Valley
Palmer
Wasilla
Talkeetna
Mount McKinley
Denali National Park
Denali Highway
Fairbanks
Tanana River
Tanana
Yukon River
Yukon Flats
Yukon Flats National Wildlife Refuge
Fort Yukon
Chena River
Chena Hot Springs
Circle
Eagle
Eagle Summit
Steese Highway
Steese National Conservation Area
White Mountains
White Mountains National Recreation Area
Fortymile River
Fortymile Caribou Herd
Delta Junction
Delta River
Tanana Valley State Forest
Tetlin National Wildlife Refuge
Tetlin
Tok
Tok Cutoff
Glenn Highway
Copper River
Copper River Delta
Copper Center
Wrangell
Petersburg
Cordova
Valdez
Valdez Arm
Prince William Sound
Port Valdez
Richardson Highway
Thompson Pass
Keystone Canyon
Worthington Glacier
Wood River
Wood River Lakes
Bristol Bay
Dillingham
Nushagak River
Nushagak Peninsula
Togiak National Wildlife Refuge
Togiak
Togiak Bay
Kuskokwim River
Kuskokwim Mountains
Kuskokwim Delta
Yukon Delta National Wildlife Refuge
Yukon Delta
Bethel
Kuskokwim Bay
Goodnews Bay
Goodnews Bay Mining District
Platinum
Nunivak Island
Hagemeister Island
Hagemeister Strait
Kilbuck Mountains
Kilbuck Range
Wood-Tikchik State Park
Togiak Wilderness
Togiak Refuge
Togiak Lake
Togiak River
Aleknagik
Aleknagik Lake
Lake Clark National Park and Preserve
Lake Clark
Lake Iliamna
Iliamna
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Redoubt Volcano
Redoubt Mountain
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Mount Spurr Volcano
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Susitna Flats State Game Refuge
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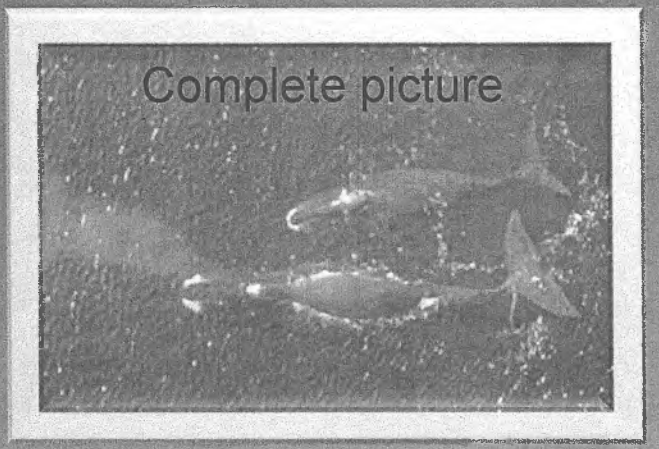
Eklutna Flats Bird Refuge Sustainability Island Viewing Area
Eklutna Flats Bird Refuge Conservation Island Viewing Area
Eklutna Flats Bird Refuge Pre

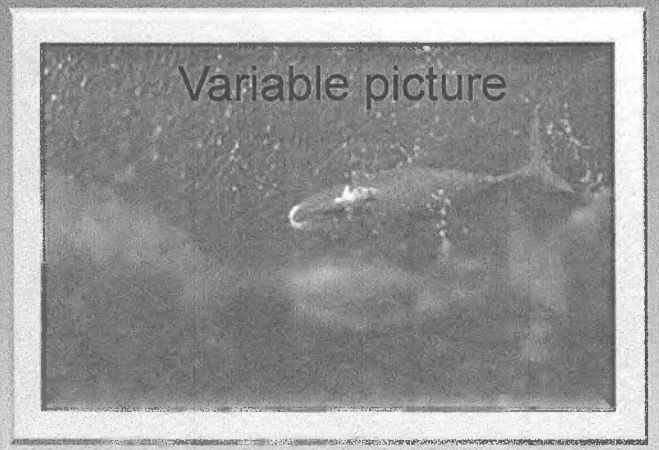
Data Quality

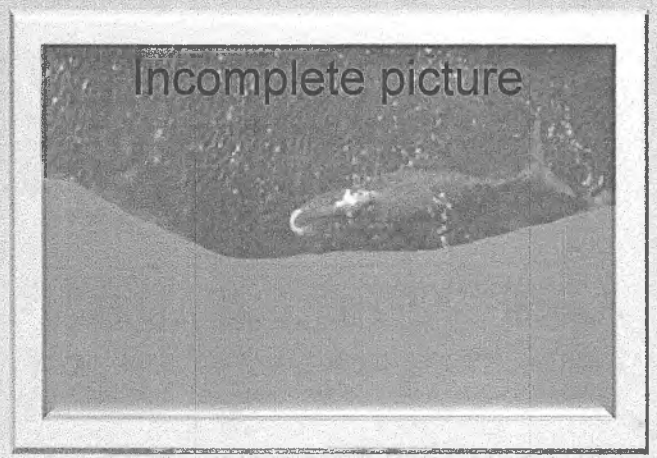
Good: provides a complete geographic picture of the resource or species

Fair: provides a variable geographic picture; some areas are represented by high-quality data and other portions are outdated or missing.

Poor: provides an incomplete geographic picture; information is missing, outdated, or deficient.







Data Quality

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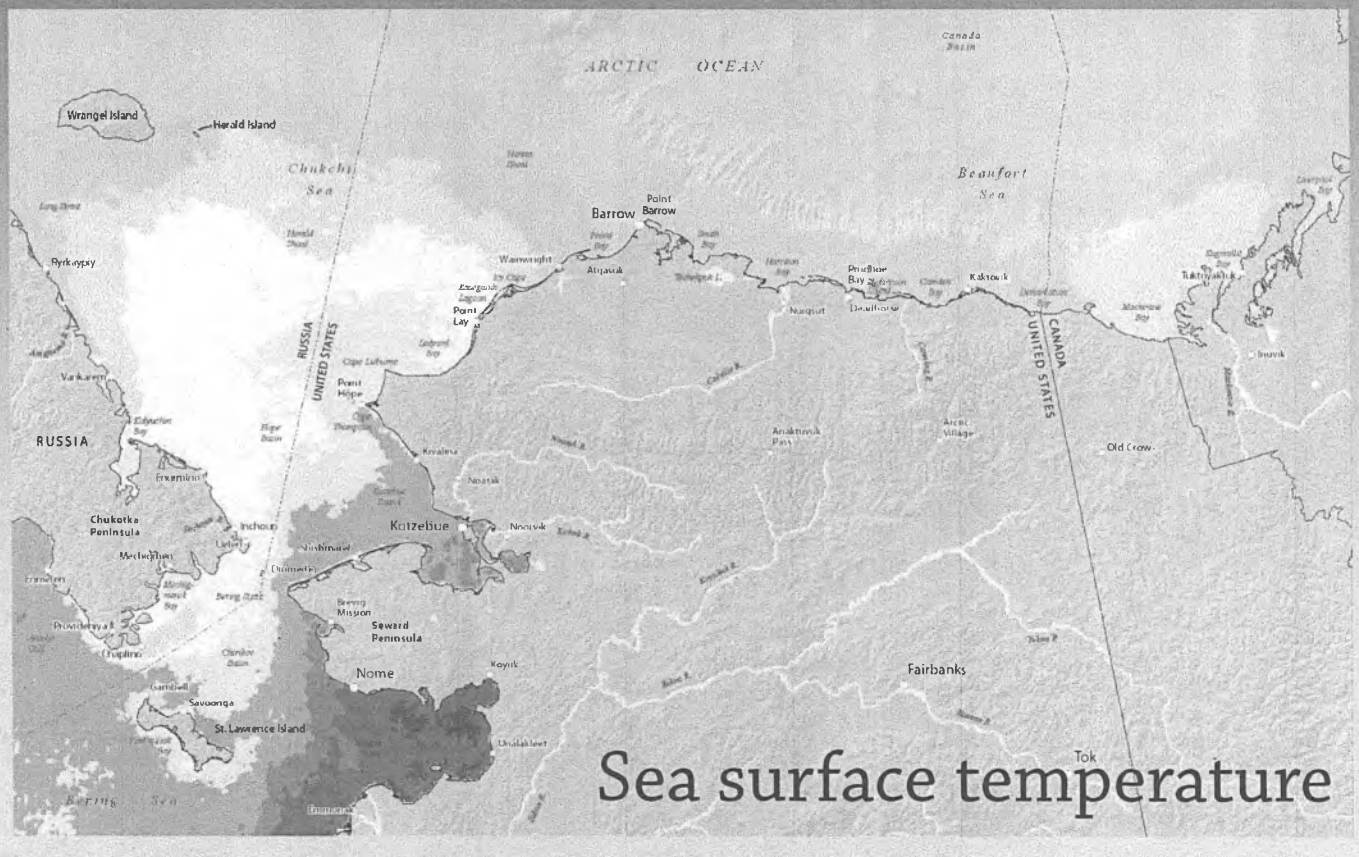
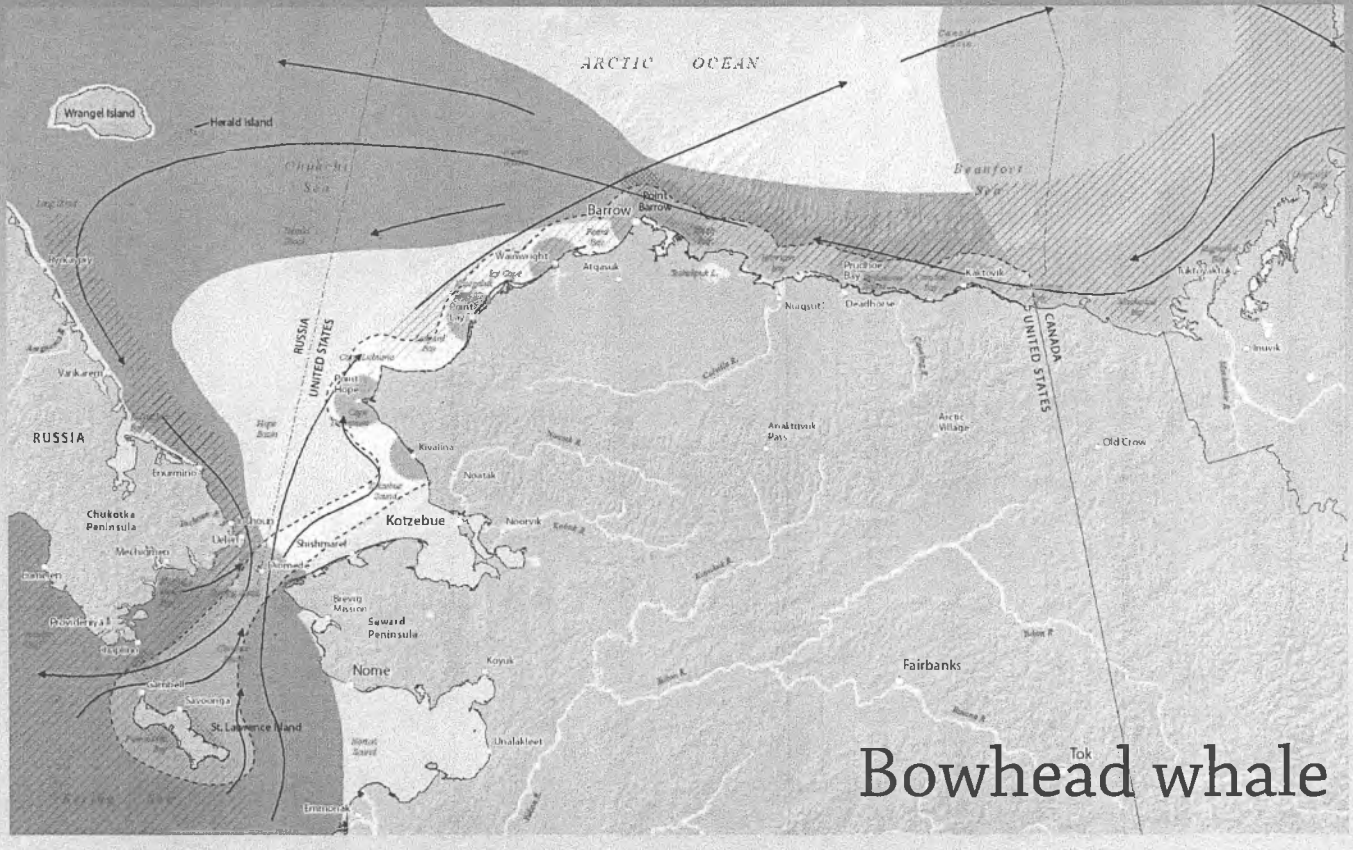


Sea surface temperature

Data Quality

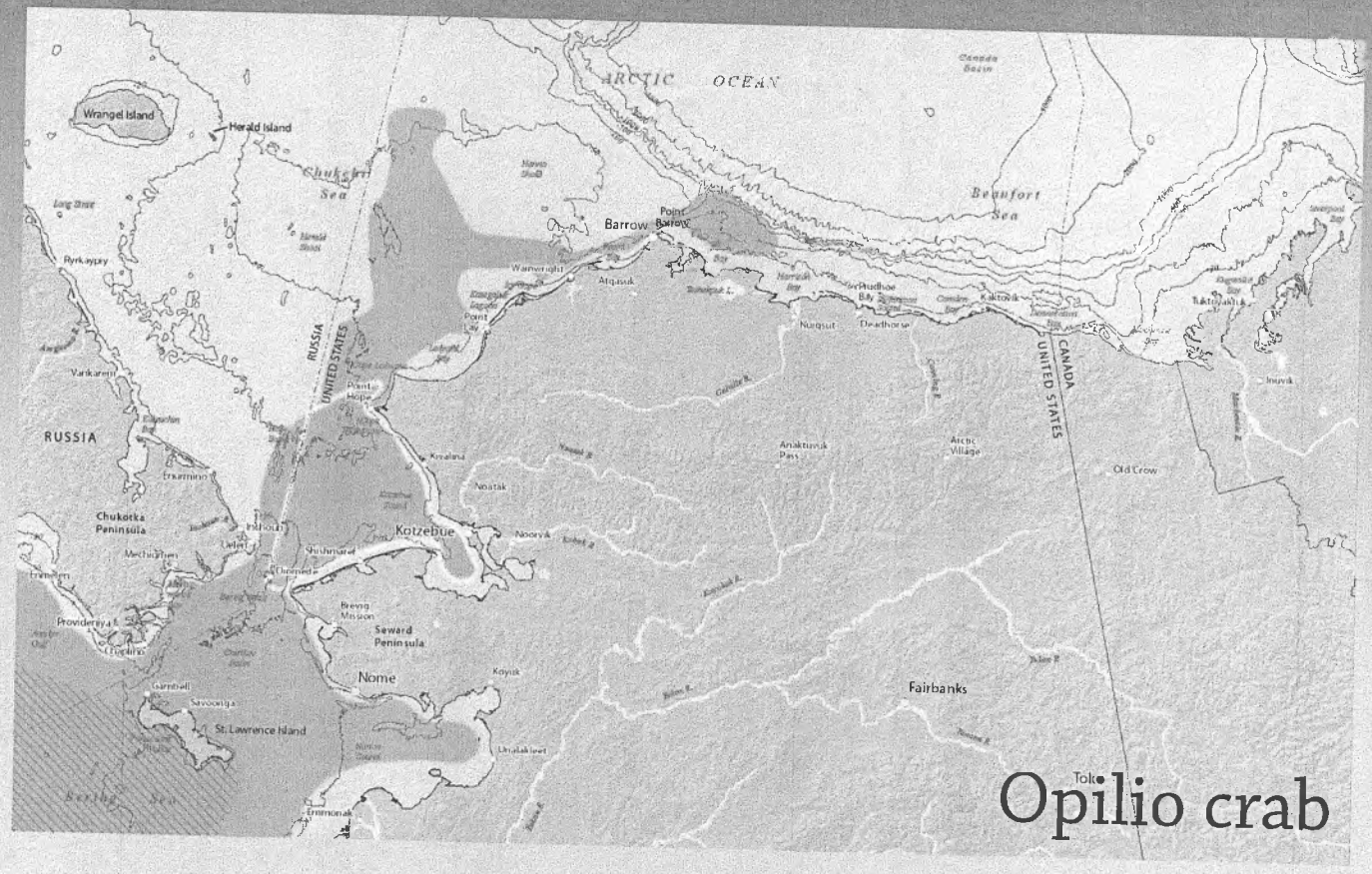
Fair: provides a variable geographic picture; some areas are represented by high-quality data and other portions are outdated or missing.



Bowhead whale

Data Quality

- **Poor**: provides an incomplete geographic picture; information is missing, outdated, or deficient.



Opilio crab

Data Gaps

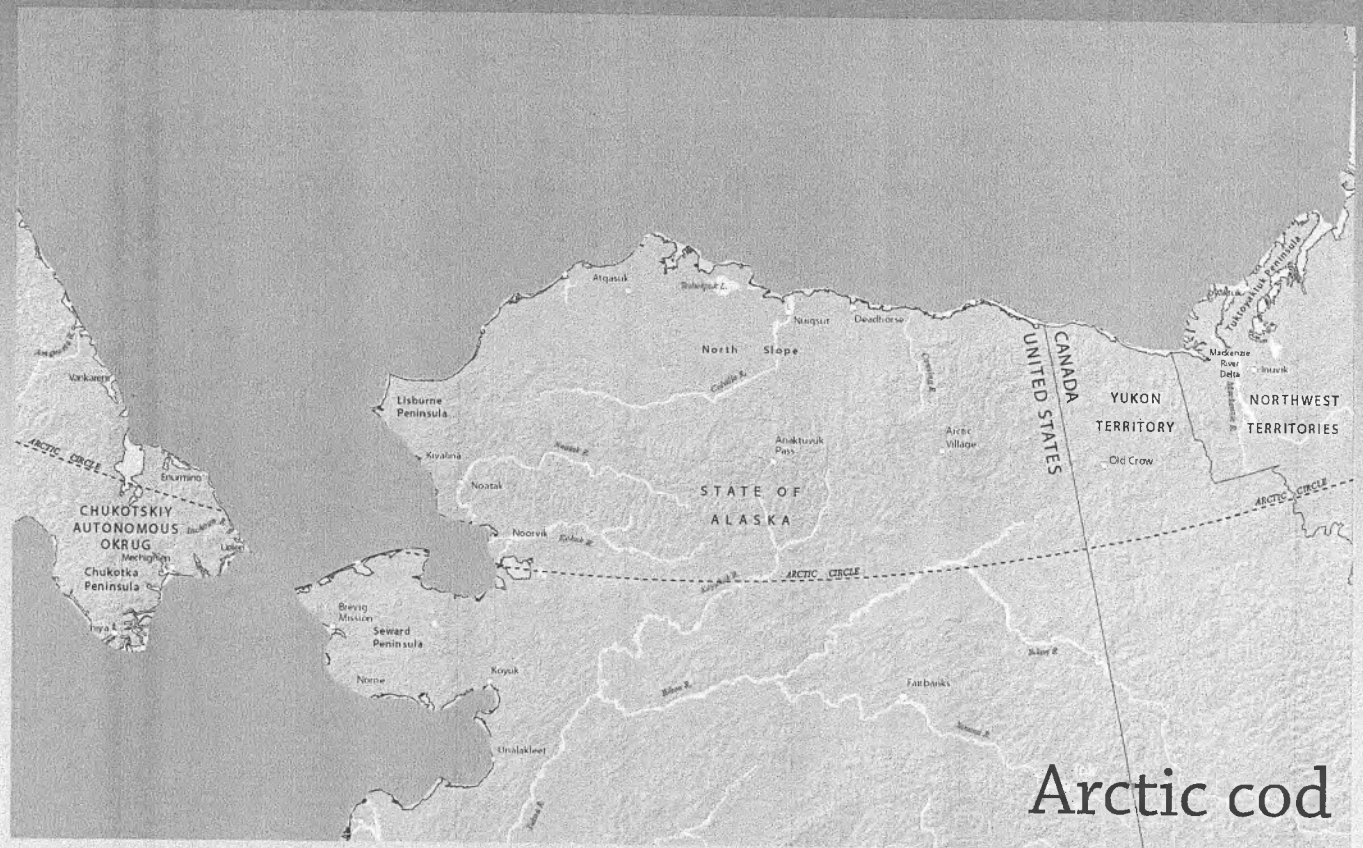
Types of Data Gaps

- **Topic:** little or no information, understanding is rudimentary.
- **Abundance:** Little or no information on population size or relative abundance among sites. Trends not detectable.
- **Spatial coverage:** Uneven sampling across the area of interest.
- **Temporal coverage:** no data to detect changes in patterns through time.
- **Spatial scale:** Fine-scale studies are not set up for broad-scale effects analysis; broad-scale data not meant for project planning.

Data Gaps

Types of Data Gaps

- **Topic:** little or no information, understanding is rudimentary.

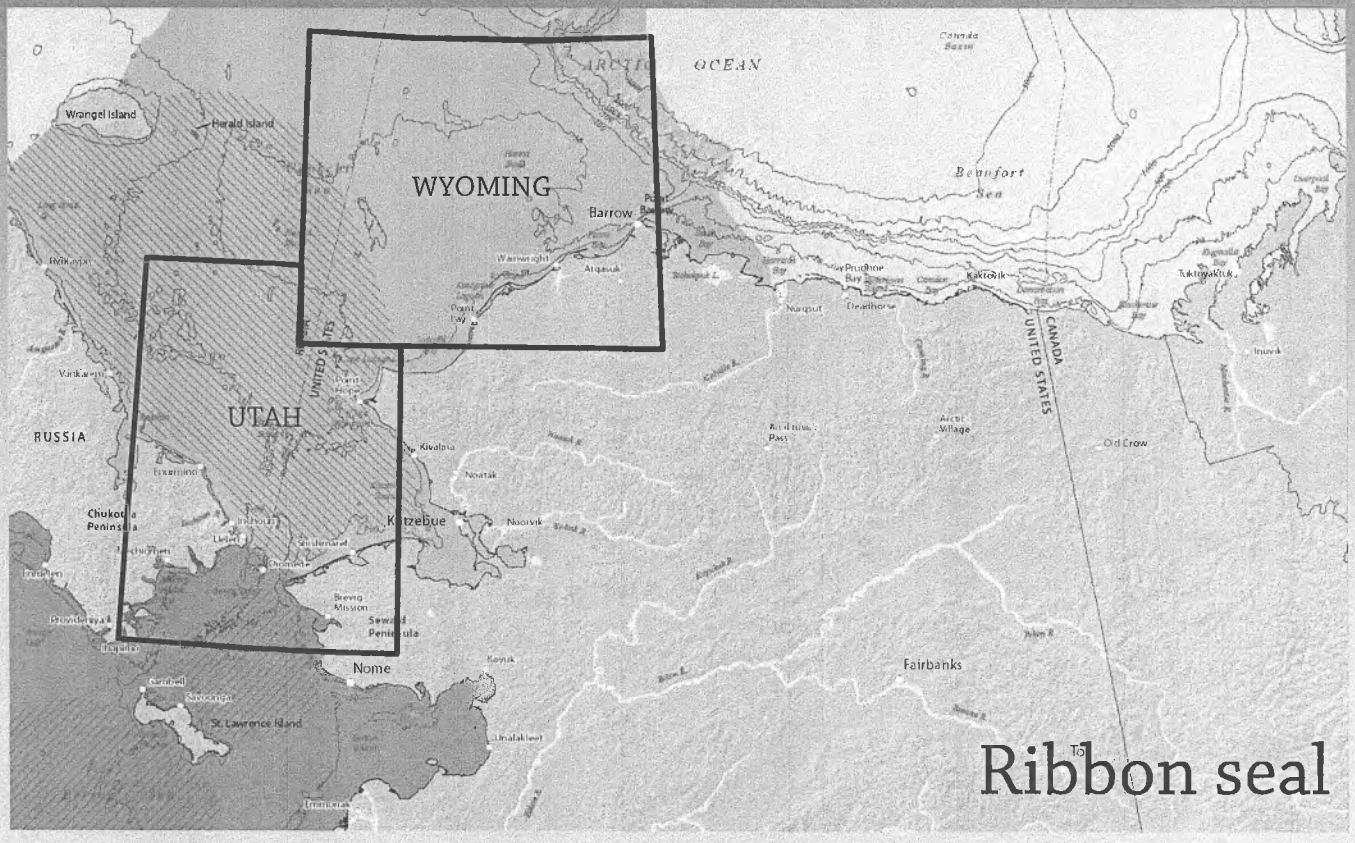


Arctic cod

Data Gaps

Types of Data Gaps

- **Abundance:** Little or no information on population size or relative abundance among sites. Trends not detectable.

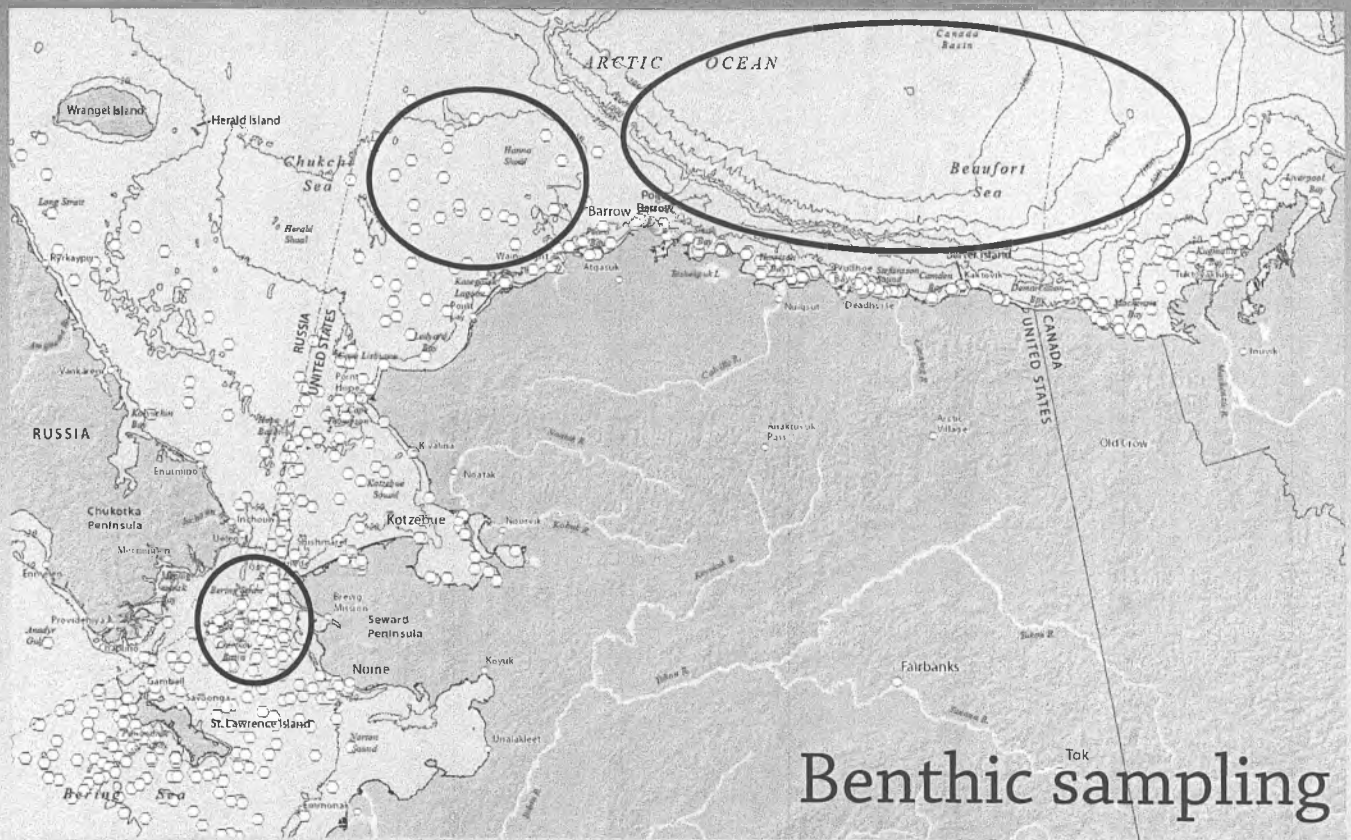


Ribbon seal

Data Gaps

Types of Data Gaps

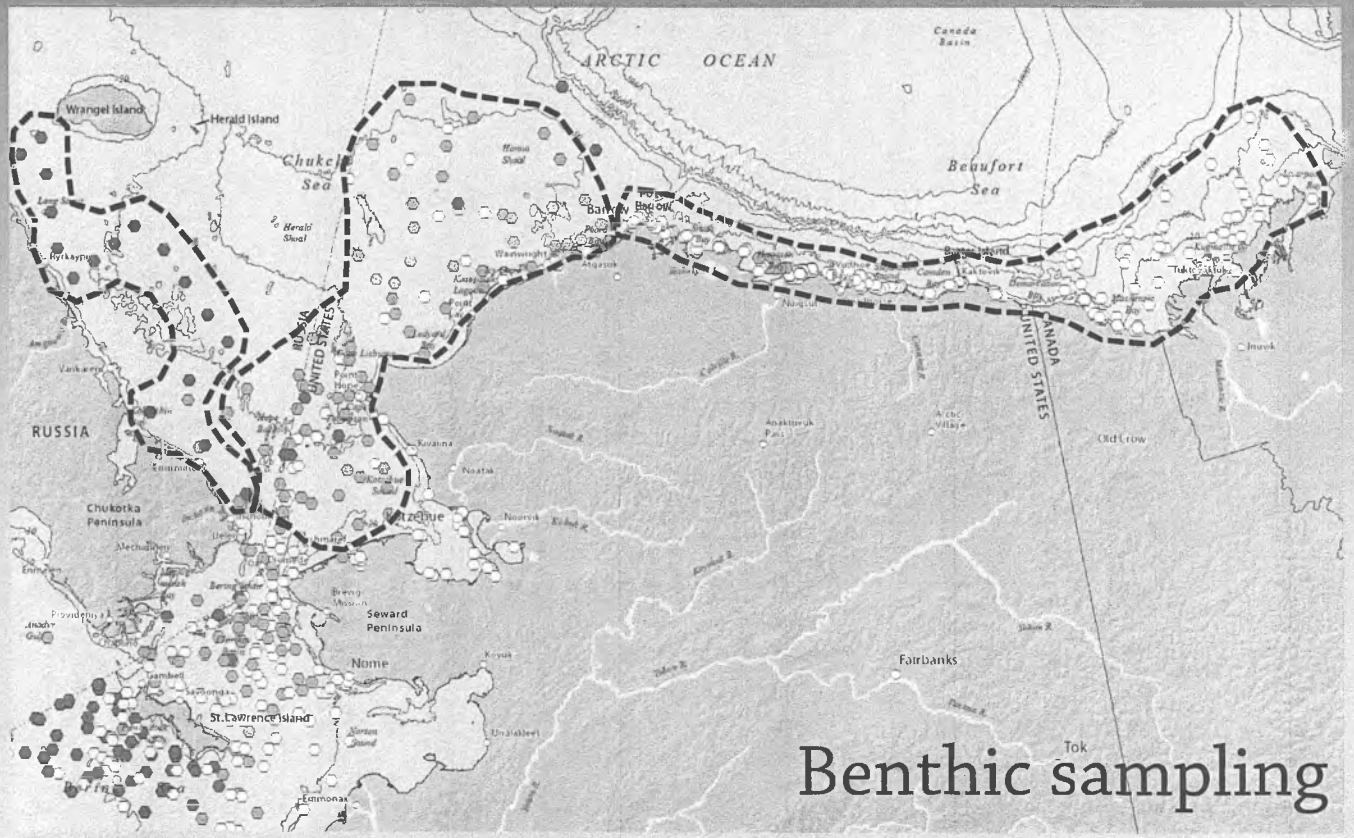
- **Spatial coverage:** Uneven sampling across the area of interest.



Data Gaps

Types of Data Gaps

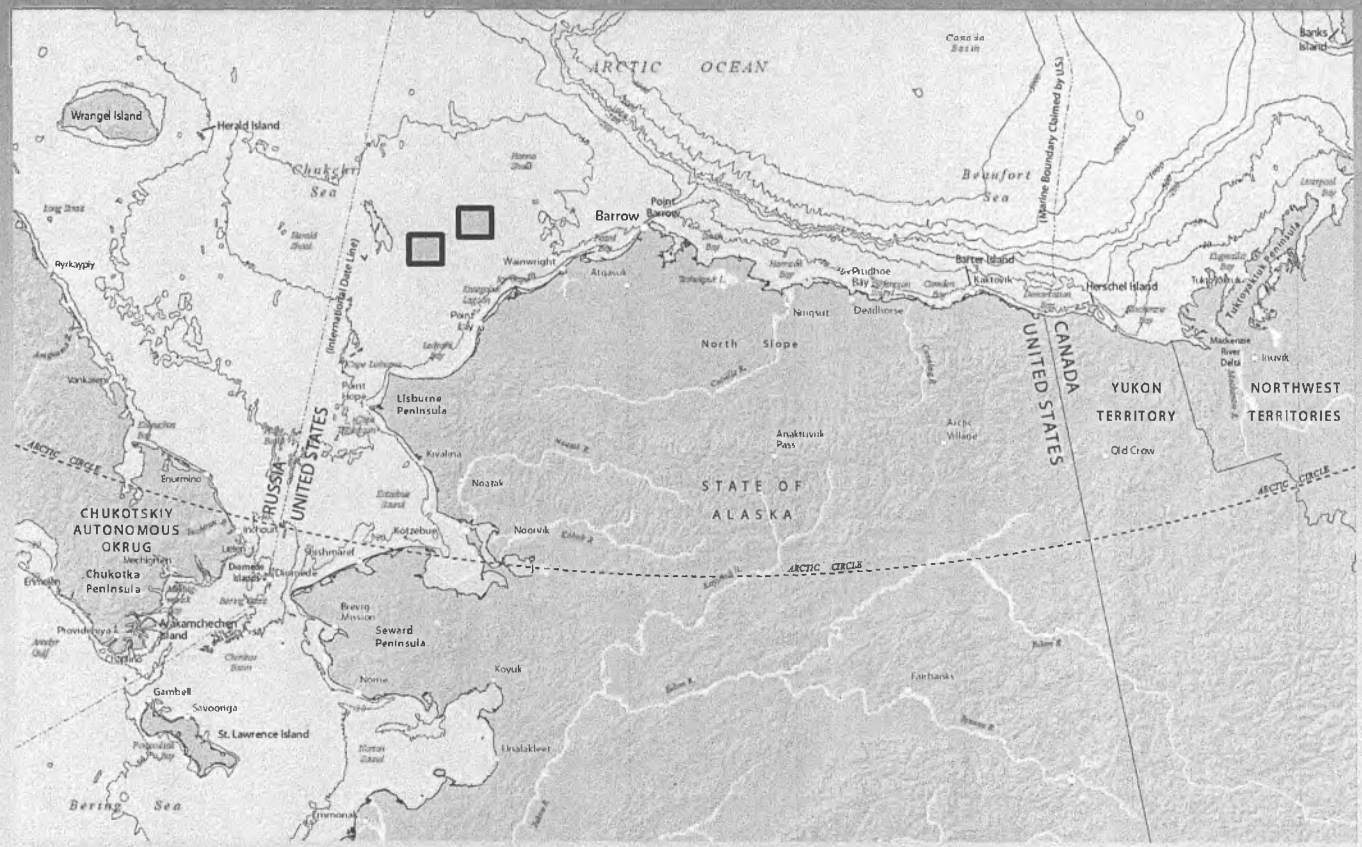
- **Temporal coverage:** no data to detect changes in patterns through time.



Data Gaps

Types of Data Gaps

- **Spatial scale:** Fine-scale studies are not set up for broad-scale effects analysis; broad-scale data not meant for project planning.



What Needs to Be Done

Make an Arctic science plan:

1. Integrate the latest research with older studies
2. Incorporate local and traditional knowledge
3. Assess data gaps spatially and temporally
4. Prioritize what we need to know
5. Create an action plan based on the USGS study

"Practical decisions about regulatory and mitigation issues are being made based on best available, but incomplete, knowledge which raises questions about how defensible these decisions are."

USGS report on data gaps

What Needs to Be Done

Data collection:

1. Revisit the Outer Continental Shelf Environmental Assessment Program (OCSEAP 1975-1982)
2. Design a sampling scheme which addresses data gaps
   - Topic: Collect data on understudied topics such as fish and invertebrates
   - Abundance: Set up sampling design to assess relative abundance between sites and total abundance within the Arctic EEZ
   - Spatial coverage: Sample the entire EEZ
   - Temporal coverage: Conduct repeated surveys for key resources, then continue long-term monitoring of key sites
   - Spatial scale: Optimize the spatial frequency of transects ; more intensive than OCSEAP
3. Collect local and traditional knowledge

What Needs to Be Done

Other recommendations:

1. Fund sustained scientific research and monitoring that matches the spatial scale of planning and development
2. Defer further leasing in the Arctic Ocean (Chukchi and Beaufort seas) during the next OCS 5-year plan (2012-2017)
3. Ensure effective oil spill response capability (dedicated nearby personnel and equipment)
4. Identify important coastal and offshore habitats that should be protected

Arctic Marine Data Synthesis and Research Gaps

Melanie A. Smith, Audubon Alaska

masmith@audubon.org

(907) 276-7034

Audubon ALASKA

The Relationship Between Permafrost and Infrastructure

A Scientist Viewpoint

Syngenetic

Talik

Epigenetic

Yetima

Lenticular Ice

Engineer's Viewpoint

Thaw Stable

Thaw Unstable

Consolidation

Ice Content

Bearing Capacity

Interests

Scientist Interested in How Permafrost Was Formed and It's History

Engineer Interested in How Permafrost Will Affect the Structure

Understanding How Permafrost was Formed and It's History Helps Predict How it Will Affect the Structure.

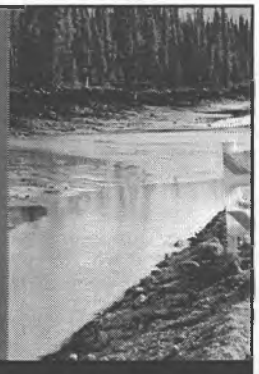
Building on Permafrost

Remove and Replace

Keep Frozen

Thaw

Accept Performance



Traditional Cost Analysis

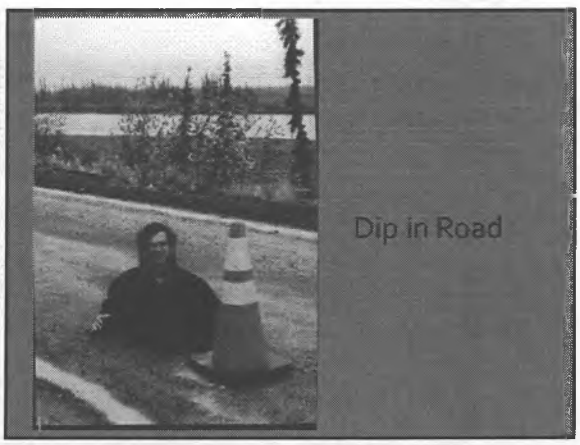
First Cost

Life Cycle Cost

A Review of Roadway Failures and What Causes Them

Differential Settlement

Causes of Differential Settlement



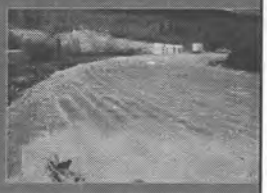
Dip in Road

Insulation

First Control Theme of Permafrost on TAPS

Works well on Cold Permafrost

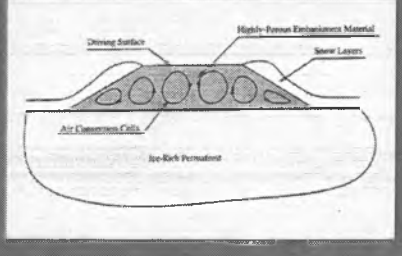
Doesn't Work on Warm Permafrost



Thermosyphons

Works Well, but High First Cost with High Maintenance

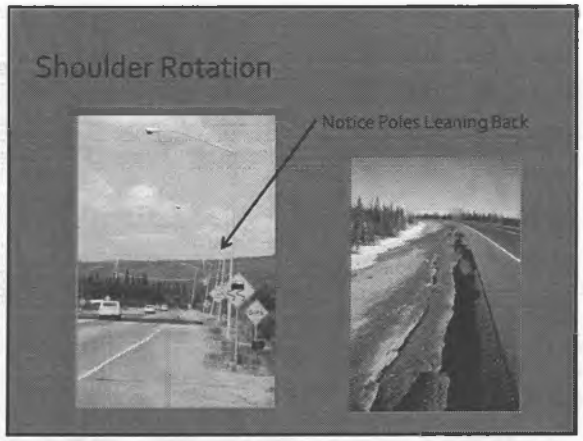
Air Convective Embankments



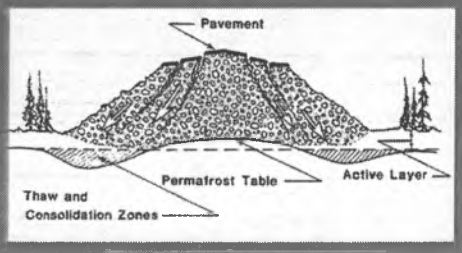
Works very well, but high first cost

Hairpin Thermosyphons

Shoulder Rotation

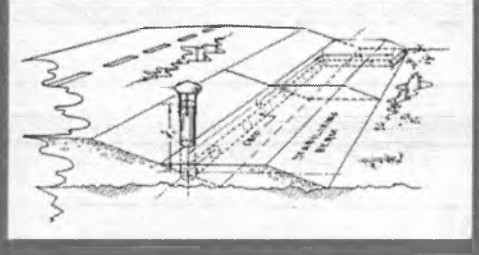


Cause of Shoulder Failures

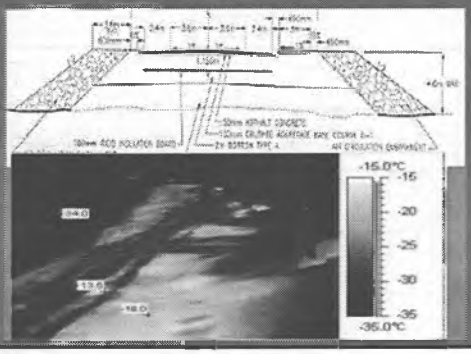


Shading Shoulders: Works well, but high first cost

Air Ducts: Works, but high first cost



ACE Works well even in warming climate, but usually high first cost



Slope Failures

Design Choices

Cut on a Slope and Insulate

High Risk of Failure, Moderate Consequences, High Cost

Cut on a Slope and vegetate

High Risk of Failure, Moderate Consequences, High Cost

Cut on a Slope and Cover with Rock

Low Risk of Failure, Low Consequences, High Cost

Cut Vertical and Let Nature Take its Course

Low Risk of Failure, Moderate Consequences, Low Cost

Last Two Work No Matter The Climate But EPA Says no Dirty Water.

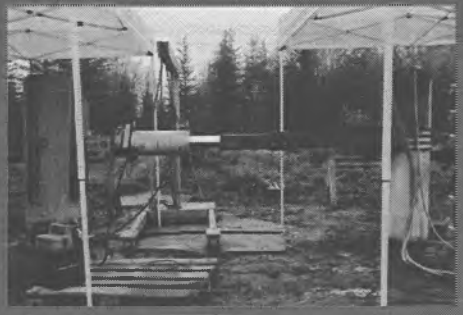
Seismic Risk

Structures Respond Differently in Frozen Ground

"...approximately 70,000 bridges located in seismic regions would be affected by seasonal freezing... Although all the bridges are affected across the world, it appears the effects of seasonal freezing are not routinely addressed in current seismic design practice around the world.

S. Saiidi

AUTC Research Is Changing Bridge Codes in Permafrost Areas.



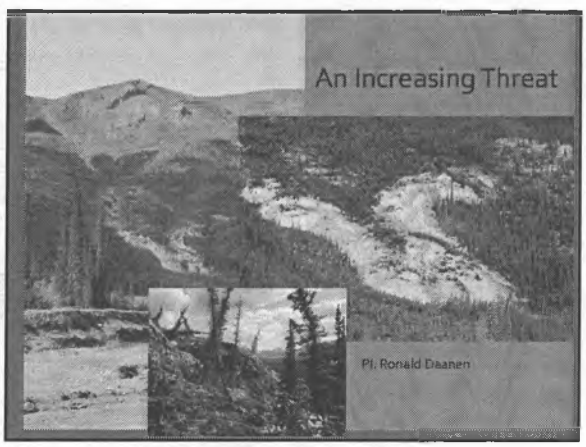
Liquefaction a Major Cause of Failure During Earthquakes

Does Frozen Soil Liquefy During a Seismic Event?

Yes, down to about -3 C

Thawing Permafrost the #1 Cause of Culvert Failure.

An Increasing Threat



Speed of debris glaciers

River and Coastal Erosion

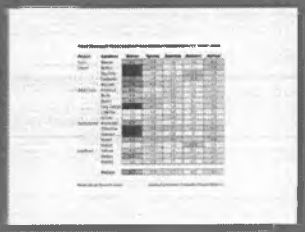
Not a New Process, but Late Freezeups Have Accelerated the Coastal Process

The new twist: No erosion control method considers thermal erosion.

Climate is Changing, But How?

The Answer Is Key to How We Look at Permafrost

There are Over 100 Accepted Climate Models Predicting Warming. All are Different.



Time for a New Approach

Rather than decision based on approach base decision on

- Cost
- Risk
- Consequences

Risk

Understanding the type of failure and the chances that failure will occur

Consequences

What happens should a failure occur?

Until Now That was Based on About 100 Years of Climate Data.

So Do We

Accept Performance

Remove and Replace

Keep Frozen

Or Thaw

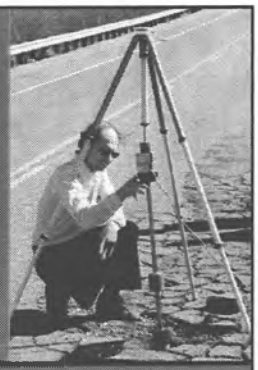
Or Do We Evaluate

Cost

Risk

Consequences

In an Uncertain Future

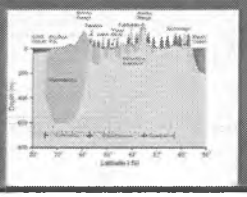


The Canadians are Choosing the Latter and Performing Vulnerability Studies.

Vulnerability Studies Allow us to Select Designs Which Will Be Best Suited to Our Future

Take-Aways

- Engineers and Scientists Must Begin to Work Together
- All Alternatives are Expensive, but we Must Move Away from the First Cost Paradigm
- We Must Adapt to an Uncertain Climate
- We Must Consider Cost, Risk and Consequences in Our Decision Process
- We Must Understand the Vulnerabilities of our Infrastructure to Thawing Permafrost



5

Testimony of Capt. Pete Garay Alaska Marine Pilots

ALASKA MARINE PILOTS LLC
P.O. Box 920226 - Dutch Harbor, AK 99692
Office (907)581-1240 - Fax (907)581-1372
www.alaskamarinepilots.com

Northern Waters Task Force Testimony of Captain Garay

Table of Contents

- Comments of Captain Pete Garay to the members of the Northern Waters Task Force
- State Compulsory Pilotage Authority Letter by Paul Kirchner and Clayton L. Diamond
- Arctic Marine Pilotage Letter by Curtis Thayer Chair with AK Board of Marine Pilots

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P.O. Box 920226 - Dutch Harbor, AK 99692
Office (907)581-1240 - Fax (907)581-1372
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To be good Stewards over the waters which we are licensed to protect

Good Afternoon,

I am Captain Pete Garay and am a member of Alaska Marine Pilots (AMP).

Since AMP's president Captain Carter Whalen has already testified before this committee my intention here today is only to address the closing comment that Captain Whalen left with you in his testimony before this task force in Dutch Harbor this summer and that comment was this: ***"AMP stands ready to help in the Arctic when and where it can."*** Unfortunately, before you or anybody else for that matter can determine how independent state licensed marine pilots may ultimately help in the Arctic there remains one outstanding questions that must first be answered which is this:

"What is the extent of a states authority to impose compulsory marine pilotage requirements in its coastal waters outside of three miles? "

This question has now been discussed / debated in front of Alaska's State Board of Marine Pilots for close to five years now and sadly has yet to be answered.

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P.O. Box 920226 - Dutch Harbor, AK 99692
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To be good Stewards over the waters which we are licensed to protect

After having heard numerous public testimony on the legality of compulsory marine pilotage (CMP) outside of a states traditional three mile limit the current Chairman of Alaska's State Board of Marine Pilots, (BOMP) Mr, Curtis Thayer drafted a letter on behalf his board to this states AG's office addressing this issue. I have that letter here today with me for your review. In this letter Chairman Thayer (to his credit) laid out the history of this issue, timelines of all ensuing public testimony and board discussion and concluded his letter with, and I quote:

"But how far outside of State waters may the board extend state marine pilotage requirements? Are special navigational factors (such as shallow waters, or extreme ice conditions) necessary to justify this extension? May the board impose pilotage requirements on vessels subject to AS 08.62 intending to moor along stationary structures such as a drilling platform? What about drilling platforms that are located outside of state waters? Are amendments in state law needed to authorize the board to adopt the measures it has discussed? What limits do federal laws place on the Boards authority in this area?" End quote.

I believe most would agree that these are, in fact, good questions.

Chairman Thayer's letter was sent to the AG's office over a year and a half ago. To date we have not seen a response from that office or Mrs. Gayle Horetski who normally handles all BOMP legal correspondence to the state. While the question is now almost two years old, given what is about to unfold in the Arctic AMP believes it is only appropriate that this state share its legal analyses / opinion on this matter with all vested stake holders.

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To be good Stewards over the waters which we are licensed to protect

With these thoughts in mind it is our specific request of this task force to focus on the legal questions surrounding pilotage. It seems that between the AG's office and Legislative Legal Services there are plenty of good legal minds to evaluate the question. AMP, however, is happy to assist in the evaluation if asked.

In addition, AMP would also ask the Task Force to consider recommending a special committee of the Legislature to assess how pilots would fit into Arctic OCS activity prospectively. That committee should be empowered to consider regulations to establish pilotage rules from the Bering Straits to the Canadian border. In the alternative, if as suggested at the Dutch Harbor meeting, there is an Arctic Shipping Risk Assessment recommended it is appropriate to recommend that a component of the analysis would be to determine the pilotage requirements for activity proposed in the Arctic.

I will close with another quote from a letter which I also have with me here today for your review that was written by Mr. Paul Kirchner. Mr. Kirchner serves as Executive Director and general counsel for the American Pilots Association. Mr. Kirchner's letter addresses not only the legality of the Chairman's question from the pilot's perspective but also from a good public policy position.

ALASKA MARINE PILOTS LLC
P.O. Box 920226 - Dutch Harbor, AK 99692
Office (907)581-1240 - Fax (907)581-1372
www.alaskamarinepilots.com

To be good stewards over the waters which we are licensed to protect

*"In our view, it is both responsible stewardship and forward – thinking for the government of Alaska to explore **now** how to utilize its pollution prevention and navigation safety authority in order to best protect its waters and marine environment. Because it would take some time to put in place the necessary pilotage infrastructure to meet the needs associated with such an extension of state pilotage waters, waiting until energy exploration and exploitation efforts are fully underway (and with it the resultant increase in commercial traffic) to consider enhanced compulsory pilotage regulation would not be prudent."* End quote.

Next year this state will more likely than not have an open water drilling season in the Arctic. The time is ***now*** to explore how to utilize the preventative tools at our disposal to protect the Arctic. Marine pilotage is one of those tools and should be given your full consideration.

AMERICAN PILOTS' ASSOCIATION

INCORPORATED
499 SOUTH CAPITOL STREET, S.W., SUITE 409
WASHINGTON, D.C. 20003
PHONE: 202-484-0700
FAX: 202-484-9320
www.americanpilots.org

CAPTAIN MICHAEL R. WATSON
PRESIDENT

CAPTAIN WHIT SMITH
SECRETARY-TREASURER

CAPTAIN GARY MADDOX
SENIOR VICE PRESIDENT
SOUTH ATLANTIC STATES

PAUL G. KIRCHNER
EXECUTIVE DIRECTOR-GENERAL COUNSEL

CLAYTON L. DIAMOND
DEPUTY DIRECTOR

LISA P. KATES
EXECUTIVE ASSISTANT

May 18, 2010

Captain Peter S. Garay, President
Alaska Marine Pilots, LLC
P.O. Box 920226
Dutch Harbor, AK 99692

RE: State Compulsory Pilotage Authority

Dear Captain Garay:

You asked the American Pilots' Association for analysis and responses to a series of questions regarding the extent of a State's authority to impose compulsory pilotage requirements in its coastal waters. We understand that these questions were posed in the context of the State of Alaska's ongoing consideration of extending its compulsory pilotage waters to cover newly ice-free areas of the Chukchi and Beaufort Seas and to extend pilotage requirements to vessels engaged in other than innocent passage in those waters.

In our view, it is both responsible stewardship and forward-thinking for the government of Alaska to explore **now** how to utilize its pollution prevention and navigation safety authority in order to best protect its waters and marine environment. Because it would take some time to put in place the necessary pilotage infrastructure to meet the needs associated with such an extension of state pilotage waters, waiting until energy exploration and exploitation efforts are fully underway (and with it the resultant increase in commercial vessel traffic) to consider enhanced compulsory pilotage regulation would not be prudent.

CAPTAIN ERIC A. NIELSEN
REGIONAL VICE PRESIDENT
NORTH ATLANTIC STATES

CAPTAIN MICHAEL C. TORJUSEN
REGIONAL VICE PRESIDENT
GULF STATES

CAPTAIN ALLEN J. "AJ" GIBBS
REGIONAL VICE PRESIDENT
GULF STATES

CAPTAIN PETER MCISAAC
REGIONAL VICE PRESIDENT
PACIFIC COAST STATES

CAPTAIN ROGER S. PAULUS
REGIONAL VICE PRESIDENT
GREAT LAKES

Responses to each of your questions are provided below.

a. *By how far outside of State waters may a State extend marine compulsory pilotage requirements?*

Neither the courts nor the Congress have established a geographic limit to a State's authority to assert its pilot regulations and pilotage waters. Rather, it is a well-established U.S. maritime law principle that a State can assert its pilotage authority and extend its compulsory pilotage waters as far from its coastline as the State reasonably believes is necessary to achieve the objectives of its compulsory pilotage system. *See, e.g.*, Gillis v. Louisiana, 294 F. 3rd 755 (5th Cir. 2002). The Court in that case held that the geographic reach of a state's pilotage jurisdiction is neither limited to three miles nor preempted by federal law.

Courts have consistently emphasized that a State's territorial limits (e.g., three nautical miles) is a wholly separate matter from the State's right to control navigation. Warner v. Dunlap. 532 F.2d 767, 772 (1st Cir. 1976). In cases dating back well over a century, a State's broad authority to establish and enforce its own compulsory pilotage regulations and requirements "at distances considerably greater than three miles from their shores" has been consistently upheld. *Id.* at 772. *See, e.g.*, Wilson v. McNamee, 102 U.S. 572, 573-574 (1881) (recognizing a State's authority to establish pilotage requirements out to at least "fifty miles from port"), and The Whistler, 13 F. 295, 296 (D.Or. 1882) (affirming state pilotage requirements out to at least "30 miles from the [river] mouth"). In summary, "wide latitude is given to the states in determining the waters in which a vessel must procure a state-licensed pilot" and there is no fixed distance from its shores beyond which a State is *per se* prohibited from establishing compulsory pilotage requirements. Admiralty and Maritime Law, at 150-151 (Robert Force ed., 2004).

b. *Are special navigational factors (such as shallow waters or extreme ice conditions) necessary to justify an extension of marine compulsory pilotage requirements beyond State Waters?*

Again, it is important not to merge the issue of a State's territorial waters with its right to establish and enforce compulsory pilotage requirements. States can establish their pilotage waters as far from their coast as is necessary to "promote navigational safety and to protect the environmental integrity of their coastlines (from, e.g., oil spills caused by tankers running aground) by regulating pilotage...." Warner, 532 F.2d at 772. While factors such as shallow waters, shoaling, reefs, bars, narrow channels, peculiar currents, environmental sensitivities, vessel traffic, and other localized navigational factors (which could include extreme ice conditions) may factor into a State's decision regarding the extent and nature of its compulsory pilotage system, State pilotage programs can and should be designed by each State government to meet its distinctive needs, address its unique challenges, and carry out its particular public policy objectives.

c. *Are amendments to Alaska state law required in order for the Alaska Board of Marine Pilots to extend the State's compulsory pilotage waters?*

We are not aware of any State or federal statutory provision or judicial holding that would require the authorization of the Alaska State Legislature before the Board of Marine Pilots could exercise its authority under AS 08.62.160 to define waters subject to the State's compulsory pilotage requirements.

d. *May a State impose compulsory marine pilotage requirements on vessels not intending to enter a State port, river, sound or other internal state waters?*

The present federal statutory provisions regarding the State regulation of pilotage, 46 U.S.C. § 8501 *et seq.*, do not expressly limit a State's authority to impose compulsory pilotage requirements to vessels intending to enter or depart from a port or place in that State. The grant of State authority over pilotage extends to pilotage in the "bays, rivers, harbors and ports of the United States." 46 USC §8501(a).[1] Obviously, this language looks to the location of the piloting activity, not to the origin or destination of the vessel, subject to the specific exemption from State regulation for U.S-flag vessels engaged in domestic, coastwise operations.[2]

Nevertheless, the U.S. Supreme Court has suggested that a State's authority to require a vessel to take a compulsory pilot is related to whether or not the vessel is bound to or from a port or place within that State. Wilson, 102 U.S. at 573. Moreover, as a matter of customary international law as reflected in the United Nations Convention on the Law of the Sea, it is our understanding that the U.S. government subscribes to the view that, as a general matter, compulsory pilotage requirements for foreign-flag vessel should be limited to vessels intending to enter or depart a port or place in the U.S.

e. *May a State impose compulsory marine pilotage requirements on vessels intending to moor along stationary structures, such as drilling platforms that are within State waters? What about drilling platforms that are beyond State waters? What limitations do federal laws place on a State's authority in this area?*

Based on federal statutes and a U.S. Customs Service (USCS) ruling, the regulation of activities associated with a drilling platform, whether within or beyond State waters,

---

[1] Each U.S.-flag coastwise vessel (e.g., a vessel transiting from one U.S. port to another) is required by federal law to use a pilot holding a federal license issued by the Coast Guard. *See* 46 U.S.C. § 8501(d).

[2] It should also be recognized that § 8501(a) is in no way a geographic limitation on State authority to regulate pilotage. In analyzing § 8501(a) and its reference to "bays, inlets, rivers, harbors, and ports," courts have made clear that "[r]ather than a limited grant of authority to the states over the specified bodies of water, the statute has been interpreted as an expression of Congress' general intent *not* to limit the power already held by the states...." Gillis, 294 F. 3rd at 761. (original emphasis).

falls under federal jurisdiction and the federal coastwise laws apply.[3] Specifically, pursuant to section 4(a) of the Outer Continental Shelf Lands Act of 1953 (OCSLA), as amended (67 Stat. 462; 43 U.S.C. § 1333(a)), the laws and jurisdiction of the United States are extended to:

> "...the subsoil and seabed of the outer Continental Shelf and to all artificial islands, and all installations and other devices permanently or temporarily attached to the seabed, which may be erected thereon for the purpose of exploring for, developing, or producing resources therefrom...to the same extent as if the outer Continental Shelf were an area of **exclusive Federal jurisdiction located within a State.**" (emphasis added).

Based upon this statutory provision, the USCS ruled that U.S. "coastwise laws are extended to...drilling platforms...and similar structures [on the outer Continental Shelf]...." Customs Letter 115293, dated March 7, 2001. If the oil platforms are located not on the outer Continental Shelf, but within state waters (3 nautical miles), they would clearly fall within in coastwise waters and, pursuant to 46 U.S.C. § 8501(d), a state's pilotage regulatory authority is limited.

Based upon the foregoing federal statutes and the ruling of the USCS, it appears that oil drilling platforms fall within the class of structures subject to U.S. coastwise laws and a State would, therefore, be limited in its authority to require compulsory pilotage for vessels intending to moor alongside such a structure.

Please feel free to call on the American Pilots' Association if we can provide any further assistance. Alaska's consideration of extending its compulsory pilotage requirements in order to meet the navigational safety challenges of newly opening Arctic waters is an important development in pilotage, and we will continue to support your efforts.

Sincerely,

Paul G. Kirchner
Clayton L. Diamond

[3] This response was focused exclusively on drilling platforms. Pursuant to the Deepwater Port Act of 1974 (33 USC 1501 *et seq*), and specifically §1518(a)(2), a deepwater port located within state territorial waters, may be subject to State laws, including pilotage requirements.

STATE OF ALASKA
DEPARTMENT OF
COMMERCE
COMMUNITY AND
ECONOMIC DEVELOPMENT
Office of the Commissioner

Sean Parnell, Governor
Emil Notti, Commissioner

April 29, 2010

The Honorable Daniel S. Sullivan
Attorney General
State of Alaska
Department of Law
P. O. Box 110300
Juneau, Alaska 99811-0300

Re: Arctic Marine Pilotage

Dear Mr. Sullivan:

As you know, there is tremendous national and international interest in the Arctic region. Continued reduction of the Arctic ice cover is expected to allow increased access to the region. The Arctic region is rich in natural resources, including fish, marine mammals, seabirds, oil, gas, and other minerals.

Over the last couple of years the Alaska Board of Marine Pilots (Board) has been discussing the extension of mandatory marine pilotage waters from those set out in 12 AAC 56.090 and 12 AAC 56.100 to encompass large areas of the Chukchi and Beaufort Seas. The boundaries of the proposed new mandatory marine pilotage waters include the outer continental shelf oil and gas lease areas where exploratory drilling is expected to occur this summer.

The Board is seeking advice from your office regarding the extent of the Board's authority under existing state and federal laws to adopt regulations that extend the state's mandatory marine pilotage waters to include large areas of the Chukchi and Beaufort Seas. Some background follows.

Like other U.S. maritime states,[1] Alaska requires foreign vessels and U.S. "registered vessels" heading for its ports, or transiting inland waters, to employ a state-

[1] *See generally*, A. Parks, The Law of Tug, Tow, and Pilotage 991-1003 (3rd ed. 1994).

P.O. Box 110800, Juneau, Alaska 99811-0800
Telephone: (907) 465-2500 Fax: (907) 465-5442 Text Telephone: (907) 465-5437
Email: questions@commerce.state.ak.us Website: http://www.commerce.state.ak.us/

licensed marine pilot.[2] The marine pilot boards the foreign vessel and guides it into and out of port, or through navigational hazards in inland waters.

The seven-person Board of Marine Pilots regulates marine pilotage in Alaska.[3] Under AS 08.62.040(a)(1) - (3), the Board must "provide for the maintenance of efficient and competent pilotage service", regulate the training, examination, and licensure of marine pilots, and "keep a register of licensed pilots, licensed deputy pilots, and agents". AS 08.62.040(a)(1) requires the Board to adopt regulations to "assure the protection of shipping, the safety of human life and property, and the protection of the marine environment" on the "inland and coastal water of and adjacent to the state".
AS 08.62.160 requires the Board to "define the mandatory pilotage water of the state", and requires a vessel subject to AS 08.62 to employ a state-licensed marine pilot while "navigating the inland or coastal water of or adjacent to the state".[4] Violation of this requirement is a misdemeanor crime.[5]

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[2] AS 08.62.160. The federal government has authority over commerce and shipping, but federal statutes grant authority for marine pilotage laws to the states.
46 U.S.C.A. sec. 8501(a) states: "[e]xcept as otherwise provided in this subtitle, pilots in the bays, rivers, harbors, and ports of the United States shall be regulated only in conformity with the laws of the States." Under 46 U.S.C.A. sec. 8502(a) vessels licensed under U.S. laws engaged in domestic or coastwise trade fall under the jurisdiction of the U.S. Coast Guard, and are not subject to state pilotage laws. These are commonly referred to as "enrolled vessels". *Hochstetler v. Board of Pilot Commissioners*, 8 Cal. Rptr. 2d 403, 407 (Cal. App. 1 Dist. 1992). Foreign vessels and U.S. licensed vessels "sailing on registry" must comply with state pilotage laws. *Ray v. Atlantic Richfield Co.*, 435 U.S. 151, 159-160 (1978), T. Schoenbaum, 2 Admiralty and Maritime Law, sec. 13-1 (4th ed. 2004). These are commonly referred to as "registered vessels". *Hochstetler v. Board of Pilot Commissioners*, 8 Cal. Rptr. 2d 403, 407 (Cal. App. 1 Dist. 1992).

[3] AS 08.62.040. The Board consists of two licensed marine pilots, two registered vessel agents, two members of the public, and the commissioner of DCCED or the commissioner's designee; AS 08.62.010.

[4] State waters are not defined in AS 08.62, but under AS 44.03.010 the state asserts jurisdiction over "water offshore from the coast of the state", including (1) the "marginal sea", (2) the high seas claimed by the United States, and (3) the submerged lands under that water.

[5] AS 08.62.190.

The boundaries of those areas where use of a state-licensed marine pilot is mandatory are set out in 12 AAC 56.090 and 12 AAC 56.100. 12 AAC 56.090 is a general provision. In 2008[6] 12 AAC 56.090 provided, in part: "[p]ilotage is compulsory at all entrances from seaward to Alaska bays, sounds, rivers, straits where the passage is within three nautical miles of this state, or other estuaries for which specific boundaries are not otherwise described in this chapter."

The boundaries of mandatory pilotage waters in specific locations are set out in 12 AAC 56.100. 12 AAC 56.100(14) describes the mandatory pilotage waters along the coast of the Chukchi Sea and in Kotzebue Sound.

During a public comment period at a Board meeting held on January 22-23, 2008, a licensed marine pilot asked the Board to consider the adoption of a Board regulation to extend the compulsory (mandatory) pilotage waters from those set out in 12 AAC 56.090 and 12 AAC 56.100. The marine pilot suggested that the compulsory pilotage waters be extended out into the Chukchi and Beaufort Seas to an area roughly concurrent to outer continental shelf oil and gas lease areas.[7]

As originally proposed, pilotage would be compulsory for all vessels subject to AS 08.62 "engaged in commercial activities" within the designated waters of the Chukchi and Beaufort Seas. As proposed, the pilotage requirements would not have been restricted to vessels entering state ports, rivers, sounds, etc., but would have applied to all commercial vessels moving through the specified waters (including oil exploration and drilling vessels).

By a vote of four to three, the Board members voted to accept the marine pilot's suggestion for a proposed regulation to extend compulsory pilotage waters into the Chukchi and Beaufort Seas. A public notice of the proposed amendment to 12 AAC 56.100(14), requesting public comment on the proposed language, was issued on March 13, 2008.[8]

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[6] As explained later in this memorandum, 12 AAC 56.090 has been amended slightly, effective November 4, 2009, Register 192.

[7] These leases are under the authority of the U.S. Department of the Interior, Minerals Management Service.

[8] This is a necessary first step in the adoption of an administrative regulation under AS 44.62.020--300 (Administrative Procedure Act); AS 44.62.190, 44.62.200.

Significant public comment on the proposed amendment was received, both in support of and in opposition to the proposal. The Board held a public hearing on the proposal at a meeting on April 18, 2008. Many of those who commented supported the proposed expansion of compulsory pilotage waters, citing the need to protect the fragile Arctic ecosystem, fish and wildlife, and indigenous peoples. Other commentators expressed concern that such a significant expansion of compulsory pilotage waters might be interpreted to apply to vessels not bound for Alaska ports, but merely passing through the lease areas, and would exceed the Board's authority. Oil companies interested in resource development in the Arctic, including ConocoPhilips, Shell Oil, and BP, were generally opposed to the proposed expansion of compulsory pilotage waters.

The Board voted to revise the proposed language in response to some of the comments received, including clarification of the right to "innocent passage".[9] The Board requested public comment on the revised version in a supplemental notice issued on June 23, 2008. The revised version also contained some technical clarifications to other existing regulations. The revised version included a new cross-reference in 12 AAC 56.090, the revised boundaries in 12 AAC 56.100(14), some technical amendments in 12 AAC 56.990(a)(5) and (8), and added a definition of the state's coastline in 12 AAC 56.990(a)(39).

A second public hearing was held at a Board meeting on October 1, 2008. The Board again considered testimony and several written comments received. The proposed amendments were further revised, and a second supplemental public notice requesting comments was issued on February 18, 2009.

A third public hearing was held at a Board meeting on April 15, 2009. At that hearing the Board decided to adopt the remaining proposed language changes dealing with the general boundaries of compulsory marine pilotage waters and definitions, but not to adopt the proposed new compulsory marine pilotage areas in the Chukchi and Beaufort Seas. These adopted regulations contain changes only to 12 AAC 56.090 and 12 AAC 56.990(a)(5) and (8), and the new definition in 12 AAC 56.990(a)(39). By the addition of the words "inlets, harbors, ports" and "adjacent to Alaska" the revised regulations are intended to make the scope of the regulations identical to the legislature's

[9] The right of innocent passage refers to the right to navigation through the territorial sea by ships of all nations, to traverse the area without entering internal waters or proceeding to or from internal waters or a port. *See* U.N. Convention on the Law of the Sea, Arts. 17 & 18 (1982).

grant of jurisdictional authority to the Board in AS 08.62.040(a)(1). These regulation changes took effect on November 4, 2009.

The Board concluded that further consideration was needed on some aspects of the Arctic pilotage proposal. A Board subcommittee was appointed to study the issue in more detail. At a Board meeting on January 28, 2010, the chair of the Board subcommittee reported his conclusion that the subcommittee likely would be unable to resolve the concerns expressed about the proposed expansion of compulsory marine pilotage into Arctic waters. Some subcommittee members questioned whether the Board possessed the legal authority to adopt the proposed regulation changes.

At a meeting held on April 28, 2010, the Board decided to ask your office for assistance in determining the scope of the Board's authority in this area.
AS 08.62.040(a)(1) requires the Board to regulate marine pilotage "on the inland and coastal water of *and adjacent to* the state" (emphasis added). By its own terms, this legislative grant of authority to the Board appears to contemplate marine pilotage requirements extending beyond state waters.[10]

But how far outside of state waters may the Board extend state marine pilotage requirements? Are special navigational factors (such as shallow waters, or extreme ice conditions) necessary to justify this extension? May the Board impose pilotage requirements on vessels subject to AS 08.62 that do not intend to enter state ports, rivers, or sounds, or even to enter state waters at all? May the Board impose pilotage requirements upon vessels subject to AS 08.62 intending to moor along stationary structures such as a drilling platform? What about drilling platforms that are located outside of state waters? Are amendments in state law needed to authorize the Board to adopt the measures it has discussed? What limits do federal laws place on the Board's authority in this area?

The Board requests advice from your office addressing the above questions, and the extent of the Board's legal authority to adopt the proposed mandatory pilotage

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[10] Maritime zones recognized under international law include: internal waters (3 nautical miles), territorial sea (12 nautical miles), contiguous zone (24 nautical miles), exclusive economic zone (200 nautical miles), and the high seas. Courts have approved mandatory marine pilotage requirements imposed by state law on vessels located many miles outside of state waters. *See, e.g., Gillis v. Louisiana*; 294 F.3d 755 (5th Cir. 2002).

STATE OF ALASKA
DEPARTMENT OF
COMMERCE
COMMUNITY AND
ECONOMIC DEVELOPMENT
Office of the Commissioner

Sean Parnell, Governor
Emil Notti, Commissioner

requirements described above. Thank you for your assistance to the Board on this important legal issue.

Sincerely,

EMIL NOTTI
Commissioner

By:
Curtis Thayer, Chair
AK Board of Marine Pilots

CT/eeh

P.O. Box 110800, Juneau, Alaska 99811-0800
Telephone: (907) 465-2500 Fax: (907) 465-5442 Text Telephone: (907) 465-5437
Email: questions@commerce.state.ak.us Website: http://www.commerce.state.ak.us/

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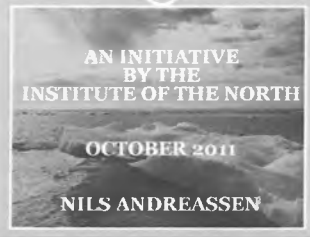
Arctic Infrastructure & Advocacy

Arctic Infrastructure and Advocacy



About the Institute

Growing Success

- Strategic partnership with UAF
- 10 new board members
- 200 participants in quarterly Arctic Policy Forums
- 550 participants in our first Week of the Arctic
- 200 attendees at the Emerging Leaders and Alaska Dialogue
- 300 young Alaskans at Institute events
- 100 Alaskans educated about ANILCA
- An Arctic Council-approved project
- Launch of the Arctic Energy Network

Sustainable Projects

- Arctic Council projects respond to real need.
- AMATII builds on the work of others...
  - The Circumpolar Infrastructure Task Force (CITF) and the Arctic Aviation Experts Conference
  - The Arctic Marine Shipping Assessment (AMSA) – recommendations 3(a) infrastructure development and 3(c) accessing response capacity

Building a Foundation for...

- Community
- Cultural
- Economic
- Environmental

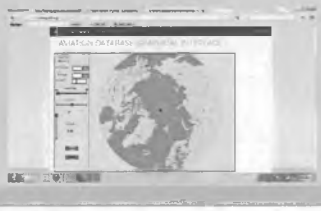
.....Resiliency!

Sustainable Development

- Connectivity
  - Connecting people to one another
  - Leveraging resources effectively
- Intermodal response capacity
  - Response should be rapid, dynamic and efficient
  - Ability is dependent on available resources

Deliverables

- Arctic Ports Dialogue and the Arctic Aviation Experts Conference
- Arctic Transportation Infrastructure Database and Map



Next Steps

- US has committed to this project – Iceland as co-lead country
- US DOT Maritime Administration, State Department, University of Alaska Fairbanks have all committed financial resources – more needed to meet full budget
- Identification of a steering committee to provide additional scope for this project, along with Subject Matter Expert Groups
- Hosts for the Arctic Ports Dialogue and Aviation Conference

Arctic Energy Network

- *Vision* - The exchange of knowledge results in the responsible development of Arctic energy resources and improves the economic, social and environmental conditions of Arctic communities, states and nations.
- *Mission* - The AEN connects stakeholders in Arctic energy issues, building bridges and creating opportunities to learn, teach and collaborate on shaping the emerging and best practices in Arctic energy policies, technology, infrastructure and security.

AEN

- Hosting networking and learning opportunities
- Educating policy makers and administrators
- Seeking out and sharing best practices

AEN

- Supporting collaborative research opportunities
- Convening around emerging energy issues
- Conducting research projects on critical challenges
- Hosting the Arctic Energy Summit

Arctic Energy Principles

- Energy should be affordable, reliable and accessible.
- Energy wealth should be invested to support community and economic development.
- A balance of non-renewable and renewable energy sources is necessary.
- Wise energy development is the cornerstone to economic sustainability in the Arctic.

Moving Forward

- Keep it simple
- Invest in success
- Educate and broaden outreach
- Build capacity, competitiveness, and competency

An Alaska Arctic Agenda

- Arctic policy development
  - Comprehensive approach
- Infrastructure investment
  - Linking transportation with energy
- Response capacity
  - Coordination command centers
- Intermodal connectivity
  - Ground, air and water transportation of resources and people
- Cross-border collaboration and sharing
  - International best practices for remote or rural economies
- Local, private, public, academic input
  - Clear lines of consultation

Thank you

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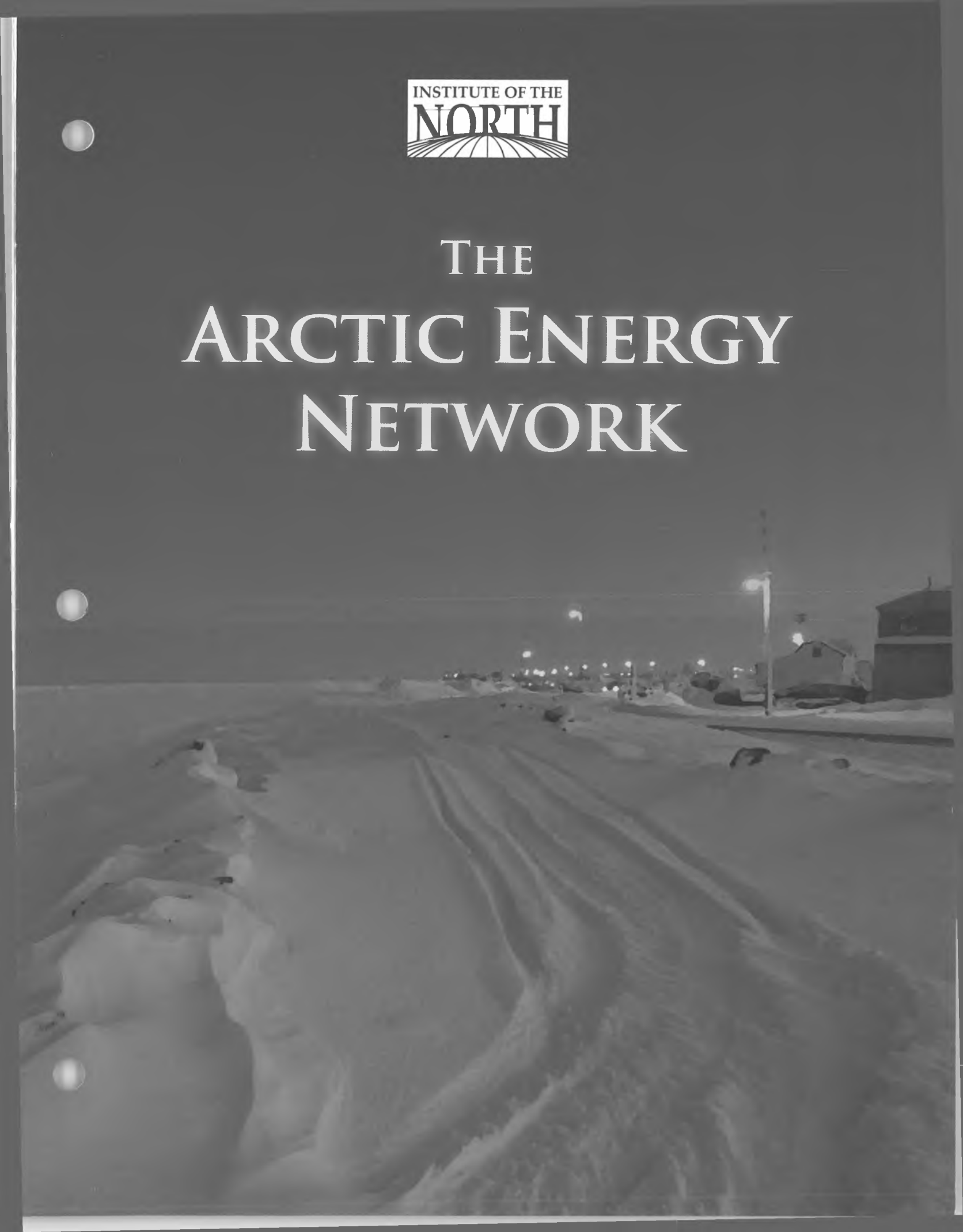
THE ARCTIC ENERGY NETWORK



Appendix A

Members of the AEN have indicated recommended the following areas of work for the Arctic Energy Network to focus their energy and attention on. The AEN Advisory Council will assist in prioritizing the most cutting edge issues, developing projects and promoting opportunities for members to engage each other, exchanging knowledge and pioneering new thoughts on these and many other critical arctic energy issues.

COMMUNITY ENERGY ISSUES

Arctic communities are consumers of energy that is not often affordable, reliable or accessible to them, greatly impacting their sustainability. In finding community energy solutions, topics of interest include improving the transportation, storage and transmission of energy, developing stranded renewable resources, improving energy efficiency, improving and developing new technology for community energy projects, financing research for development, testing and implementation of new technology, creating viable energy markets in remote and rural locations, reducing diesel consumption, and enhancing leadership development and training opportunities for local people to administer, develop and improve on community energy solutions.

RESOURCE DEVELOPMENT

Responsible development of extractive and renewable energy resources is a challenge and an opportunity in the Arctic. It is estimated that 25% of the undiscovered global oil and gas resources are in the Arctic as well as bountiful supply of renewable resources including bio-mass, wind and geothermal energy. Creating infrastructure to develop and transport these resources, addressing indigenous and other community concerns with resource development, the security of the projects being developed, evaluating new technologies that are being deployed, sharing best practices for development in sensitive Arctic environments, promoting technology exchange between the renewable and extractive energy sectors, and strengthening trust and facilitating better relationships are among the hot topics that the members of the AEN are interested in.

PUBLIC POLICY

Public policy for the Arctic has not necessarily kept pace with the changes in the Arctic. While Arctic environment has been the subject of much hotly contested policy work, the Arctic as a global commons, indigenous rights, stewardship, local, national and international standards for development, improvements in regulatory structures, disaster mitigation, public-private partnerships, projected increases in Arctic development particularly by non-Arctic nations, sovereign wealth funds, sustainability of communities, the effects of climate change, reducing black carbon, and other unique Arctic issues have received less attention.

DATA COLLECTION

Significant gaps still exist in the Arctic knowledge base that can be filled by the AEN from creating a comprehensive database of expertise, knowledge, best practices and current projects in the Arctic, to mapping energy use in the Arctic and proving assessments of resource wealth and renewable energy resources.

INSTITUTE OF THE NORTH
509 WEST THIRD AVENUE, SUITE 107
ANCHORAGE, ALASKA 99501
Phone: (907) 771-2444
Fax: (907) 771-2466
www.institutenorth.org

Arctic Maritime and Aviation Transportation Infrastructure Initiative

Providing a Comparative Analysis of Port and Airport Infrastructure in Arctic Nations

Proposal Developed by the Institute of the North
Anchorage, Alaska, United States

June 2011

DRAFT

Arctic Maritime and Aviation Transportation Infrastructure Initiative

Coordinating Institution
Institute of the North
509 West Third Ave., Suite 107
Anchorage, AK 99501
United States

Lead Country
United States

Co-Lead Country (proposed)
Iceland, Canada and/or Norway

- Participation as co-lead country could mean a financial contribution, an in-kind contribution of staff/technical resources or agreement to host either the Arctic Port Response Infrastructure Conference or Arctic Aviation Experts Conference

Principal Investigator
Nils Andreassen, Institute of the North

Steering Committee and Work Group members (potential)
Composed of government, academic and private sector entities
See attached for draft list

Deliverables

- Guidance document to include benchmarking and baseline assessment of port and airport infrastructure
- Web-based, interactive map of current maritime and aviation infrastructure
- Arctic Aviation Experts Conference and Arctic Port Response Infrastructure Conference

Accountability
Outcomes will be communicated regularly to the Sustainable Development Working Group of the Arctic Council.

Deliverables will better illustrate gaps in knowledge and capacity; and may propose guidelines for addressing both. Any formal recommendations produced from this process will be reviewed by SDWG members for approval.

Deliverables will be included for submission as a product of SDWG under the 2011-2013 Swedish Chairmanship.

Overview

The Arctic Maritime and Aviation Transportation Infrastructure Initiative (Initiative) is a result of the work of the Arctic Council's Arctic Marine Shipping Assessment (AMSA) and the on-going work of a multi-agency (including DOT, FAA and Transport Canada) effort that sponsors the Arctic Aviation Initiative (AAI). It builds on and responds to past efforts and projects of two working groups within the Arctic Council – PAME's AMSA (2009) and the SDWG's Circumpolar Infrastructure Task Force (CITF), which acted as a platform for the Arctic Aviation Experts Workshop in 2005 and 2006. More directly, it follows on the strategic plan set forth at the 2010 Arctic Aviation Experts Conference (AAEC).

It is important to recognize the intermodal nature of transportation challenges in the Arctic – and an increasingly busy circumpolar North – and the AAEC and AMSA highlighted the unique needs and opportunities for Arctic transportation. Increased resource extraction to support economic and community development; increased shipping traffic through the Northern Sea Route and activity in the Northwest Passage due to a lessening of sea ice extent; and increased passenger traffic for the same reason, have resulted in the corresponding need for an increased capacity to respond by sea and by air. Response, which would include Search and Rescue (a response to human safety needs in the Arctic maritime environment) and Oil Spill Response (or more broadly any environmental disaster), is most effective when addressed through a strategic, intermodal approach that includes marine and air ability. Arctic ports and airports act as an important base for response capability; with each serving as a gateway anchor that supports SAR; resource extraction and development activities; pollution prevention and environmental safety; and community health and security. These can be considered critical components of sustainable development and the resiliency of Arctic peoples and communities.

The Initiative seeks to address the infrastructure deficit – a lack of ports and airports that have adequate infrastructure and response capabilities (and in some nations a lack of ports in general) - by inventorying maritime and aviation assets in the Arctic that impact the region's ability to respond. This will be accomplished by developing guidance for a robust, effective transportation system in the North. By setting benchmarks for what capacity and capability should look like and establishing a current baseline of Arctic maritime and aviation transportation infrastructure, the Initiative will be able to produce a gap analysis that more efficiently facilitates the application of resources by federal, regional and local governments, as well as international bodies. In this, the intermodal approach helps to avoid duplication, leverages a multiplicity of efforts and provides efficiencies to infrastructure development in a region that often struggles with economies of scale.

As part of the scope of this Initiative, it is envisioned that a multi-year campaign take place. In the first year, a budget of $440,000 (see Annex 1) establishes a foundation to work from and begins the benchmarking process as well as gathering baseline data. Much of this has been done on the marine side by the AMSA, which will be updated and correlated with current and best aviation information. Baseline data will be fed into both a final guidance document and a revised version of the Institute of the North's Arctic Aviation Database, an updated form of which will be a deliverable from this effort; it will include port infrastructure and be renamed to reflect this expanded scope. The **Arctic Maritime and Aviation Infrastructure Database** will include a

web-based, searchable map that illustrates the overlapping spheres of responsibility and capacity as well as perceived gaps in the system as a whole. Arctic nations' ability to respond will be coordinated, intentional and built upon a well-established understanding of both need and capability.

A second deliverable will be the **2012 Arctic Aviation Experts Conference**, which will review and assess the aviation portion of the guidance document. This is the only venue to date in the world dedicated to Arctic aviation and provides an invaluable service in connecting stakeholders from across the Arctic to one another and critical issues. A corresponding **2012 Arctic Port Response Infrastructure Conference** will take place to evaluate the maritime transportation portion of the final document. A draft version of the Guidance Document will then be delivered to the Arctic Council's SDWG for review and input.

In the second year of the project, the Guidance Document will be refined and finalized, with results of the Initiative disseminated and work groups identified to address individual projects identified in the final document. At the same time, the Arctic Maritime and Aviation Infrastructure Database will be launched and outreach conducted. Similar funding needs are anticipated for this phase (see budget, in Annex 1).

Background

AMSA as a Foundational Document
Released in 2009 by the Arctic Council, the focus of the AMSA is marine safety and marine environmental protection, which is consistent with the Arctic Council's mandates of environmental protection and sustainable development. The Arctic Council's PAME Working Group was an instrumental driver in the delivery and production of the AMSA, which provides a useful framework for the Sustainable Development Working Group (SDWG) in its approach to addressing the human dimension of AMSA.

Two recommendations from AMSA that directly relate to, or have impacts upon, Arctic peoples and communities are found within one of AMSA's three major themes, that of **Building the Arctic Marine Infrastructure.** Specifically, the following two recommendations can be addressed through a sustainable development approach:

> **III A. Addressing the Infrastructure Deficit:** That the Arctic states should recognize that improvements in Arctic marine infrastructure are needed to enhance safety and environmental protection in support of sustainable development.
>
> **III C. Circumpolar Environmental Response Capacity:** That the Arctic states decide to continue to develop circumpolar environmental pollution response capabilities that are critical to protecting the unique Arctic ecosystem.

A well-developed Arctic infrastructure ensures that Arctic nations have the capacity to address community needs and environmental response. An Arctic Maritime and Aviation Initiative that has as its goals to benchmark and conduct a baseline assessment of aviation and maritime infrastructure and capacity lends itself to sustainable development in the Arctic.

Furthermore, specific findings within AMSA point to the need for an intermodal approach to maritime infrastructure in the Arctic. It is worth highlighting that

> Emergency response capacity for saving lives and pollution mitigation is highly dependent upon a nation's ability to project human and physical resources over vast geographic distances in various seasonal and climatic circumstances. The current lack of infrastructure in all but a limited number of areas, coupled with the vastness and harsh environment, makes carrying out a response significantly more difficult in the Arctic. Without further investment and development in infrastructure, only a targeted fraction of the potential risk scenarios can be addressed. (AMSA, 2009)

An intermodal approach to a nation's and region's ability to respond to this challenge is necessary and the Arctic Council has an opportunity to address this through this Initiative.

CITF and the Arctic Aviation Experts Conference

In 2005, as Chair of the Circumpolar Infrastructure Task Force – a project of the SDWG – the Institute of the North hosted the Arctic Aviation Experts Workshop held in Khanty-Mansiysk Autonomous Okrug, Russia. As a follow up to that workshop, with support from LPS Aviation and the Government of Manitoba, the Institute was able to host the first Arctic Aviation Experts Conference in 2006.

The outcomes from that event continue to resonate today, and the importance of the issues addressed is highlighted in the growing demand for Arctic-specific conversations. That demand resulted in the 2010 Arctic Aviation Experts Conference (AAEC), where many previous recommendations were re-explored and evaluated. The most recent AAEC:

- addressed growing social, political, and economic needs for air transportation and the challenges to sustaining and improving transportation in the north;
- acknowledged the unique economic pressures on arctic aviation, as well as the application of technological advances in the unique northern environment;
- discussed ways to improve the reliability and safety of arctic aviation and airport operations;
- facilitated conversations that further the deployment of advanced aviation technology to enhance safety, capacity and connectivity in the Arctic;
- compared the response of circumpolar communities to the emerging sustainability, climate and environmental challenges of arctic transportation; and
- worked to develop an overarching process for change that addresses the interdependency of the social, economic, environmental, technological, and safety aspects of Arctic aviation.

From the 2010 Arctic Aviation Experts Conference (AAEC) that was hosted in Fairbanks, Alaska a better understanding of the unknown has been realized. Key to this has been the development of an increased awareness of parallel activities, programs and resources being delivered/expended throughout the Arctic that impact Arctic aviation policy, technology, and infrastructure. The Institute of the North and AAEC participants identified an urgent need for

coordination, collaboration, and networking of aviation related systems if Arctic nations are to improve aviation access and transit within the Circumpolar North to its fullest potential.

At the AAEC, participants identified numerous current and future infrastructure and service projects intended to improve aviation, which are essentially isolated projects, confined to local areas of implementation and local use. Many of the activities and infrastructures are paralleled with other ongoing activities that could be linked together in some manner to provide a more seamless service to a broader audience and across borders. Collaboration and coordination of parallel activities such as Automatic Dependent Surveillance Broadcast (ADS–B), weather data networks, camera networks, Search and Rescue (SAR) services and methods, and other systems, could provide broader, more effective services and achieve greater success if they were 'connected'. This connectivity could provide great socio-economic benefits and savings; and could improve the quality of services to governments, communities, and airports, as well as improving the delivery of passengers and cargo throughout the Circumpolar North.

Numerous technologies, engineering and construction methods and best practices are in place in Arctic nations, as well as efforts on research and development projects. Many of these are isolated knowledge bases, which have great potential to benefit a much broader aviation related audience than they do today. Put simply, it is evident that those working to address these issues could do so more effectively with a coordinated, intermodal approach.

Increased activity in the Arctic brings with it human impacts. The aviation industry must be positioned to respond to the need for an expansion in the delivery of services, whether they are related to Search and Rescue, community resupply, development efforts or an environmental disaster. This expansion brings with it an increasing need for the facilitation of shared knowledge, collaboration of services, and coordination of activities amongst the eight Arctic nations.

An Arctic Maritime and Aviation Transportation Infrastructure Initiative – the Project
There is – clearly – a need for the Arctic Maritime and Aviation Transportation Infrastructure Initiative to facilitate the development of aviation and port policy, infrastructure, and technology throughout the Circumpolar North for the benefit of all of the Arctic nations. Recognizing an increasingly busy Arctic – driven in part by climate change and economics – the Institute of the North's Arctic Maritime and Aviation Transportation Infrastructure Initiative provides a platform for addressing Arctic marine and air transportation infrastructure challenges and opportunities. In order to ensure the continuity in the discussion and to be able to actively work toward recommendations from past efforts, this Initiative is best approached through the Arctic Council's Sustainable Development Working Group.

The Initiative will approach Arctic air and maritime transportation policy, education, and research from many different vantage points and will facilitate ongoing and increased communication and collaboration throughout the Arctic. It will act as a coordination point for conducting research to identify gaps in port and airport infrastructure; and will facilitate technology transfer within and between Arctic nations in order to ensure best practices in infrastructure development. It is important to keep in mind the impact that climate change will have on infrastructure; and to work toward future infrastructure that prevents pollution and is

climate resilient. At the same time, the Initiative will provide an education and outreach role in developing a robust maritime and air transportation industry in the Arctic, able to meet community, environmental and economic needs. This effort will be focused on highlighting the ongoing efforts to address the infrastructure deficit by educating policy makers and administrators, community leaders, and the general public.

The Institute of the North will develop and manage the Arctic Maritime and Aviation Transportation Infrastructure Initiative with the following in mind, to be referenced throughout the life of the Initiative and reflected upon/updated by all stakeholder/partners as it evolves.

> ***Mission Statement***: To initiate a strategic approach to the development of a sustainable, resilient maritime and aviation transportation infrastructure in the North.
>
> ***Founding Principle***: To promote Arctic maritime and aviation transportation policies and technologies that support critical infrastructure while enhancing safety and environmental protection in support of sustainable development .
>
> ***Vision***: To create a safe, environmentally sensitive and effective maritime and air transportation system in the Arctic.

The Initiative's mission will be accomplished through the guidance of an international steering committee, as well as two expert groups comprised of subject matter experts. These groups will convene regularly to re-engage in the recommendations and action items from previous efforts. The task of each expert group will be to accomplish the intended outcomes – as described here-in – that work together to develop and support the mission, objectives, and goals of the Arctic Maritime and Aviation Transportation Infrastructure Initiative.

These two expert groups will address separately the Arctic Maritime and Port Infrastructure; and Arctic Aviation and Airport Infrastructure. Groups will work to

- Identify, define and promote Arctic maritime and aviation transportation policies that affect infrastructure development, through reciprocal education and communication with stakeholders and partners.

- Accelerate implementation of available/emerging technologies and operational practices into the maritime and aviation infrastructure, for improved services that support community safety and access as well as the protection of the Arctic environment.

- Provide guidance to Arctic nations to build, improve and maintain infrastructure that supports increased and changing maritime and aviation activity in the Arctic, balancing the social, economic, and environmental needs of local communities by incorporating lessons learned from across and beyond the Arctic.

These three missions will be accomplished in the initial phase of the Initiative through research and analysis that accurately depicts current conditions and informs future conditions of Arctic maritime and aviation infrastructure.

With regard to current and future Arctic maritime and aviation policy, technology, and infrastructure, each expert group will provide a Gap Analysis Report and deliver a Summary of Findings to improve maritime and aviation transportation capacity within the Circumpolar North to its fullest potential. Upon completion of these deliverables, an Arctic Maritime and Aviation Transportation Guidance Document will be produced.

This Phase One activity will develop a comparison of actual conditions with its potential future conditions. At its core are three questions: "Where are we?", "Where do we want to be?", and "How do we get there?" These questions will be addressed with the completion of three Phase One Deliverables:

- Expert Group Gap Analysis Reports
- Expert Group Summary of Findings
- Arctic Maritime and Aviation Transportation Guidance Document

Each Expert Group will deliver a Gap Analysis Report and a Summary of Findings. Upon completion of these deliverables, the project Steering Committee in conjunction with the Expert Groups will develop the final Arctic Maritime and Aviation Transportation Guidance Document.

Gap Analysis

This Gap Analysis will be a formal study and assessment of maritime and aviation transportation and infrastructure capacity (including critical support functions such as meteorological forecasting, marine/ice conditions, and communications) in the Arctic. This technical analysis will be divided into three milestone events: develop a benchmark; research current conditions; and produce a gap assessment. The outcomes of this Analysis will be used to develop the Expert Group Summary of Findings as a deliverable of this phase of work.

The Benchmark is intended to describe the desired and potential future conditions of aviation and maritime transportation in the Arctic. The Current Conditions milestone will define the current conditions of Arctic marine and air transportation – specifically, this will assess, describe and map port and airport infrastructure. The Gap Assessment will identify and articulate the gaps, deficiencies, and differences between current conditions and the potential future conditions.

This study and assessment should include analysis of findings from AMSA, as well as the recommendations of the 2005 and 2006 CITF Arctic Aviation Experts Conferences and those of the 2010 AAEC.

Summary of Findings

Upon completion of the Gap Analysis each Expert Group will develop a Summary of Findings that will describe actionable items found within the Gap Analysis. This document will provide an overall 'picture' of the current conditions of the Work Groups' specific focus. The Summary of Findings document will include conditions, activities, and projects that are planned or in progress in various locations, or areas, of the Arctic, as well as to identify future possibilities.

These documents will remain as "living documents" to be updated as new information becomes available from ongoing research and other activities and can be analyzed for potential use in future projects and Initiative course changes or corrections.

Arctic Maritime and Aviation Transportation Guidance Document

The Arctic Maritime and Aviation Transportation Guidance Document will be developed from the outcomes of the Gap Analysis and Summary of Findings documents that will be delivered by each of the Expert Groups of this phase of work.

The Guidance Document will be a stand-alone document that can be used as a roadmap to the future of Arctic air and maritime transportation infrastructure in the North and can be used to set the international benchmark for the development of well-crafted policy, best and latest technology, and effective infrastructure; as well as a communications and sharing format for Arctic maritime transportation and aviation system providers, users, stakeholders, sponsors, and other interested parties.

This document will:

- Identify the ongoing parallel projects, plans, policies, and technologies that could be combined or shared for the use and benefit of a broader Arctic maritime transportation and aviation audience.
- Point to potential methods, actions, and collaborations.
- Develop an overall picture of the gap between the future of Arctic air and maritime transportation and the current conditions of Arctic air and maritime transportation infrastructure.
- Provide the recommendations and information necessary to achieve the goal to improve capacity, access and services in the Arctic while enhancing human safety and the environment in support of sustainable development.

The Arctic Maritime and Aviation Transportation Database

With inputs from Civil Aviation authorities, the Arctic Council's CITF and the Institute of the North compiled a database of over 600 airports north of 55 degrees in all circumpolar countries: United States, Russia, Canada, Greenland/Denmark, Iceland, Norway, Sweden, and Finland.

The web-based data describes the location and infrastructure for the airports along with statistics and contact information. The information is meant for investigation and planning purposes and not for air navigation. This data needs to be updated to more accurately reflect increased activity – and corresponding needs – in the Arctic.

In addition to updating the airport information, it is envisioned that adding port infrastructure to what becomes an Arctic Maritime and Aviation Transportation Database will better demonstrate the capacity Arctic nations have to respond to environmental safety concerns, community needs, and development activity. This will be a significant contribution to the Arctic community's understanding of aviation and maritime infrastructure. These data sets could be added to the Arctic Portal for a comprehensive examination of Arctic challenges and opportunities.

Significance and Justification

The Arctic Maritime and Aviation Transportation Infrastructure Initiative has the potential to be an incredibly successful platform for addressing critical needs in the Arctic's aviation and maritime environment. At the same time, it demonstrates international cooperation and collaboration by translating prior Arctic Council efforts into a comprehensive approach to infrastructure development. It also works to incorporate and leverage new efforts such as the multi-agency Regional Response Team (RRT) in the U.S.; the U.S. National Ocean Policy and Arctic Strategic Action Plan; EPPR's proposed Arctic Region Oil Spill Response Resource and Logistics Guide; the State of Alaska's Arctic Ports Study; the Arctic ERMA; SAON (Sustaining Arctic Observing Networks) and other initiatives taking place in other Arctic nations.

AMSA's impact on Arctic policy will be felt well into the future. Its relevance to a connected, intermodal approach to Arctic air and maritime transportation is clear. The Arctic Maritime and Aviation Transportation Infrastructure Initiative is a next step in that approach and by leveraging international resources, global interest and local input the Arctic Council's SDWG will be fulfilling its mission and responding to the human condition.

Aviation and marine shipping infrastructure in the Arctic are inextricably linked in their ability to deliver goods and services, respond to needs, produce community and economic development, and protect the environment and human health. Not only that, but they link Arctic nations and peoples and build a resilient North. Partners and stakeholders from the eight Arctic nations – Sweden, Norway, Denmark, Finland, Iceland, Canada, Russia and the United States – can jointly work to address an infrastructure deficit in the Arctic. At the same time, this Initiative responds to more recent efforts such as the Search and Rescue Agreement signed by Arctic nations at the Arctic Council Ministerial in Nuuk, Greenland.

Timeline (draft)

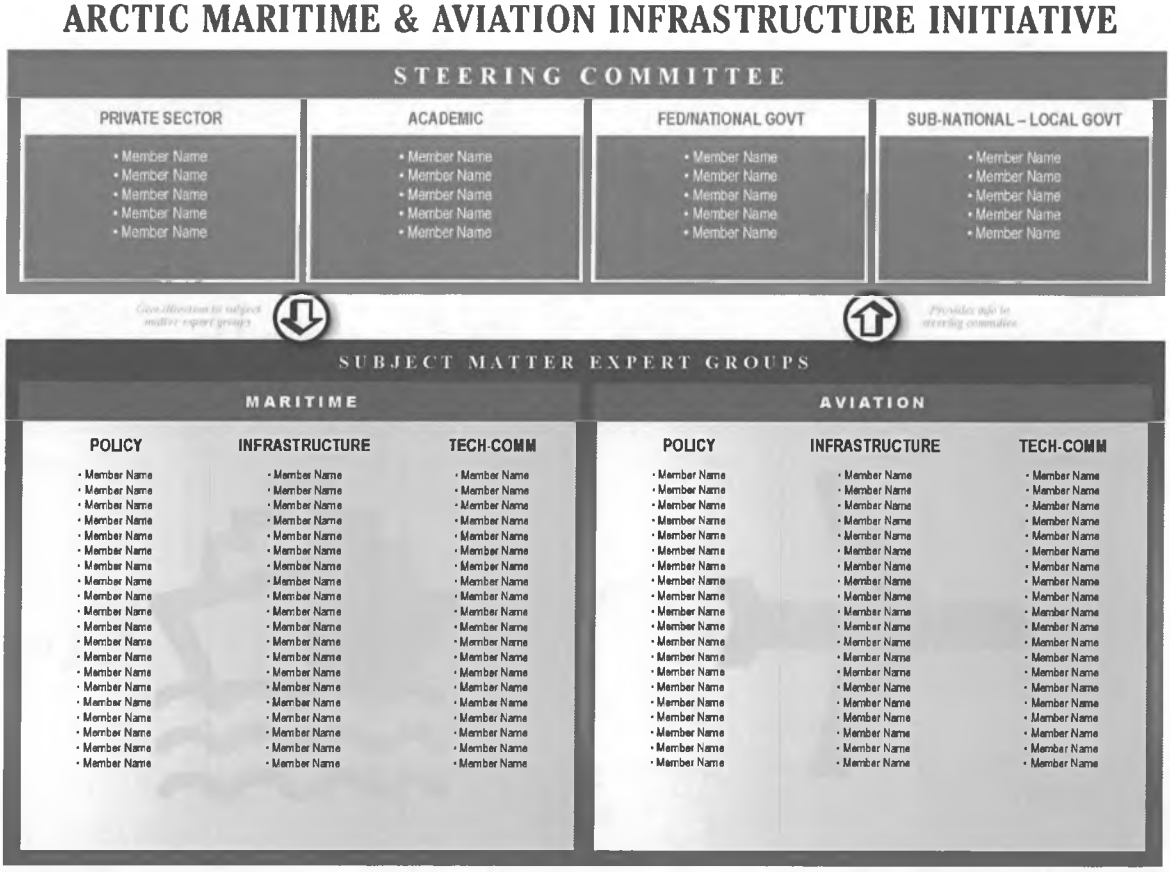
Year 1:

1) Obtain SDWG Project Approval
2) Enlist participating countries and form Steering Committee/SMEGs
3) Develop Project Management Plan and Scope of Work
4) Develop database and identify web-based platform
5) Host Arctic Port Response Infrastructure Conference and Arctic Aviation Experts Conference
6) Brief SDWG twice a year on progress/milestones

Year 2:

1) Compile and organize data from participating countries
2) Test and launch pilot Arctic Maritime and Aviation Infrastructure Database
3) Brief SDWG twice a year on progress/milestones and conduct demonstration of system
4) Produce hard copies of Guidance Document and Database
1) Obtain SDWG/SAO review/approval of final deliverables
2) Publicize & disseminate Guidance Documents and Database

The Steering Committee and Project Timeline/Process



AMATII's Steering Committee will reflect the overall commitment to balanced, informed discussion that incorporates economic, social and environmental perspectives from four sectors – private industry, academia, local/sub-national government, and national government agencies. Twenty high-level committee members will be selected based on established relationships developed during AMSA and the AAEC, with input from the co-lead countries.

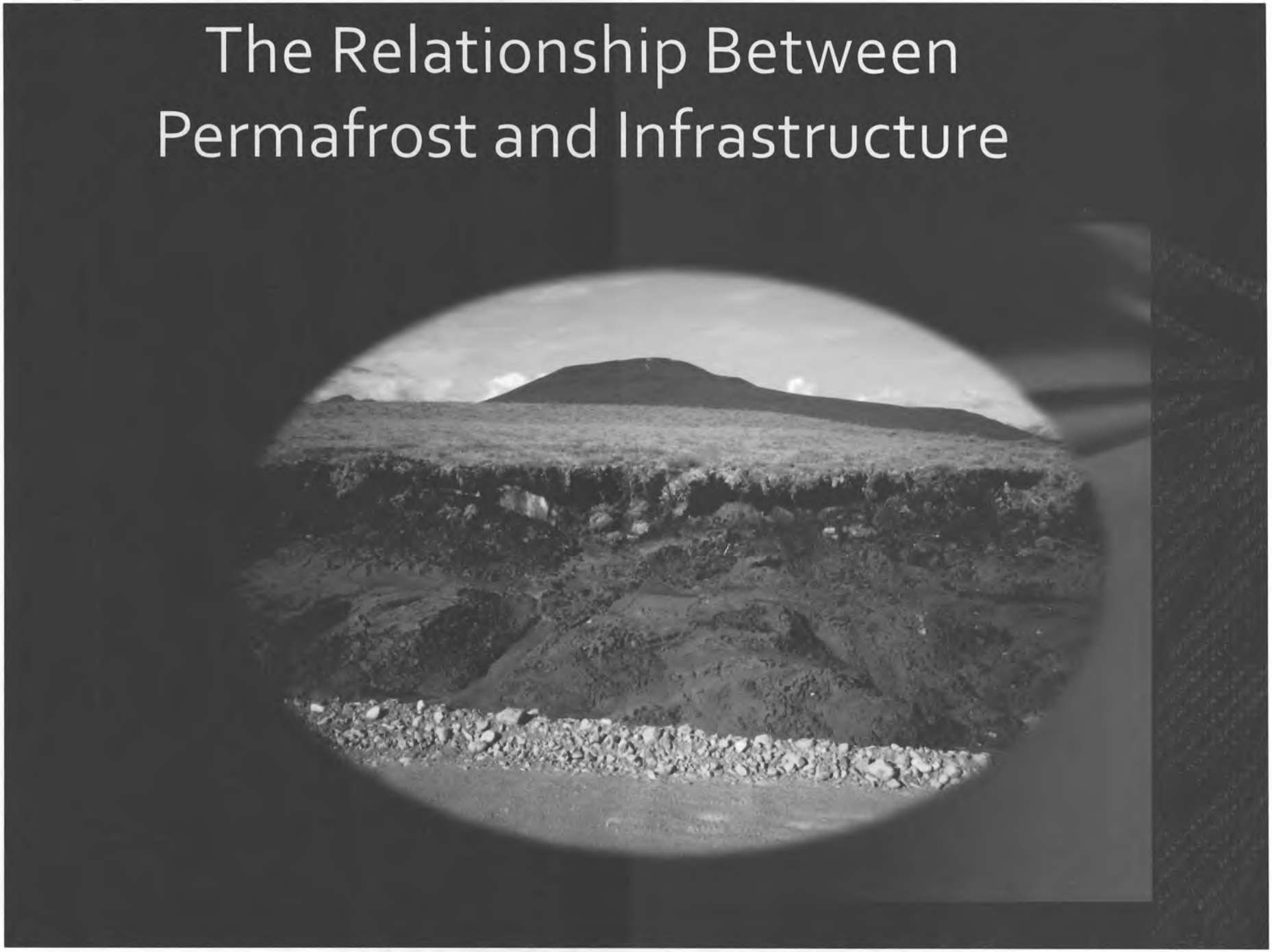
The purpose of the steering committee is to:

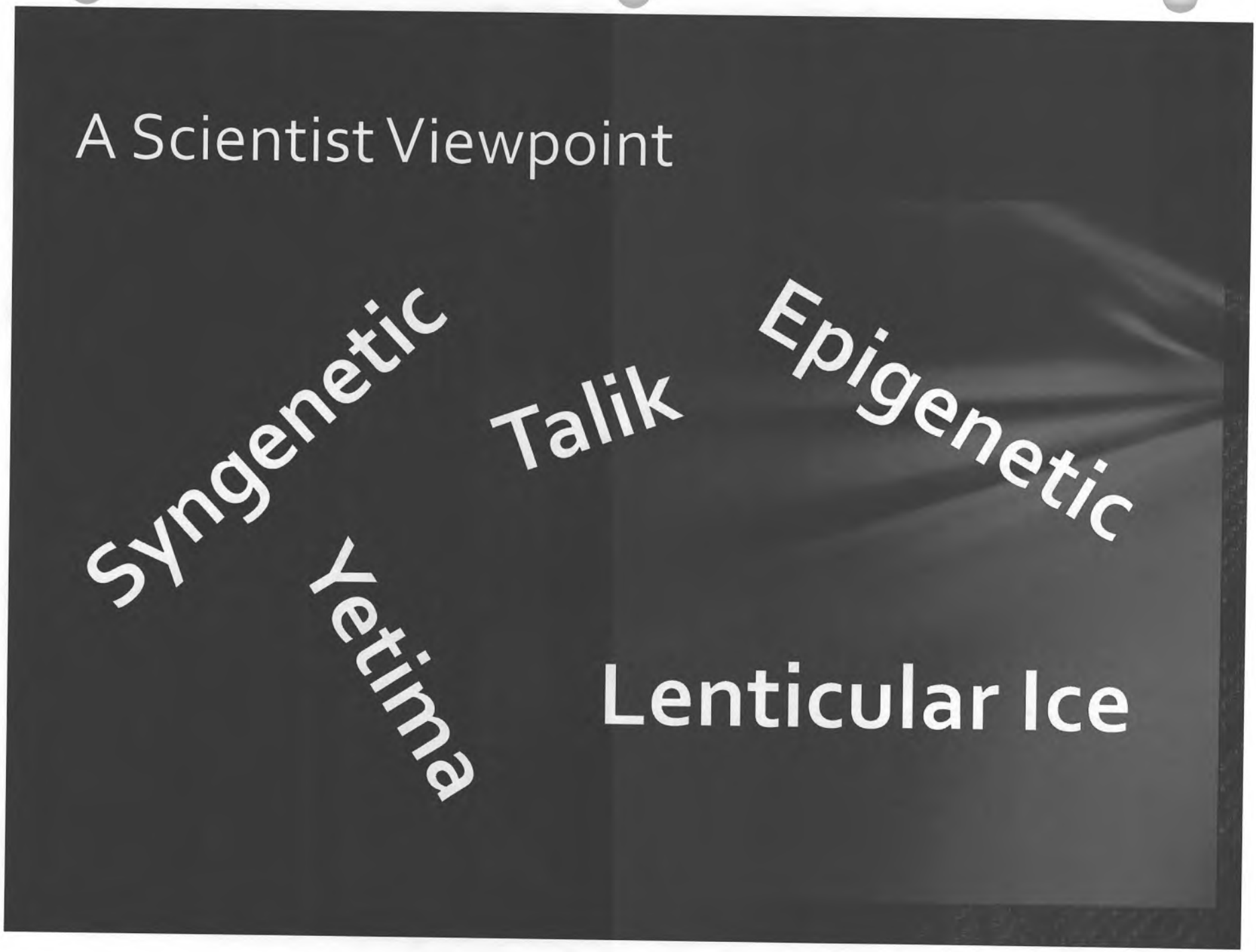
- Establish and maintain a transparent, inclusive consultation process
- Establish and maintain consistent goals for Subject Matter Expert Groups
- Establish timeline for meeting goals and project deliverables
- Reconcile differing views; taking into consideration cross-sectoral issues and working toward their resolution
- Review and approve assessment, benchmarking and gap outputs
- Provide regular updates and reports to SDWG

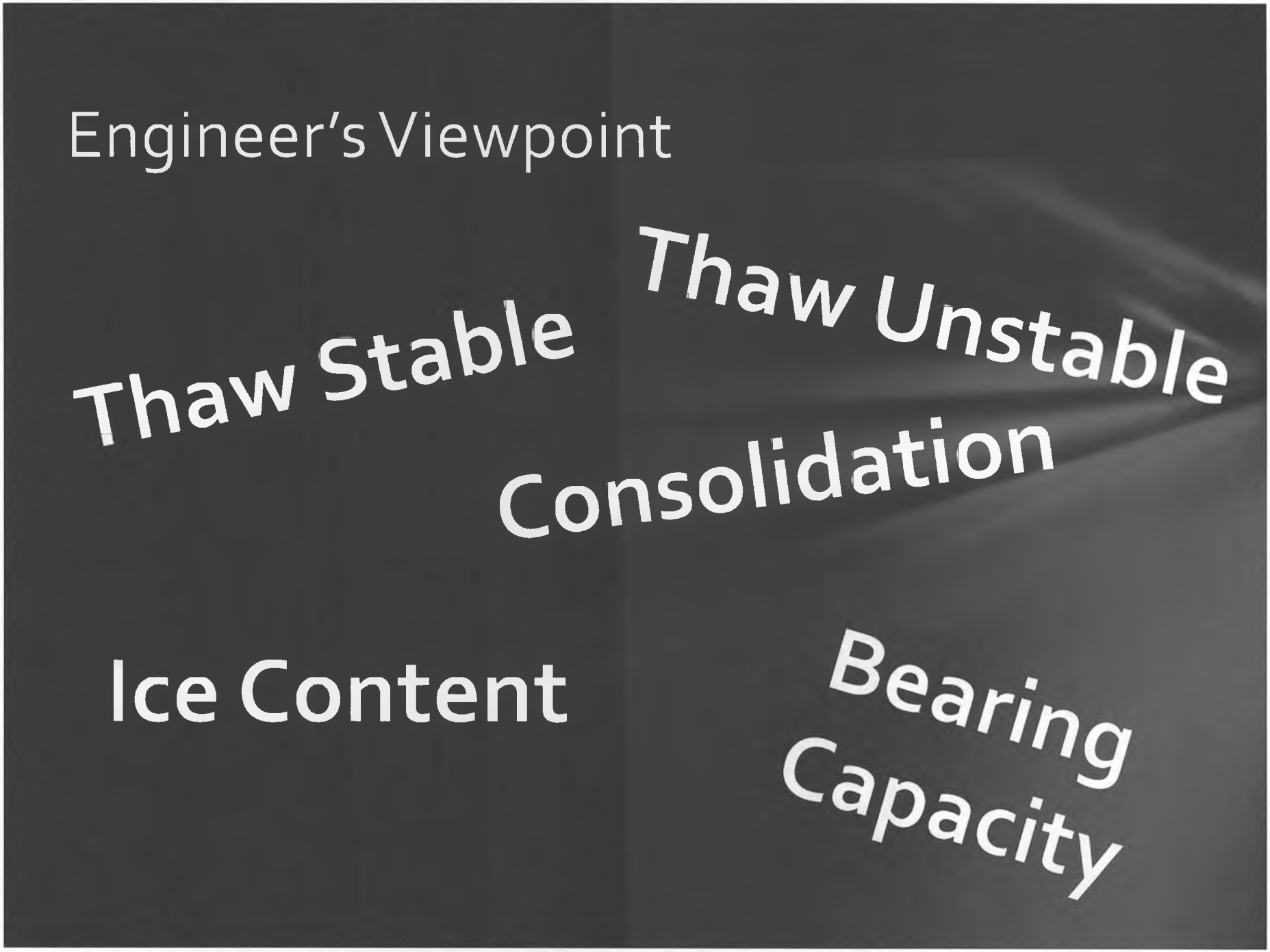
7

Relationship Between Permafrost and Infrastructure

The Relationship Between Permafrost and Infrastructure




A Scientist Viewpoint
Syngenetic
Talik
Epigenetic
Yetima
Lenticular Ice


Engineer's Viewpoint
Thaw Stable
Thaw Unstable
Consolidation
Ice Content
Bearing Capacity

Interests

Scientist Interested in How Permafrost Was Formed and It's History

Engineer interested in How Permafrost Will Affect the Structure

Understanding How Permafrost was Formed and It's History Helps Predict How it Will Affect the Structure.

Building on Permafrost

Remove and Replace

Keep Frozen

Thaw

Accept Performance

Traditional Cost Analysis

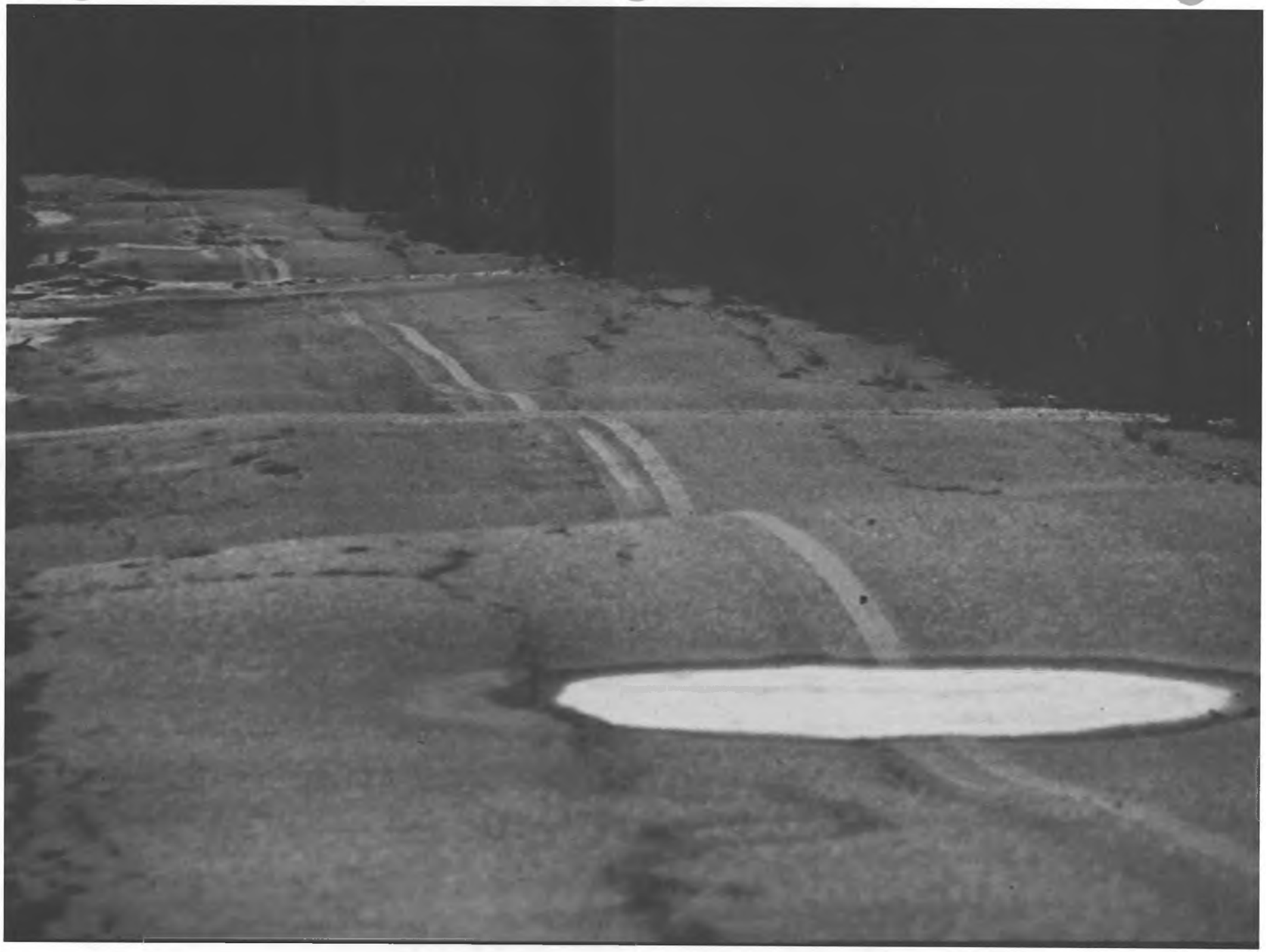
First Cost

Life Cycle Cost

A Review of Roadway Failures and What Causes Them

Differential Settlement

Causes of Differential Settlement



Dip in Road

Insulation

First Control Thaw of Permafrost on TAPS

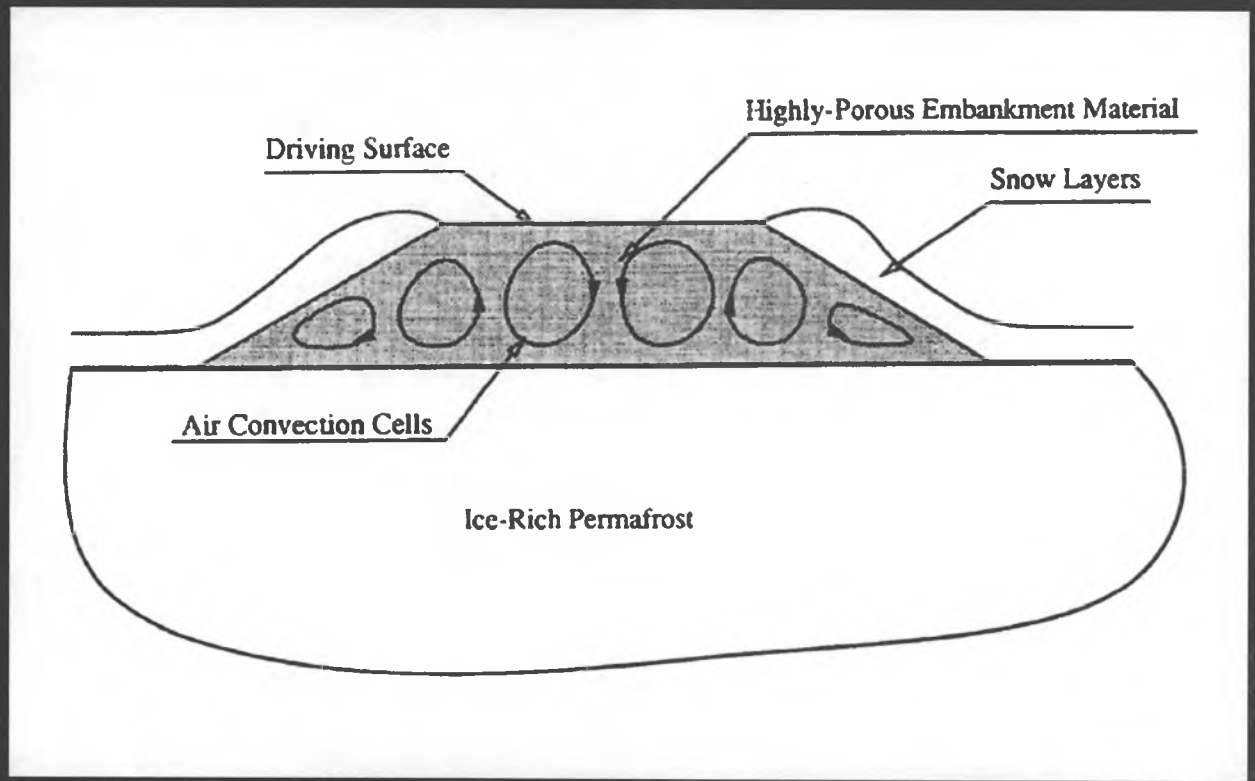
Works well on Cold Permafrost

Doesn't Work on Warm Permafrost

Thermosyphons

Works Well, but High Frist Cost with High Maintenance

Air Convective Embankments



Works very well, but high first cost

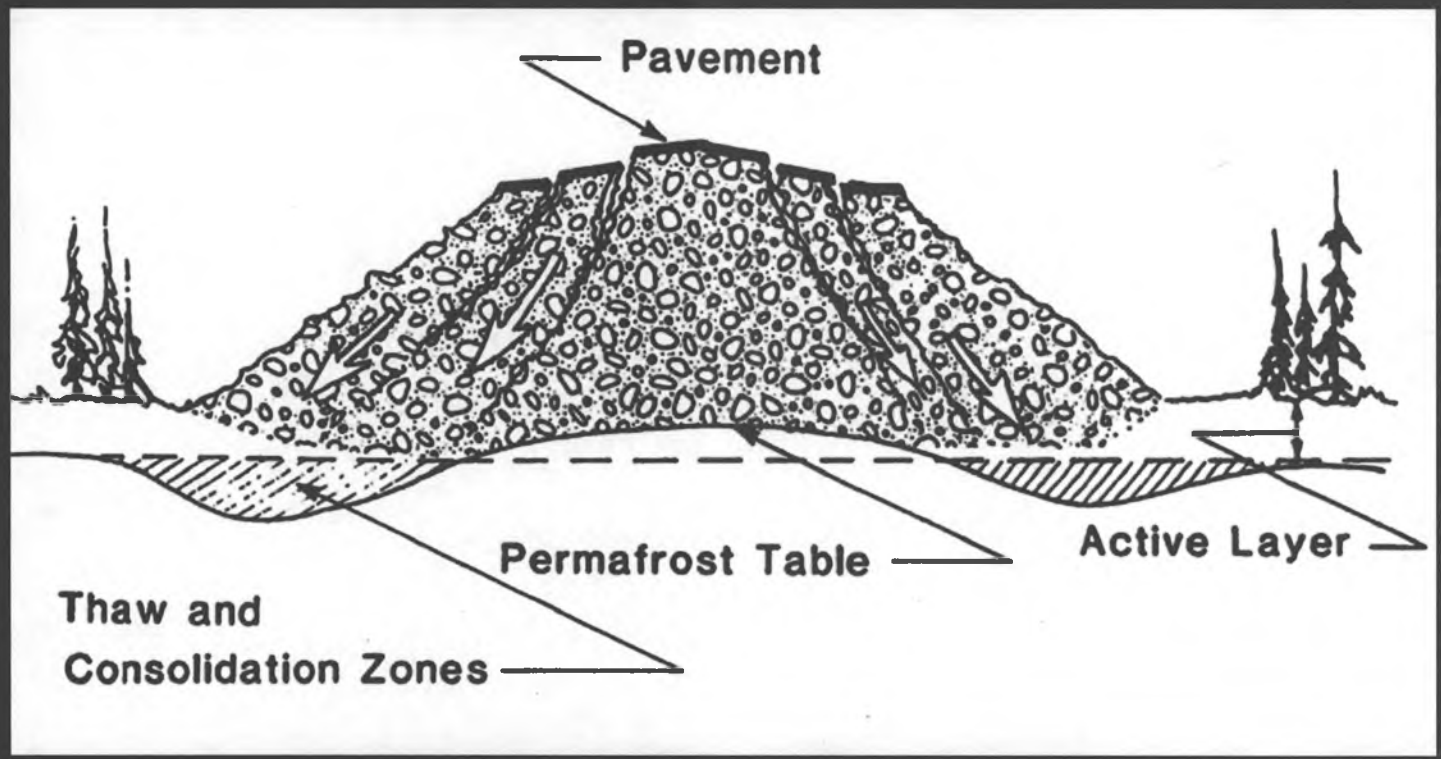
Hairpin Thermosyphons

Works well even in warming climate, but expensive.

Shoulder Rotation

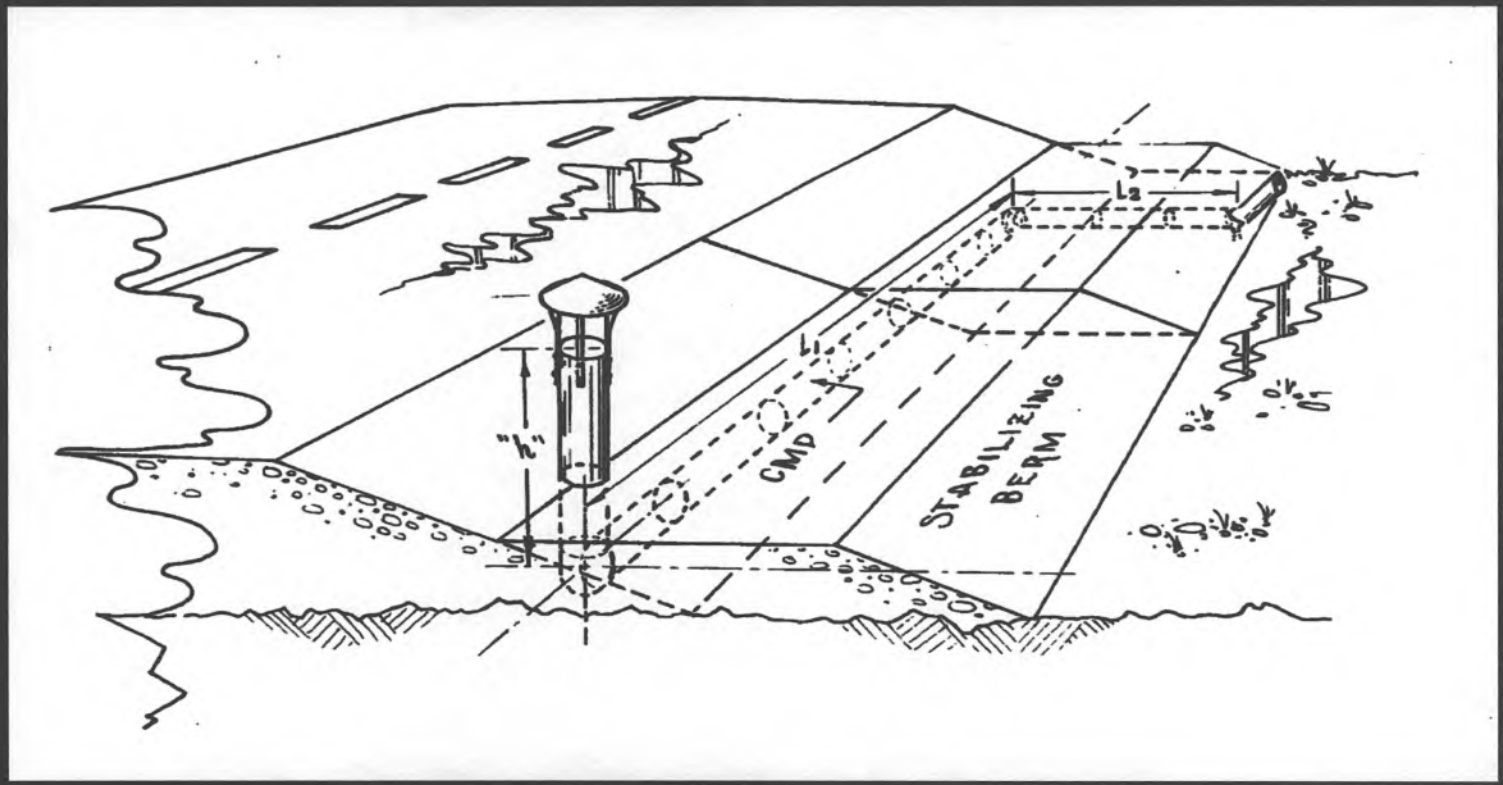
Notice Poles Leaning Back

Cause of Shoulder Failures

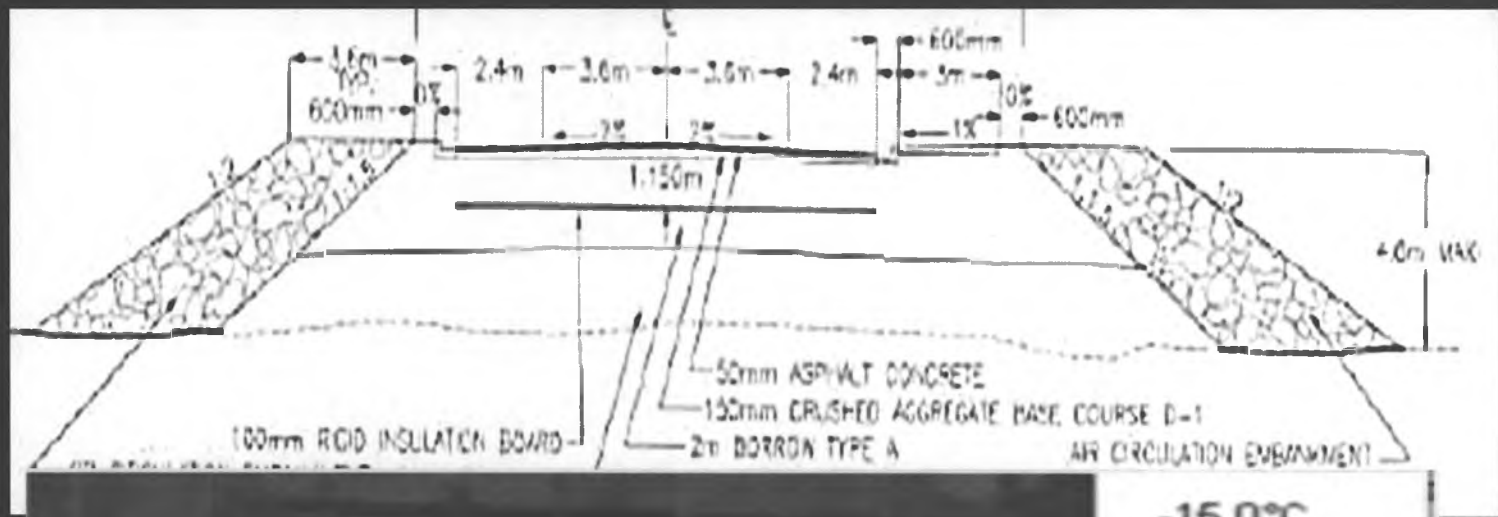


Shading Shoulders: *Works well, but high first cost*

Air Ducts: Works, but high first cost



ACE Works well even in warming climate, but usually high first cost.



Slope Failures

Design Choices

Cut on a Slope and Insulate

High Risk of Failure, Moderate Consequences, High Cost

Cut on a Slope and vegetate

High Risk of Failure, Moderate Consequences, High Cost

Cut on a Slope and Cover with Rock

Low Risk of Failure, Low Consequences, High Cost

Cut Vertical and Let Nature Take Its Course

Low Risk of Failure, Moderate Consequences, Low Cost

Last Two Work No Matter The Climate
But EPA Says no Dirty Water.

Seismic Risk

Structures Respond Differently in Frozen Ground

...approximately 70,000 bridges located in seismic regions would be affected by seasonal freezing... Although all the bridges are affected across the world, it appears the effects of seasonal freezing are not routinely addressed in current seismic design practice around the world.

S. Sritharan

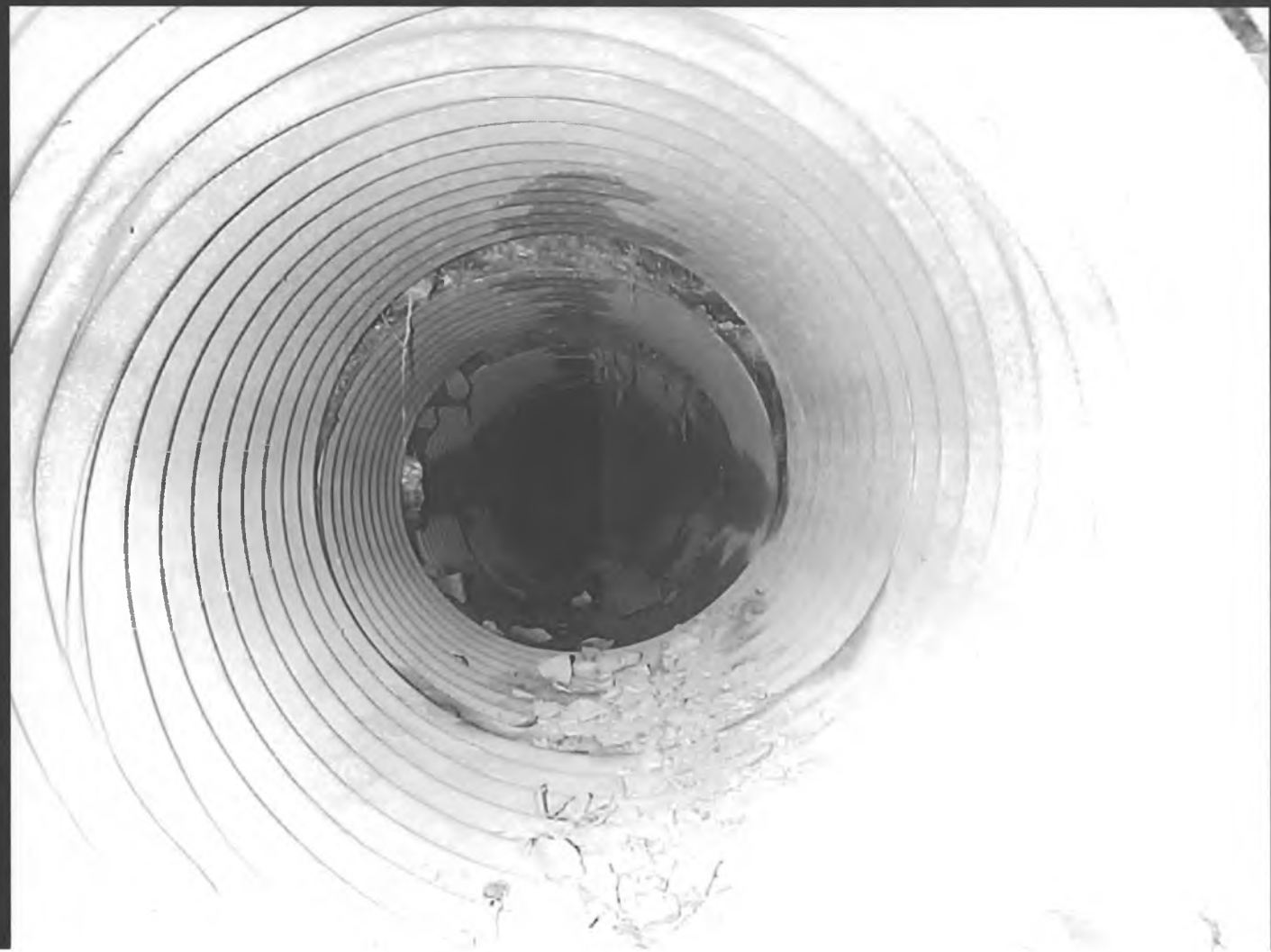
AUTC Research Is Changing Bridge Codes in Permafrost Areas.

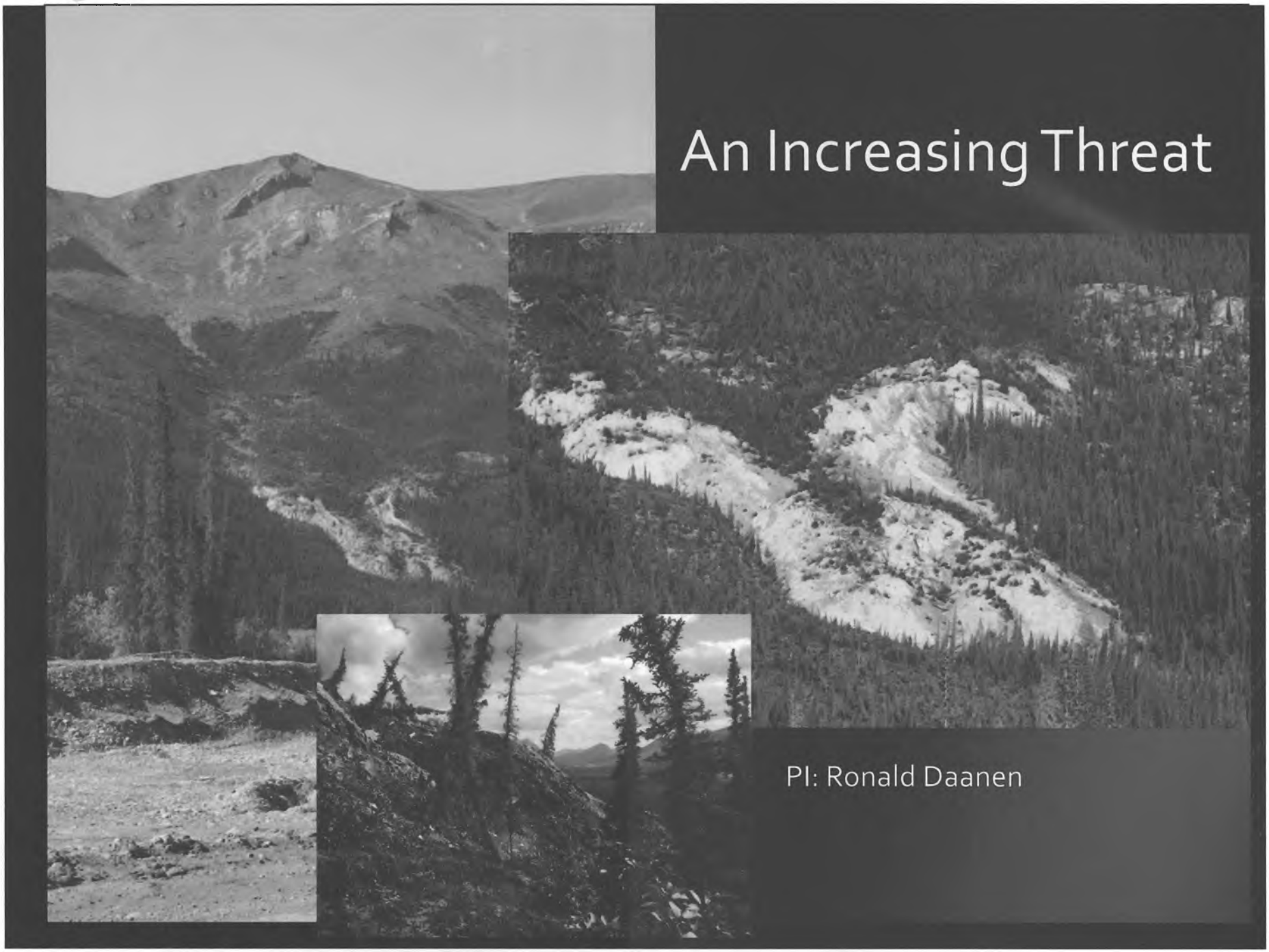
Liquefaction a Major Cause of Failure During Earthquakes

Does Frozen Soil Liquefy During a Seismic Event?

Yes, down to about -3 C

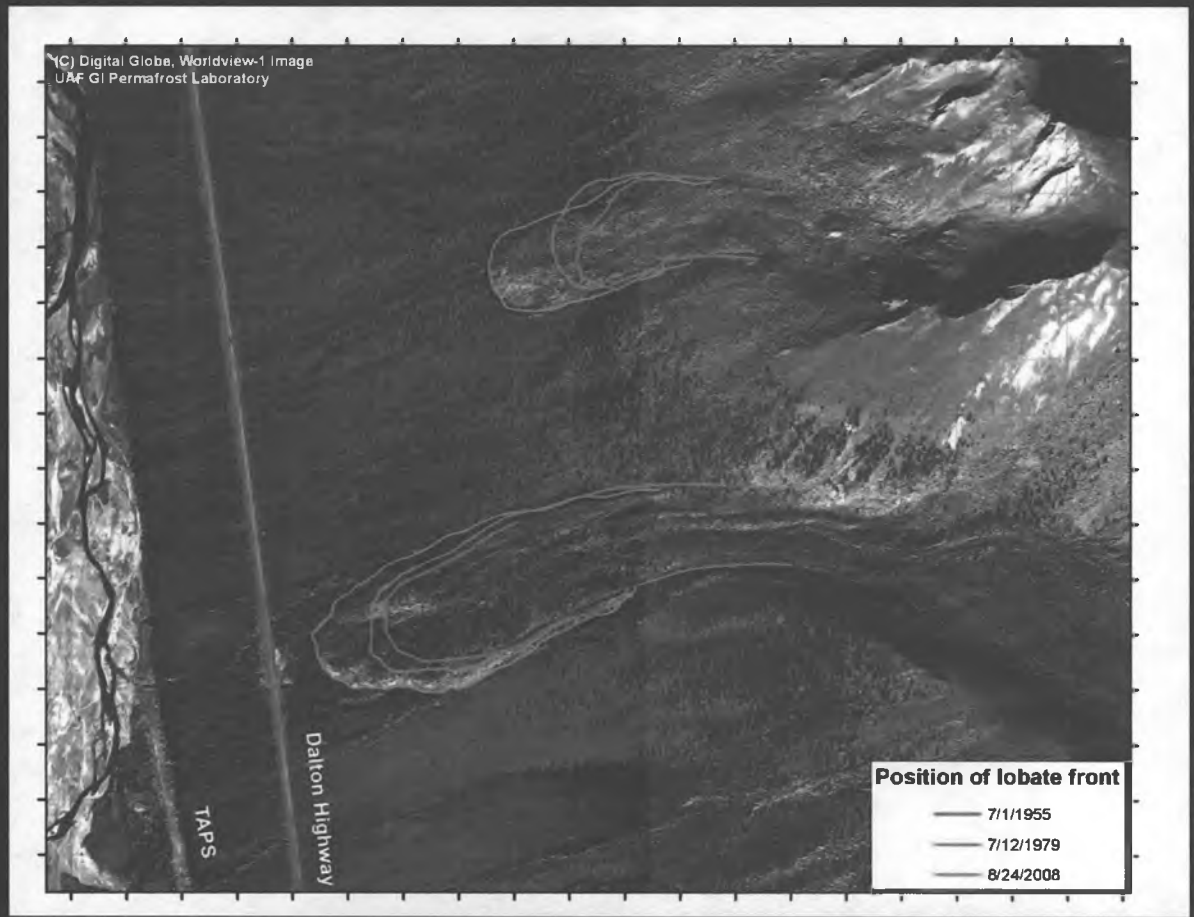
Thawing Permafrost the #1 Cause of Culvert Failure.




An Increasing Threat
PI: Ronald Daanen

Speed of debris glaciers

Guido Grosse



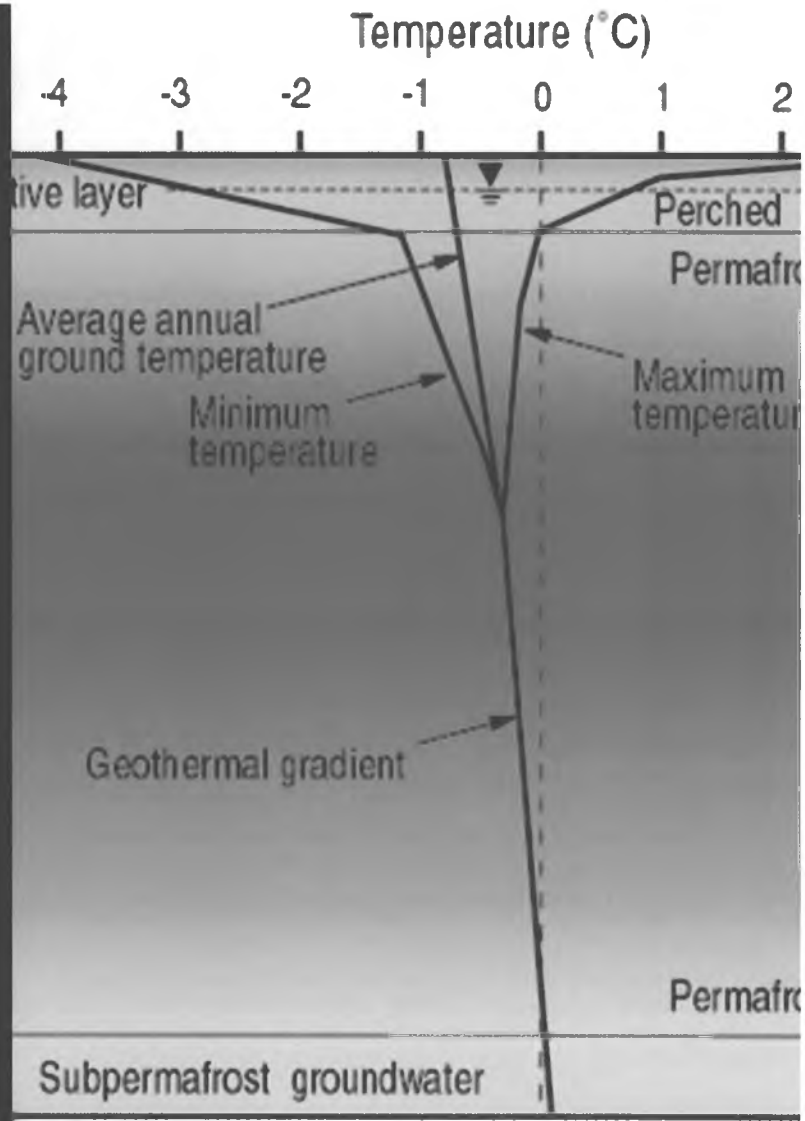
River and Coastal Erosion

Not a New Process, but Late Freezeups Have Accelerated the Coastal Process

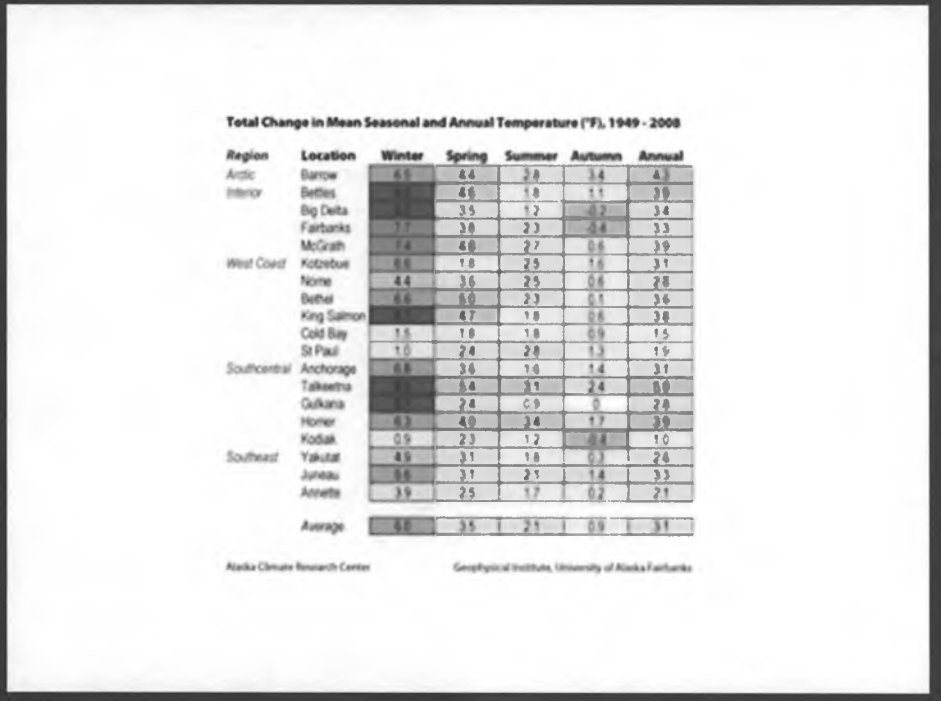
The new twist: Thermal Erosion Must be Considered.

Climate is Changing, But How?

The Answer Is Key to How We Look at Permafrost.



There are Over 100 Accepted Climate Models Predicting Warming. All are Different.



Total Change in Mean Seasonal and Annual Temperature (°F), 1949 - 2008

Region	Location	Winter	Spring	Summer	Autumn	Annual
Arctic	Barrow	4.5	4.4	2.8	3.4	4.3
Interior	Bettles	7.1	4.6	1.8	1.1	3.9
	Big Delta	7.1	3.5	1.2	-0.2	3.4
	Fairbanks	7.7	3.0	2.3	-0.4	3.3
	McGrath	7.4	4.8	2.7	0.6	3.9
West Coast	Kotzebue	6.6	1.8	2.5	1.6	3.1
	Nome	4.4	3.6	2.5	0.6	2.8
	Bethel	4.6	5.0	2.3	0.1	3.6
	King Salmon	6.1	4.7	1.8	0.6	3.8
	Cold Bay	1.5	1.8	1.8	0.9	1.5
	St Paul	1.0	2.4	2.8	1.3	1.9
Southcentral	Anchorage	4.8	3.6	1.6	1.4	3.1
	Talkeetna	7.1	5.4	3.1	2.4	5.0
	Gulkana	7.1	2.4	0.9	0	2.8
	Homer	6.3	4.0	3.4	1.7	3.9
	Kodiak	0.9	2.3	1.2	-0.4	1.0
Southeast	Yakutat	4.9	3.1	1.8	0.3	2.6
	Juneau	5.6	3.1	2.5	1.4	3.3
	Annette	3.9	2.5	1.7	0.2	2.1
	Average	4.8	3.5	2.1	0.9	3.1

Alaska Climate Research Center — Geophysical Institute, University of Alaska Fairbanks

Time for a New Approach

Rather than decision based on approach base decision on

- Cost
- Risk
- Consequences

Risk

Understanding the type of failure and the chances that failure will occur

Consequences

What happens should a failure occur?

Until Now That was Based on About 100 Years of Climate Data.

So Do We

Accept Performance

Remove and Replace

Keep Frozen

Or Thaw

Or Do We Evaluate

Cost

Risk

Consequences

In an Uncertain Future

The Canadians are Choosing the Latter and Performing Vulnerability Studies.

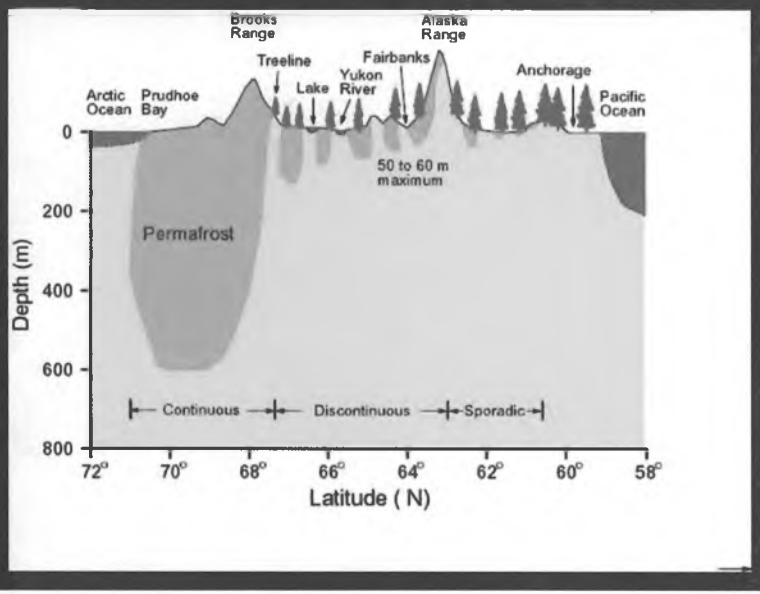
Vulnerability Studies Allow us to Select Designs Which Will Be Best Suited to Our Future

Take-Aways

Engineers and Scientists Must Begin to Work Together

All Alternatives are Expensive, but we Must Move Away from the First Cost Paradigm

We Must Adapt to an Uncertain Climate

We Must Consider Cost, Risk and Consequences in Our Decision Process

We Must Understand the Vulnerabilities of our Infrastructure to Thawing Permafrost