01/29/13 Overviews (4): Invasive Species and Tsunami Marine Debris

<TARGET><BILL></BILL><SUBJECT>01-29-13 Overviews (4) Invasive Species and Tsunami Marine Debris</SUBJECT><COMM>HFSH28</COMM></TARGET>

Department of Fish and Game Invasive Species Program: 2013

Status Report

House Fisheries Committee
January 29, 2013

Overview

- Invasive species are…
- Effects they impose
- Pathways: Getting from there to here
- Species of concern
  - History of infestation, Response actions, Status
    - Didemnum vexillum, colonial tunicate
    - Northern pike in Southcentral
- Monitoring efforts statewide
- Prevention and Outreach

Invasive Species

- An organism introduced outside its native range that can damage environments, cause economic hardship, or pose risk to human health.

- Not all nonnative species can sustain populations in their new environment. They require
  - an agreeable host environment;
  - few to no natural predators, parasites or diseases;
  - an abundance of food that lacks defenses against the newcomer;
  - ability to out-compete native species in similar trophic levels.

Effect on Native Species

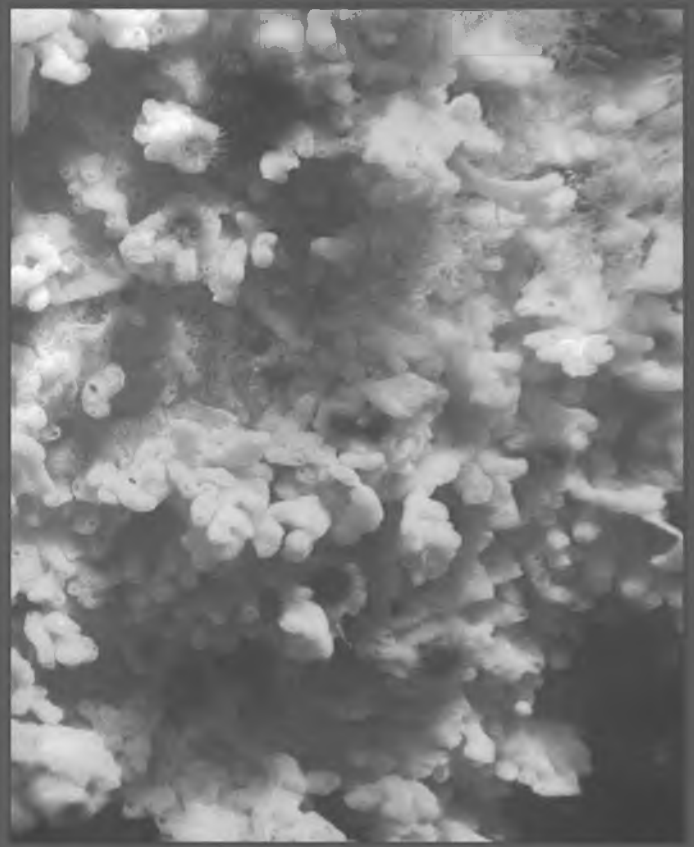
- Invasive species:
  - Out-compete native species for habitat, food, space.
  - Degrade or destroy habitats required by native organisms.
  - Upset ecosystem functions, such as food webs, and predator/prey interactions.
  - Limit commercial, recreational, and subsistence activities such as fishing, hunting, wildlife viewing, boating, etc.

Pathways for Introduction

- Invasive species arrive in Alaska many ways:
  - Human-mediated: Shipping, recreational vessels and gear, floatplanes, floating infrastructure, release of unwanted animals and plants, illegal stocking, aquaculture transfers and escapees.
  - Natural pathways: Ocean and river currents, cross-basin connections such as high water events, larval distribution.

Didemnum vexillum (D.vex)

Colonial tunicate found growing on nets used in the production of oysters



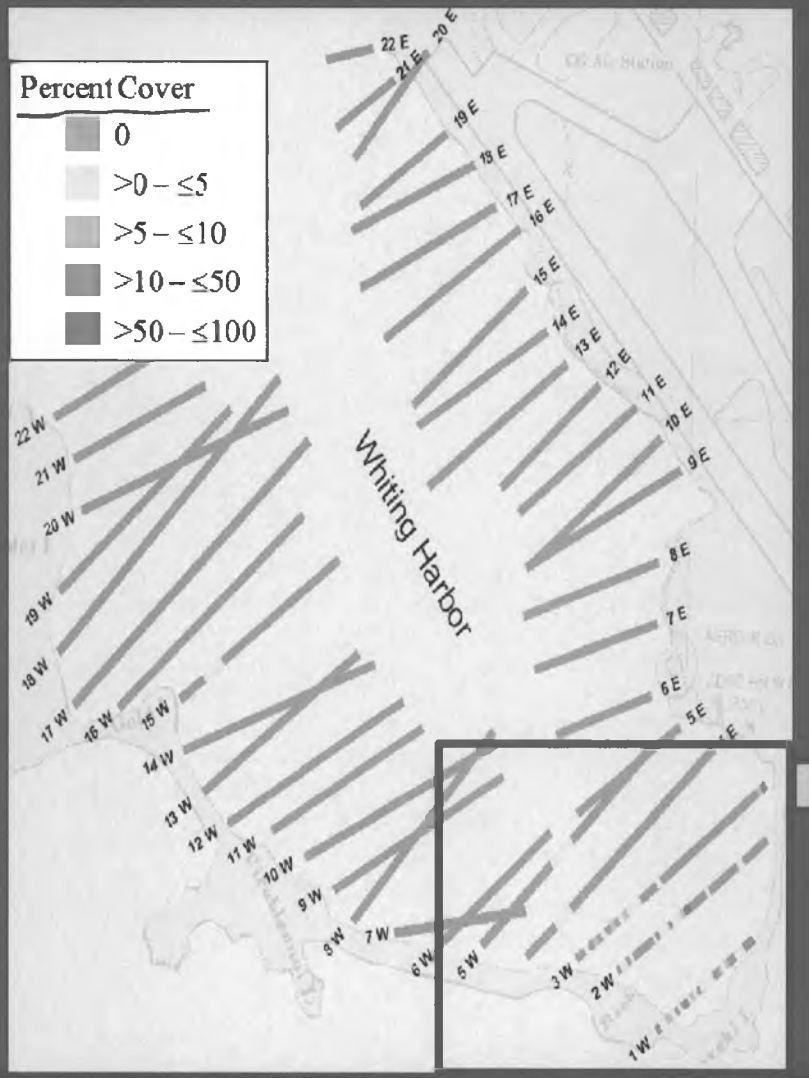
Whiting Harbor is a man-made embayment located adjacent to the Sitka airport and near the USCG base.

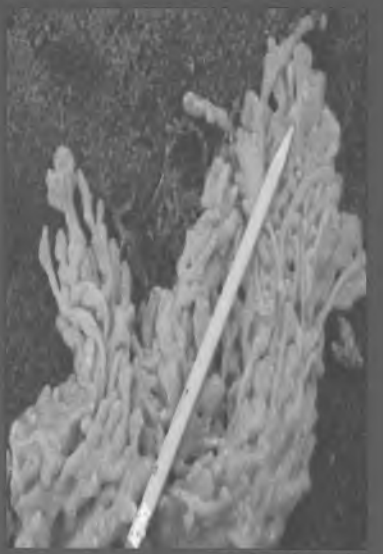
History

D. vex

- 2010: First detection during BioBlitz.
- 2010- present: Outreach to aquatic farmers, agencies, stakeholder groups, the public.
- 2010- 2012: ADF&G annual survey to map distribution, coordinate response team, decommission aquatic farm.
- 2011 & 2012: Restrict commercial and subsistence fisheries access and request public avoid the area.
- 2012: Rapid Response Plan completed.
- 2012: Legislature approves $500K CIP.

2011 Survey and Distribution



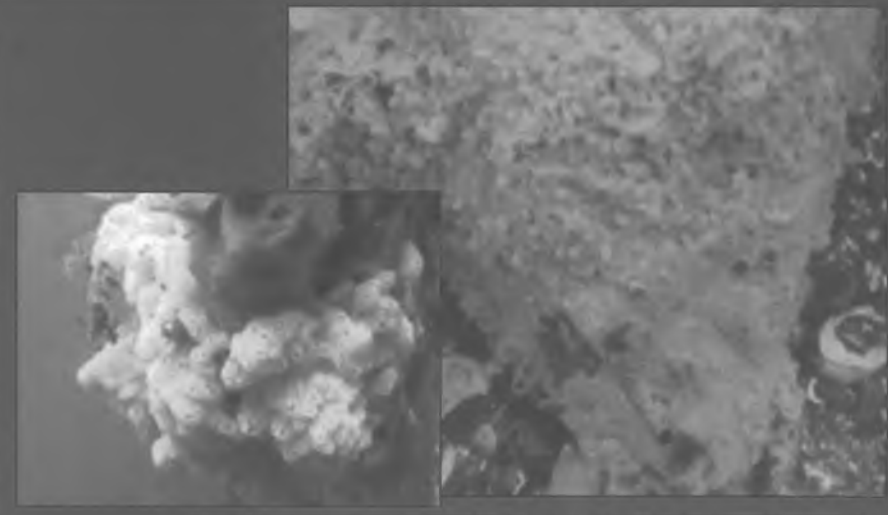


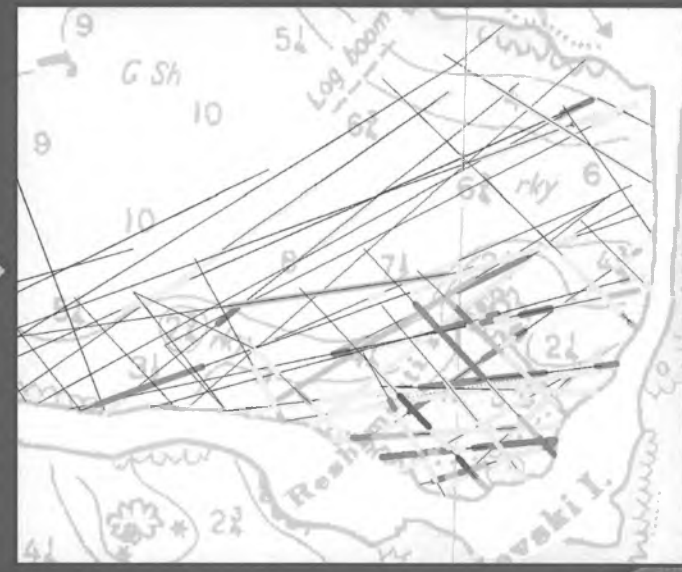
D. vex: Removing the Source

- Bag and remove lantern nets: Aug. early Sept. 2011
- Major clean up effort to remove aquatic farm infrastructure from the water: November 2011
- Collaborative effort: City of Sitka, DNR, UAS, Sitka Tribe, SERC, SSSC, USFWS, USFS, BLM, USCG, local volunteers

D. vex: Decommissioning

2012 Survey and Distribution





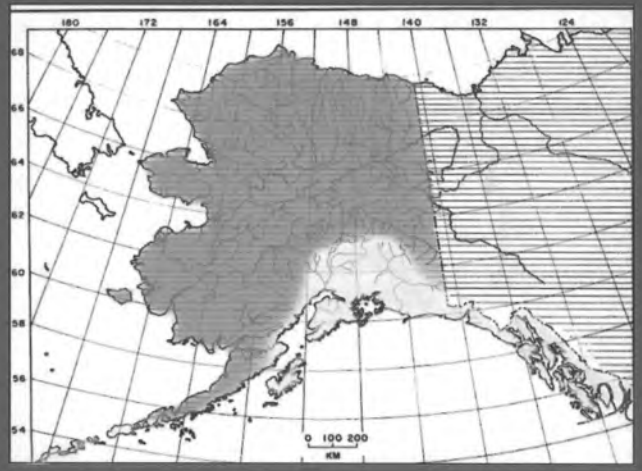
D. vex: Best Means for Success

- Communication
  - Experienced international experts
  - Researchers: new technologies for eradication
  - Permitting agencies
  - State and Federal agencies for collaboration
  - The public
- Scope of Work near completion
- Request for Proposal- early spring
- Eradication work to begin in summer
- Monitoring: 3 years post-treatment
- Outreach and Monitoring statewide

2013

Invasive Northern Pike: Southcentral

- Distribution
  - Northern pike are not native south and east of the Alaska Range.
  - Pike were first illegally-introduced to Southcentral in the 1950s.
  - They continue to spread and be illegally transplanted.
  - Invasive northern pike are presently in > 150 water bodies in Southcentral.
- Known Impacts
  - Highly predatory on juvenile salmonids
  - Can reduce or eliminate wild and stocked fish



Invasive Northern Pike: Actions

- Planning
  - A management plan for invasive northern pike was completed in 2007; updates to the plan will be completed this year.
  - A strategic planning committee was formed in 2010; meets biennially to prioritize projects.
  - Six of the top eight priorities are currently underway.
    - Phase I of Soldotna Creek project to begin 2013.

Northern Pike Priorities

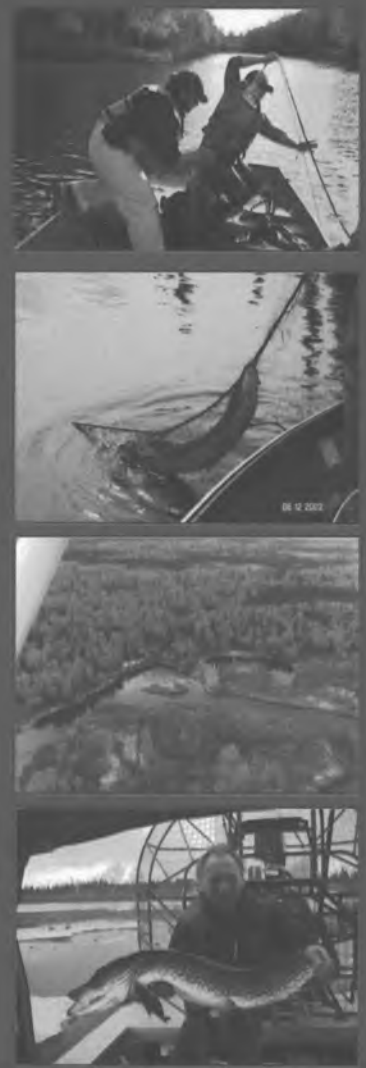
1. Alexander Creek pike control
2. Soldotna Creek pike eradication
3. Stormy Lake pike eradication
4. Alexander Creek radio telemetry
5. Otter Lake pike eradication
6. *Susitna River pike distribution assessment
7. Kenai Peninsula eDNA study
8. *Pike eradication in Knik, Prator, North Rolly, & Taniana Lakes

** Projects #6 and #8 require additional resources*

Invasive Northern Pike: Actions

- Control
  - Control Netting: Gillnets are used to reduce the number of northern pike in a water body when complete removal of the population is cost or logistically prohibitive.
  - Alexander Creek
    - Largest pike control project in the state.
    - Netting conducted in 61 side-channel sloughs along 40-mile stretch of the creek in May 2011 and May - June 2012. Netting continues in 2013.
    - ~7,000 pike have been removed and used for educational purposes, food resource, etc.

      >4,000 in 2011, ~3,000 in 2012
    - Salmonid monitoring for long-term evaluation of suppression effort.
    - Goal: Restore salmon fisheries.



Invasive Northern Pike: Actions

- Research
  - Pike Diet: Projects quantify prey type and abundance.
    - Alexander Creek: 2011-2013
    - Mat-Su Valley pike projects: 2000-present
  - Movement Patterns: Radio telemetry detects when and where pike occur.
    - Alexander Creek: 2011-2013
    - Stormy Lake: 2010-2012
  - Detection Techniques: Evaluate new approaches for determining presence or absence of pike.
    - Environmental DNA-
      - Kenai Peninsula: 2013 - 2014

Invasive Northern Pike: Actions

- Eradication
  - Objective: remove entire population of northern pike from individual freshwater systems.

  - Rotenone Treatments: 2008-Present
    - Mortality to fish caused by inhibiting cellular respiration.
    - Requires extensive permitting and Federal NEPA compliance.
    - Since 2008, ADF&G has successfully eradicated pike from 5 lakes in Southcentral.
    - Stormy Lake: Largest lake treated, Sept. 2012.
    - ADF&G plans to treat 5 lakes and portions of Soldotna Creek in 2013-14.

Monitoring for Invasive Species

- Citizen monitoring
  - Educational programming and training for the public and school children - KBRR
- ADF&G staff monitoring and investigation
  - Crayfish in Buskin Lake
    - Begin trapping in 2012, will continue in 2013
  - Elodea on Kenai Peninsula
    - Known invader detected in 2012 by staff working in Stormy Lake
    - Rapid surveys of Northern Kenai Peninsula lakes
  - Opportunistic monitoring
    - Staff to scout for invasives while engaging in field work
  - Rats in Anchorage-
    - Investigate reported incidents

Monitoring for Invasive Species

- QZAP- Quagga and zebra mussel action plan monitoring (w/UAA)
  - Locations: Glennallen, Kenai Peninsula (4), Richardson Hwy. (5), Fairbanks (6), Anchorage (7)
- Platewatch-Pacific coast tunicate monitoring
  - Locations: Gustavus, Homer, Kodiak, Seward, Sitka, Ketchikan (2),
- European green crab monitoring
  - Locations: Chenega Bay, Juneau, Seward, Sitka, Valdez (3), Ketchikan (4), Kachemak Bay (5)

Prevention & Outreach

- Regulations
- Collaboration: Statewide and regional partnerships
- Outreach
  - Educational programs and materials
  - Presence at sportsmen's shows, festivals, workshops, trainings and forums
  - Materials to stakeholder groups and the public via broad consortium of entities
  - Signage at infested and high use water bodies
  - Work with partners to share common messages
- Prioritize actions based on risk, pathways and species.

Pacific NorthWest Economic Region Invasive Species Working Group

- The Invasive Species Working Group addresses the regional economic and environmental impact of invasive species and promotes regional collaboration and sharing of best practices.
- The Group is focused on creating and sharing preventative measures that policy makers can adopt to prevent the spread of invasive species.
- Because the threats posed by invasive species are regional, they must be met through a regional response.

•PNWER Invasive Species Working Group Co-Chairs:

- Dr. Mark Sytsma, Professor of Environmental Sciences and Associate Vice-president for Research at Portland State University
- Rep. Eric Anderson, Idaho Chairman of the Idaho House Ways and Means Committee
- Megan Levy, PNWER

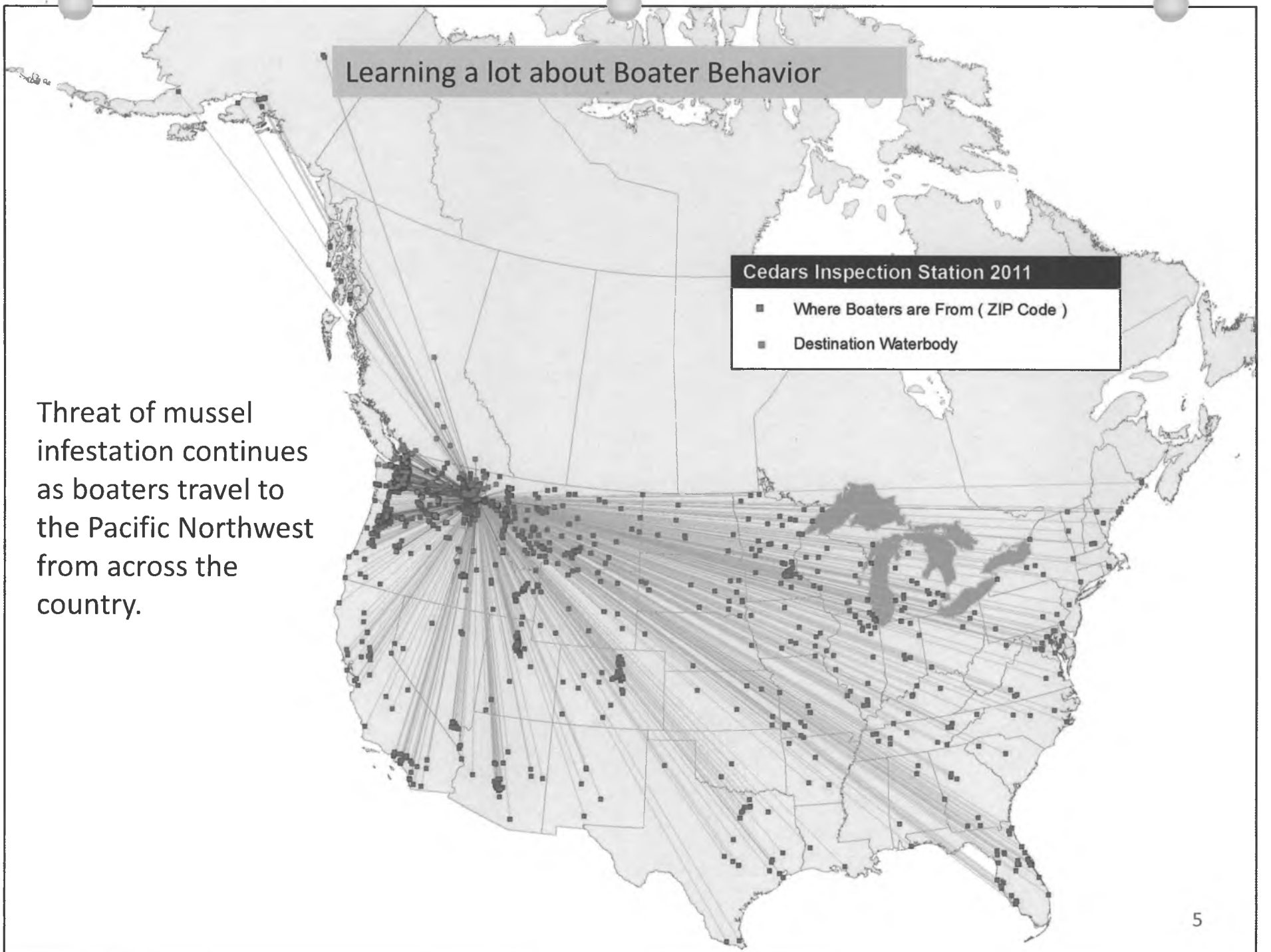
The Quagga and Zebra Mussels

- The Quagga and Zebra mussels are native to Europe but have been spreading through North America since the 80's.
- Without their natural predators found in their original habitat the populations have exploded and are now causing environmental and economic problems in the United States

- Mussels can produce up to 1 million eggs per year.
- They destroy motors, clog dam openings, and compromise the environment.
- In Southern California, the Metropolitan Water District is expected to spend $8-10 million per year removing mussel infestations and repairing damaged infrastructure.

PNWER is the last uninfested region in North America

Learning a lot about Boater Behavior



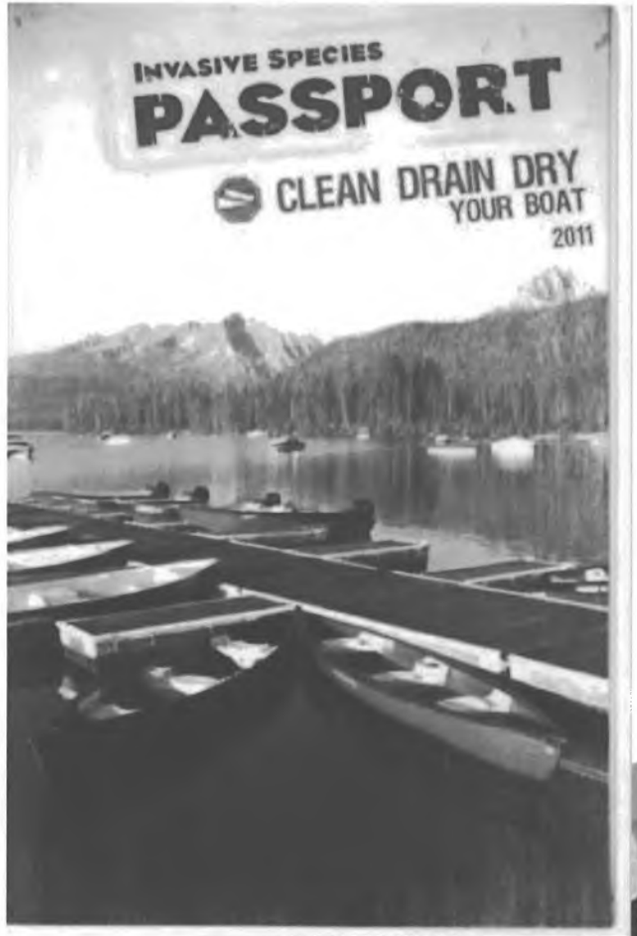
Threat of mussel infestation continues as boaters travel to the Pacific Northwest from across the country.

Regional Impact

- Installation of typical zebra mussel control measures at federal hydropower facilities in the Columbia River Basin are estimated to be $23 million.
- Before chemical control is implemented an environmental impact study is necessary.
- There will be additional costs to protect drinking water systems, fish and tourism, and other industries

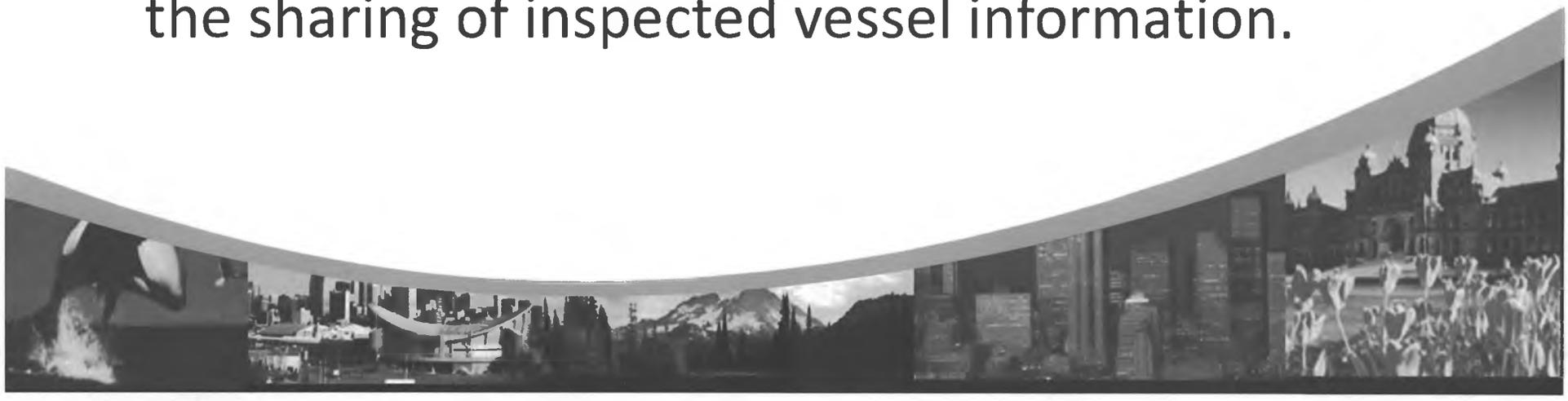
Preventative Measures

- Checkpoints in Idaho have stopped 93 contaminated vessels.
- Idaho has created the Invasive Species passport to expedite watercraft inspection.
- Need for regional preventative policies.
- Estimated costs of zebra mussel control in Great Lakes States is $40.5 million.
- Prevention is the most cost effective strategy.



Policy Action

- Expand the July 2011 multi-state agency staff MOU to include pilot use of regional passport based on the Idaho Model.
- Develop a real-time data tracking system and share data throughout the region to track vessels coming into the region with inspection results.
- Legislation providing additional funding for inspection and cleaning stations and possibly of a regional organization responsible for facilitating the sharing of inspected vessel information.



2013 PNWER Annual Summit

•Join more than 600 legislators and business and government leaders for the **2013 PNWER Annual Summit from July 14-18 in Anchorage, Alaska**.

• The summit will serve as a platform for policy makers to address issues affecting the region and discuss solutions.

•Experience Anchorage through policy tours, evening receptions, and nature excursions.

•Please mark your calendars for **July 14-18 2013** for the Annual Summit!

Questions?

- **For More Information on PNWER's Invasive Species Program, and reports referenced in this presentation, go to:**

www.pnwer.org

Tsunami Marine Debris in Alaska

Alaska Department of Environmental Conservation
Airborne Technologies, Inc
Gulf of Alaska Keeper
January 29, 2014

Tsunami-Generated Marine Debris Background

- Devastating March 2011 Earthquake and Tsunami in Japan

- Government of Japan estimates 5 million tons of debris swept into Pacific Ocean
  - Estimated 70% sank almost immediately
  - 1.5 million tons floating off coast of Japan, caught by wind and ocean currents

- Composition
  - Materials typically found in urban areas, homes, and fishing communities
  - Styrofoam, buoys, bottles, jugs, household items (refrigerators, freezers, etc)
  - Rigid urethane insulation and wood from destroyed buildings and homes
  - Fishing & boating docks, floats, bumpers, nets,

- NOAA models show debris will reach US and Canadian shores for next several years
  - High-windage (lighter) debris carried by wind; arrived much sooner than expected
  - Low-windage (heavier) debris carried by ocean current;

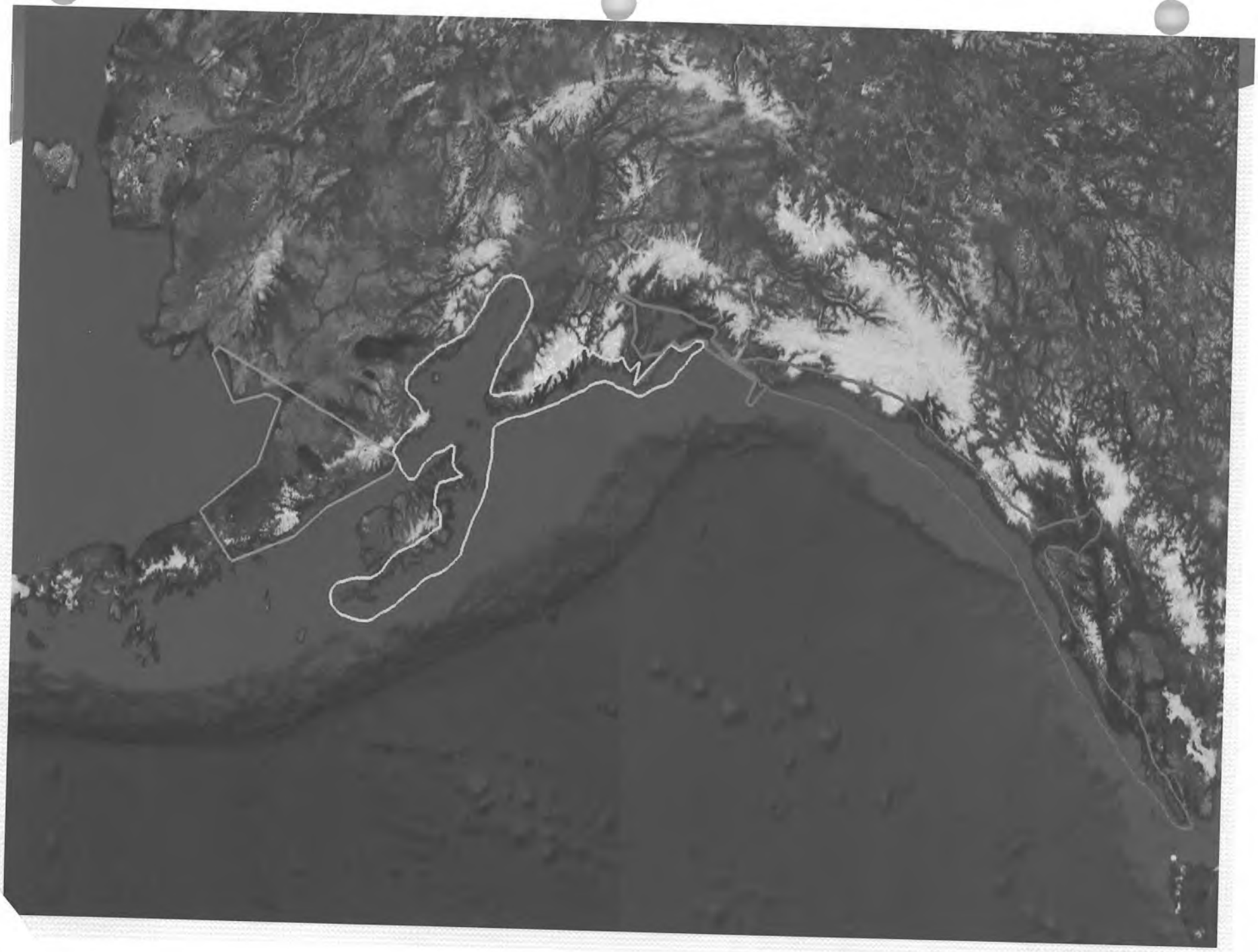
Detailed Aerial Survey
Airborne Technologies, Inc (ATI)

- Approximately 2500 miles of coastline surveyed

- Over 8200 high resolution images
  - Southeast Alaska
  - Gulf of Alaska
  - Prince William Sound
  - Alaska Peninsula
  - Bristol Bay

- Every image individually ranked for density and debris type

- Data analysis and GIS mapping



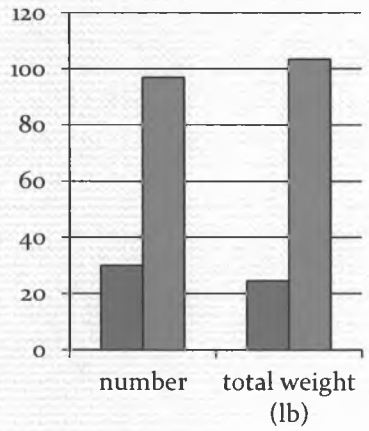
Observations Relating to Amount, Location and Composition of Tsunami Marine Debris in Alaska

- Significant increase in volume
- Large volume of high windage items
- Evidence of March 2011 Tsunami-generated debris
  - Oyster Buoys
  - Rigid Urethane Insulation
  - Common Japanese household items
  - White Styrofoam

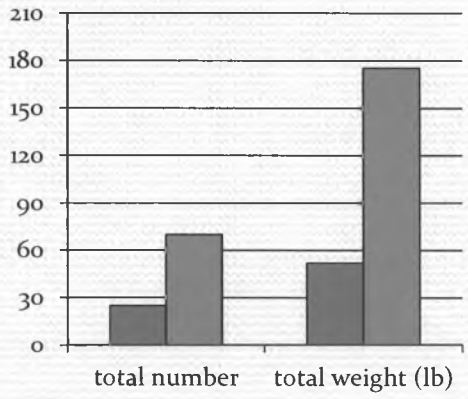
Gulf of Alaska Keeper
Tsunami Debris - Summer 2012

Combined changes in amount of high-windage MD 2011 to 2012, pre- and post-tsunami, on two Gore Point monitoring sites and two Prince William Sound sites. Pre-tsunami in blue, post-tsunami in red. ***(Debris collected and data analyzed by Gulf of Alaska Keeper, August 2012.)***

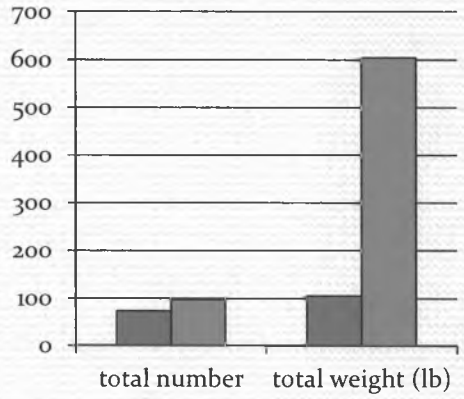
Buckets (≤ 7 gallon size)



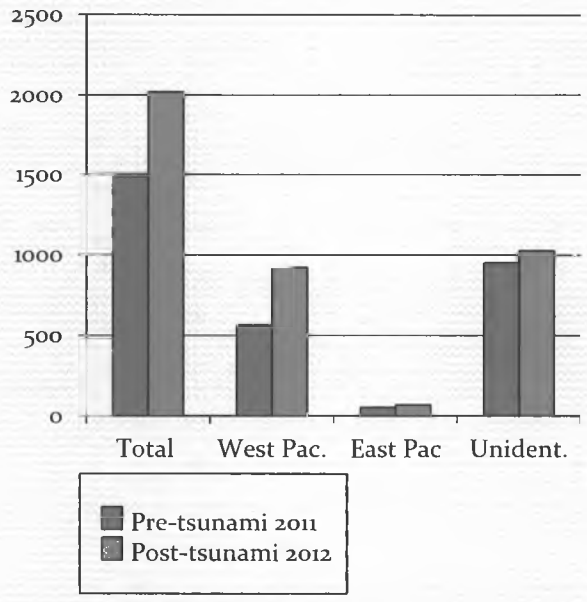
Plastic drums (≤ 6 gallon)



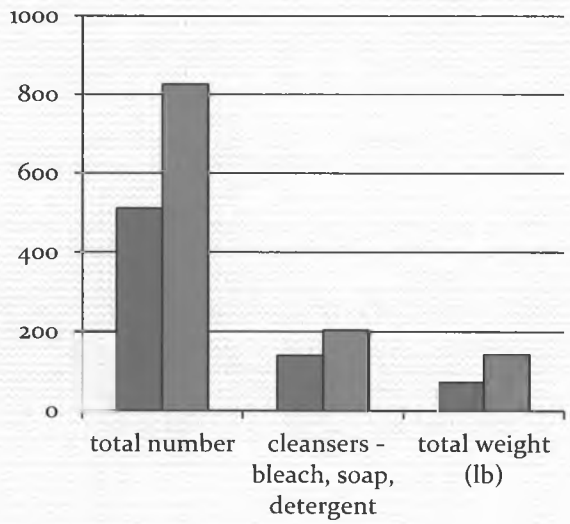
Hard plastic buoys



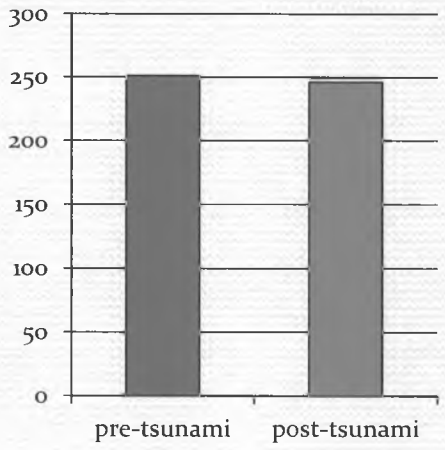
Beverage bottles (number)



Non-beverage bottles (number)



Combined rope and line fragments (lbs)



Control

Low-windage, current-driven debris

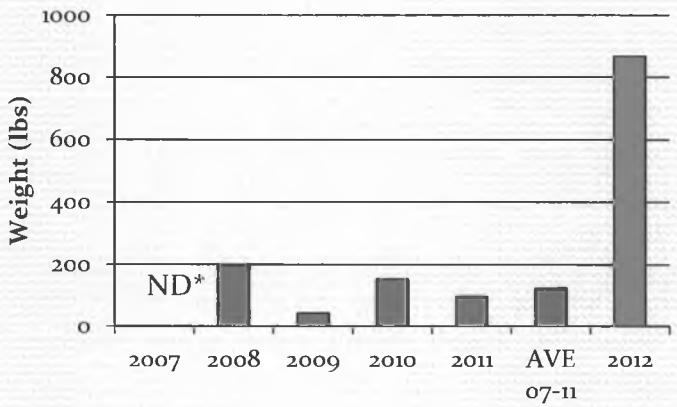
Gulf of Alaska Keeper Marine Debris Monitoring Program.

Styrofoam Data Summary as of August 20, 2012.

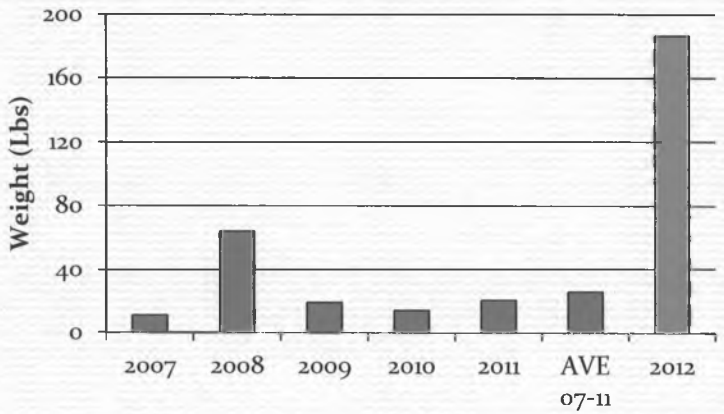
Effect Of The 2011 Japanese Tsunami On Marine Debris In PWS And Gore Point.

Styrofoam Weight

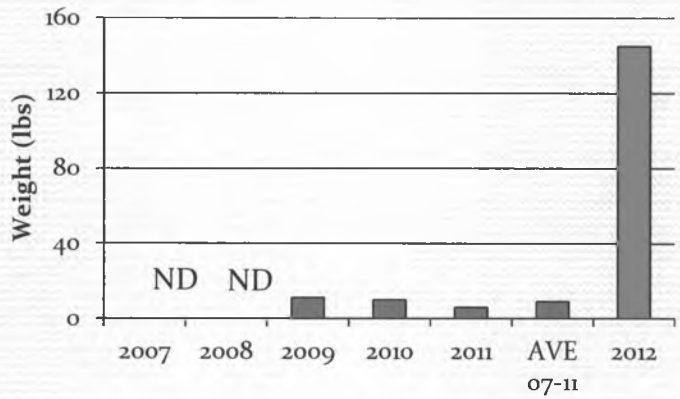
Gore Point East - Styrofoam



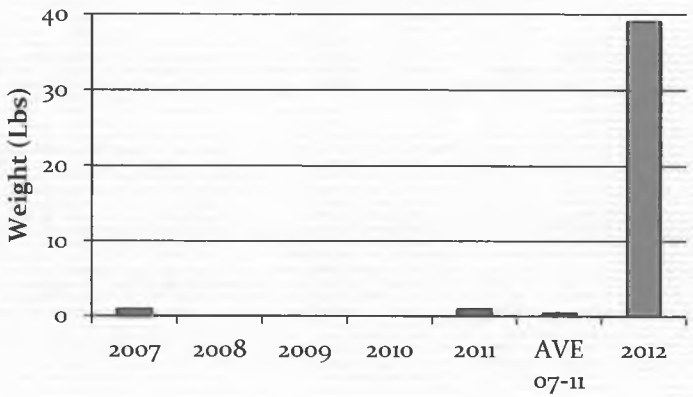
Mega Byte- Styrofoam

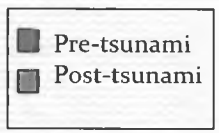


Gore Point North - Styrofoam



Block Island - Styrofoam

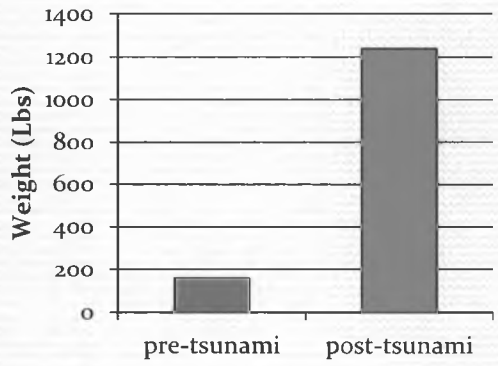




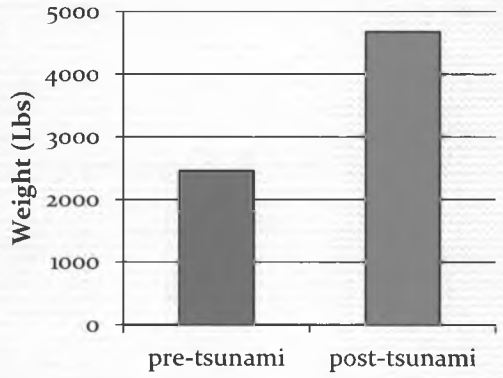
* ND, no data

Gulf of Alaska Keeper Marine Debris Monitoring Program.
Styrofoam data summary as of August 20, 2012.
Average percentages, before and after tsunami.
Totals for the 4 sites.

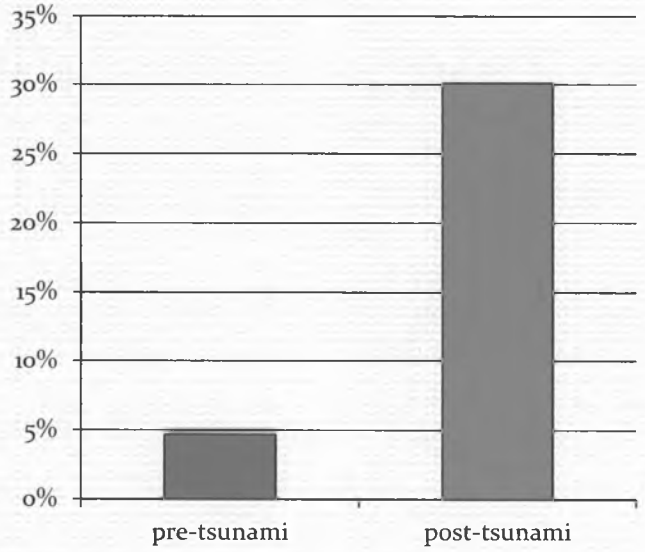
Total Styrofoam weight

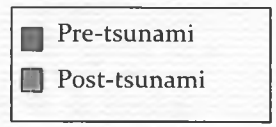


Total MD weight



Total Styrofoam weight/total MD weight



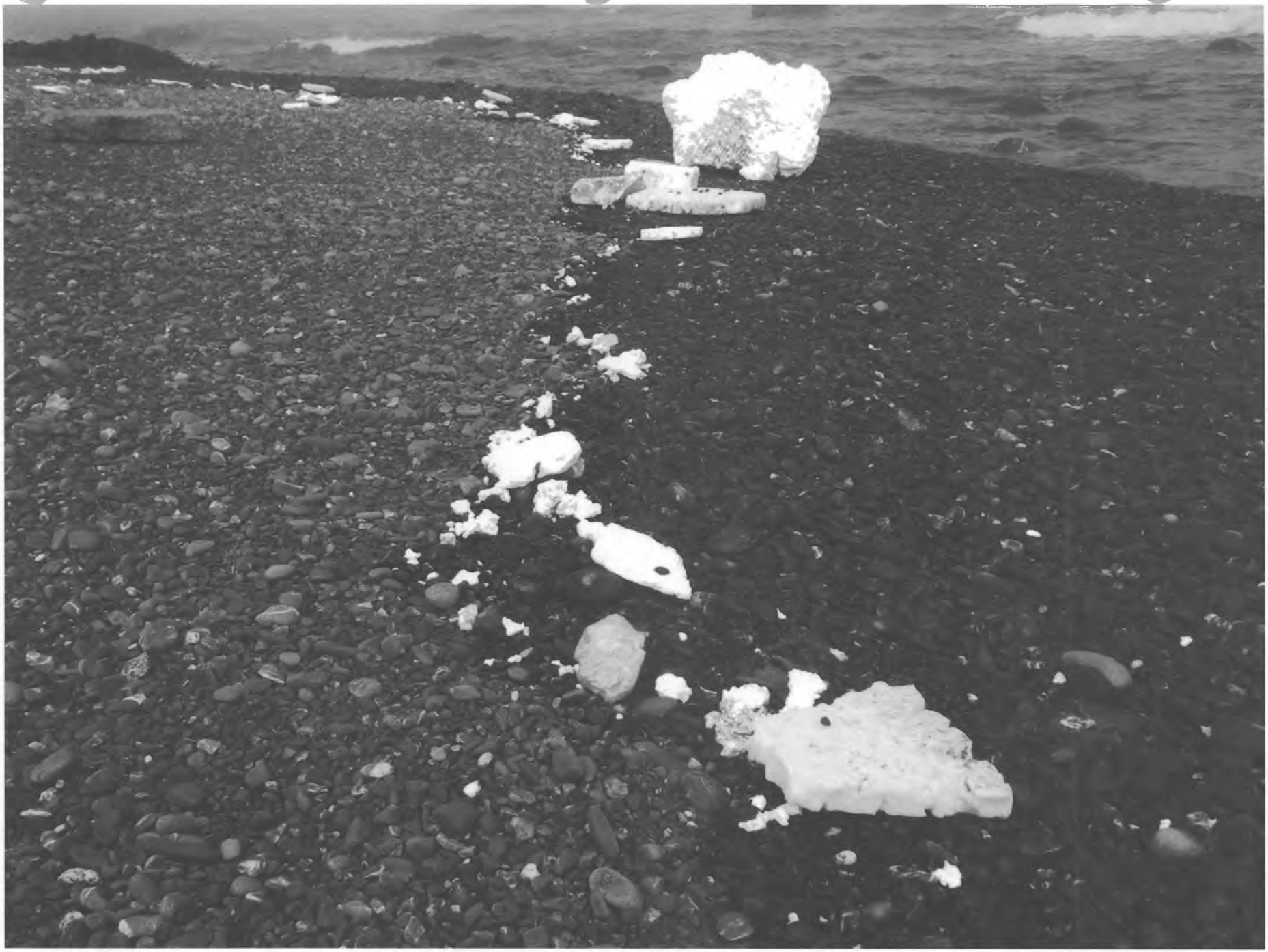



e Constantine
Gore Point
Montague Island
Kayak Island
Tugidak Island
Cape Muzon
Yukon

- Late Fall 2012 Pictures

More Tsunami Debris Observations

- New Debris Lines
- Storm Surges Move Debris Farther Up Beach
- Wind Carries Debris Inland
- Collector Beaches
- Heavier Debris Arriving Now



Concerns Related to Marine Debris

- Unknown Total Quantity or Composition
- Potential Toxicity of Components
- Breaking up and Disbursement
- Potential Impact of Small Styrofoam Pieces on Marine and Terrestrial Life
- Smothering of Sensitive Habitats
- Invasive Species
- Disposal
- Safety Risks (weather, remote sites, sea conditions, wildlife)
- Potential Navigation Risks Due to Large Debris

Radiation

- It is highly unlikely that tsunami debris has been affected by radiation from Japan's Fukushima Nuclear Reactor.

- By the time the radioactive water leak developed, the debris was already in the ocean, miles away from the reactor, and moving farther offshore.

- Recent inspections of Alaska beaches by DHSS's Radiological Health Physicist have turned up no marine debris with levels of radiation above background.

- For additional questions on radioactivity and radiation testing, visit: www.epa.gov/japan2011/index.html or contact EPA spokesperson Molly Hooven at 202-564-2313.

Cleanup Cost Considerations

- Re-Cleaning a Beach
- First Time Marine Debris Removal
- Landing Craft, Crew Vessel, Skiffs, Equipment, Supplies
- Crew Costs: Wages or Contractors
- Helicopters and Planes: Site Access or Debris Movement
- Disposal

Funding Tsunami Marine Debris Removal

- **Funding from Federal Government**
  - $50,000 grant from NOAA that funded tsunami debris removal in Prince William Sound, late Fall of 2012.
- **Funding from State of Alaska**
  - $200,000 for aerial survey and data analysis (SFY 2012)
- **$5 Million goodwill gesture from Government of Japan**
  - Small equal allocation initially to 5 states, 2 territories
  - Transfer mechanism via MOA with NOAA and submission of Statement of Work
  - First allotment expected in April 2013
  - Subsequent allotments are need-based upon approval by NOAA review team

Recent and Upcoming Events

- Alaska effectively demonstrated significant debris arrival, treacherous, difficult to access, and extensive coastline.

- Therefore, it is possible for Alaska to receive a greater portion of the reserved funding that NOAA will release based on need. This approach benefits Alaska.

- Prioritization and planning meeting January 17, 2013 in preparation for the 2013 field season for debris removal; ongoing coordination with NOAA, State & Federal land and animal managers .

- Alaska Forum on the Environment February 4-8, 2013

Marine Debris

NOAA Marine Debris Program | Office of Response and Restoration | NOAA National Ocean Service

Japan Tsunami Marine Debris:

Information and actions

January 29, 2013

Peter Murphy
Alaska Coordinator
NOAA Marine Debris Program

Marine Debris

JTMD - AK Legislature - 01/29/2013

NOAA Marine Debris Program | Office of Response and Restoration | NOAA National Ocean Service

NOAA Marine Debris Program

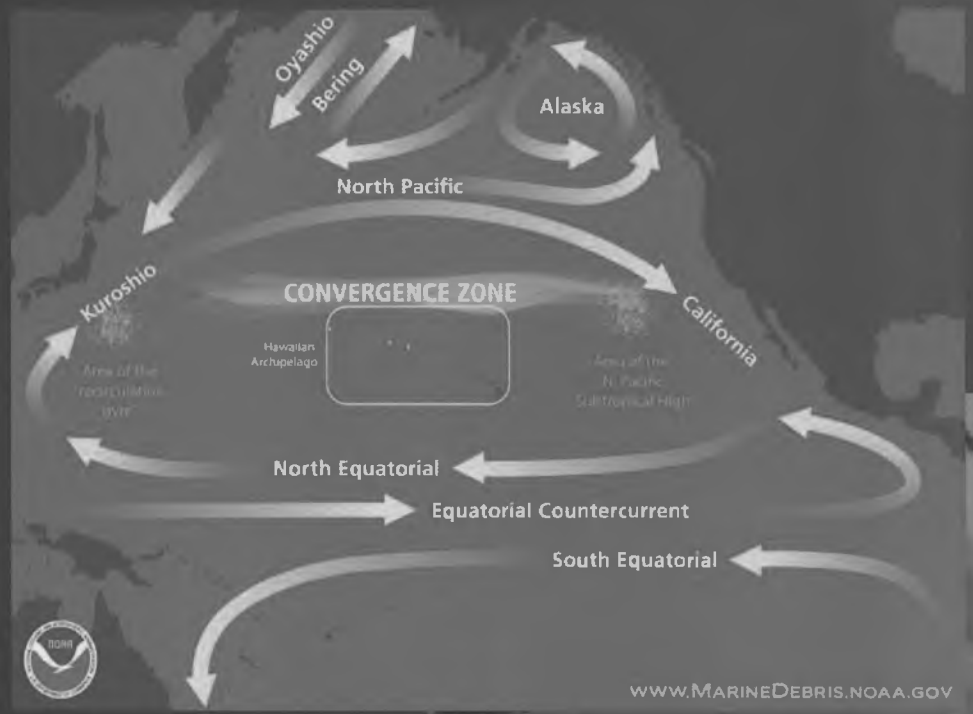
- Established in 2005
- Mandated by the Marine Debris Research, Prevention, and Reduction Act, Dec. 2006
- Dedicated to leading and promoting research, prevention, and reduction activities nationwide
- Regional Structure
- Website: **http://marinedebris.noaa.gov/**

Marine Debris

JTMD - AK Legislature - 01/29/2013

NOAA Marine Debris Program | Office of Response and Restoration | NOAA National Ocean Service

Marine Debris in Alaska.



Marine Debris

JTMD - AK Legislature - 01/29/2013

NOAA Marine Debris Program | Office of Response and Restoration | NOAA National Ocean Service

Marine Debris – Already in Alaska

MDP in AK

- 23 projects
  - Research
  - Outreach
  - Removal

EX: Gore Point

- <2 mile beach
- 20+ tons of debris in removed 2007

Marine Debris

JTMD - AK Legislature - 01/29/2013

NOAA Marine Debris Program | Office of Response and Restoration | NOAA National Ocean Service

Tsunami Marine Debris – What is it?

Photo: US Navy Pacific Fleet

Photo: US Navy Pacific Fleet

Marine Debris

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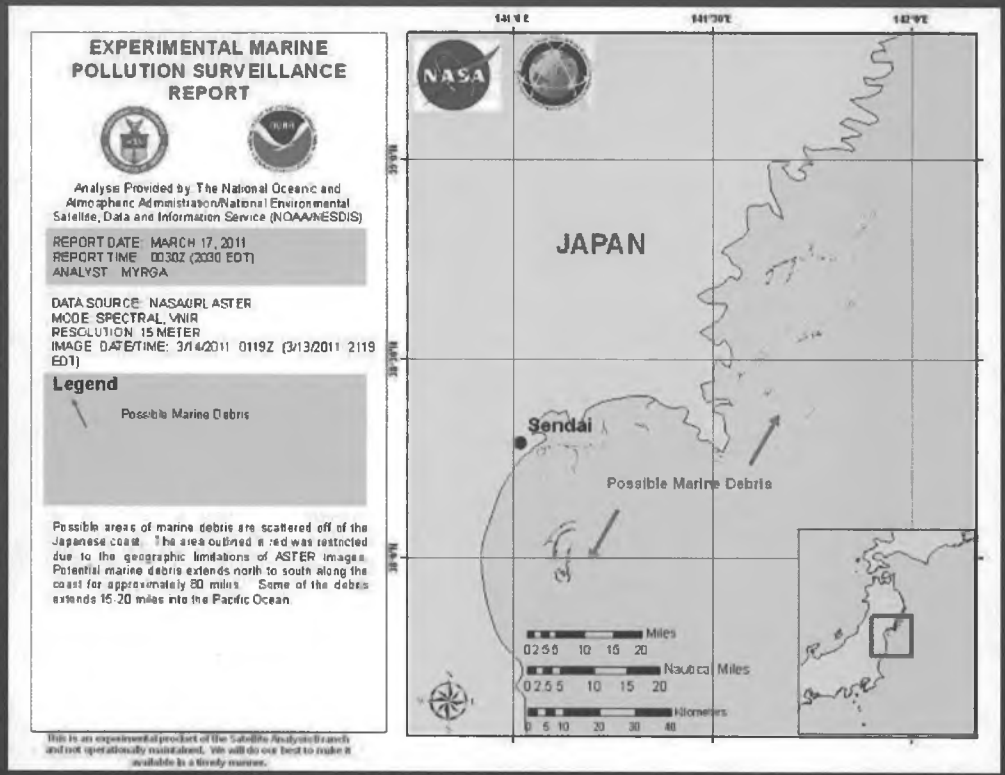
Marine Debris – Early Sightings

Photo: US Navy Pacific Fleet

Aerial Imagery – March 13

- Patches and fields
- Wood, construction materials abundant



Satellite Imagery – March

- Patches and fields – By April 14, debris no longer visible

Marine Debris

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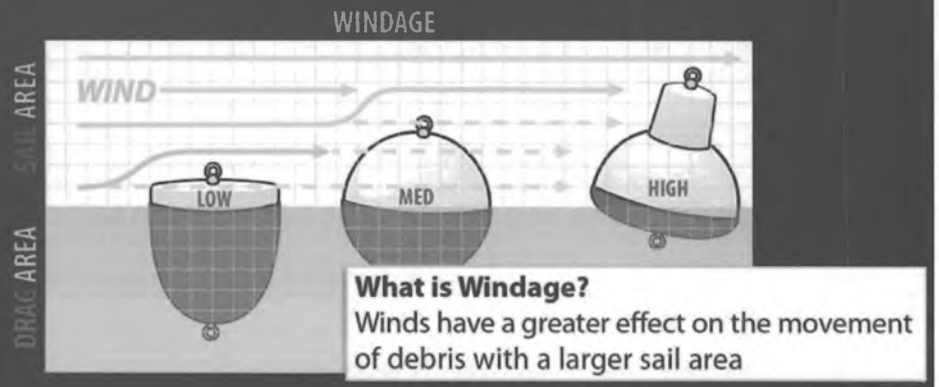
Modeling

Where will the debris go, and when?

Ocean currents + **Winds**



What is Windage?
Winds have a greater effect on the movement of debris with a larger sail area

- Combination of sail area and drag
- **Low = slow (e.g., wood, nets)**
- **Medium = moderate (e.g., fishing vessel)**
- **High = fast (e.g., unoccupied inflatable life raft, Styrofoam)**

Marine Debris

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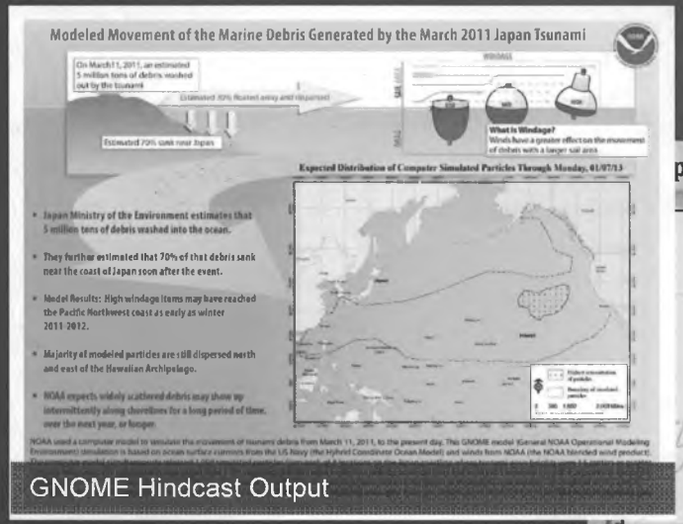
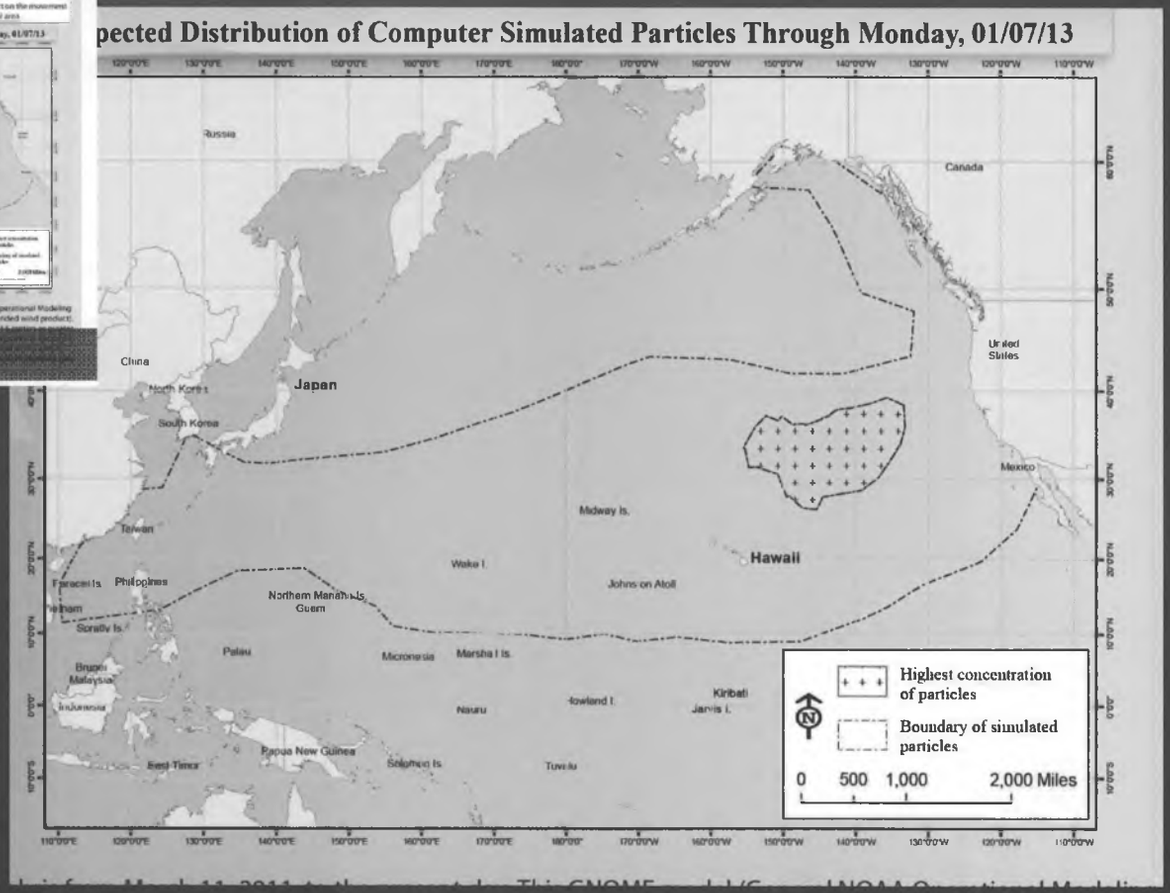
Modeling



GNOME Hindcast Output



GNOME Hindcast

- 8,000 total particles from 8 locations
- Random windage: low to high
- Where debris may be NOW

Marine Debris

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Marine Debris Sightings as of January 10, 2013

Sightings

Japan Tsunami Marine Debris

Debris Detection Satellite Target Areas (updated 9/20/12)

- No Debris Sighted
- Processing

Sightings

Japan Tsunami Debris Potential Sightings (updated 1/10/13)

- Potential

Japan Tsunami Debris Confirmed Sightings (updated 1/10/13)

- Confirmed

...rted to NOAA as possible tsunami debris ...htings (red triangle) indicate objects that ... the tsunami impact area. Potential sightings ...t may be linked to the tsunami, based on ...that may not have the unique identifiers ...er or contact information, to confirm its origin.

...blem, and not all debris found on U.S. shore- ...t to note that potential sightings may not be ...t items lost or abandoned before or after the tsunami from sources around the Pacific Rim. For more information regarding tsunami marine debris from Japan please visit: http://marinedebris.noaa.gov/tsunamidebris

0 450 900 1350 1800 mi

Coastal Response Research Center
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ERMA Environmental Response Management Application Pacific Islands

Marine Debris

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Tsunami Marine Debris – Actions

1. Detection
   - *Satellite, Aerial, Vessel*
2. Modeling
3. Monitoring
   - *Baseline data*
4. Planning / Preparedness
   - *Regional*
5. Communication

Marine Debris

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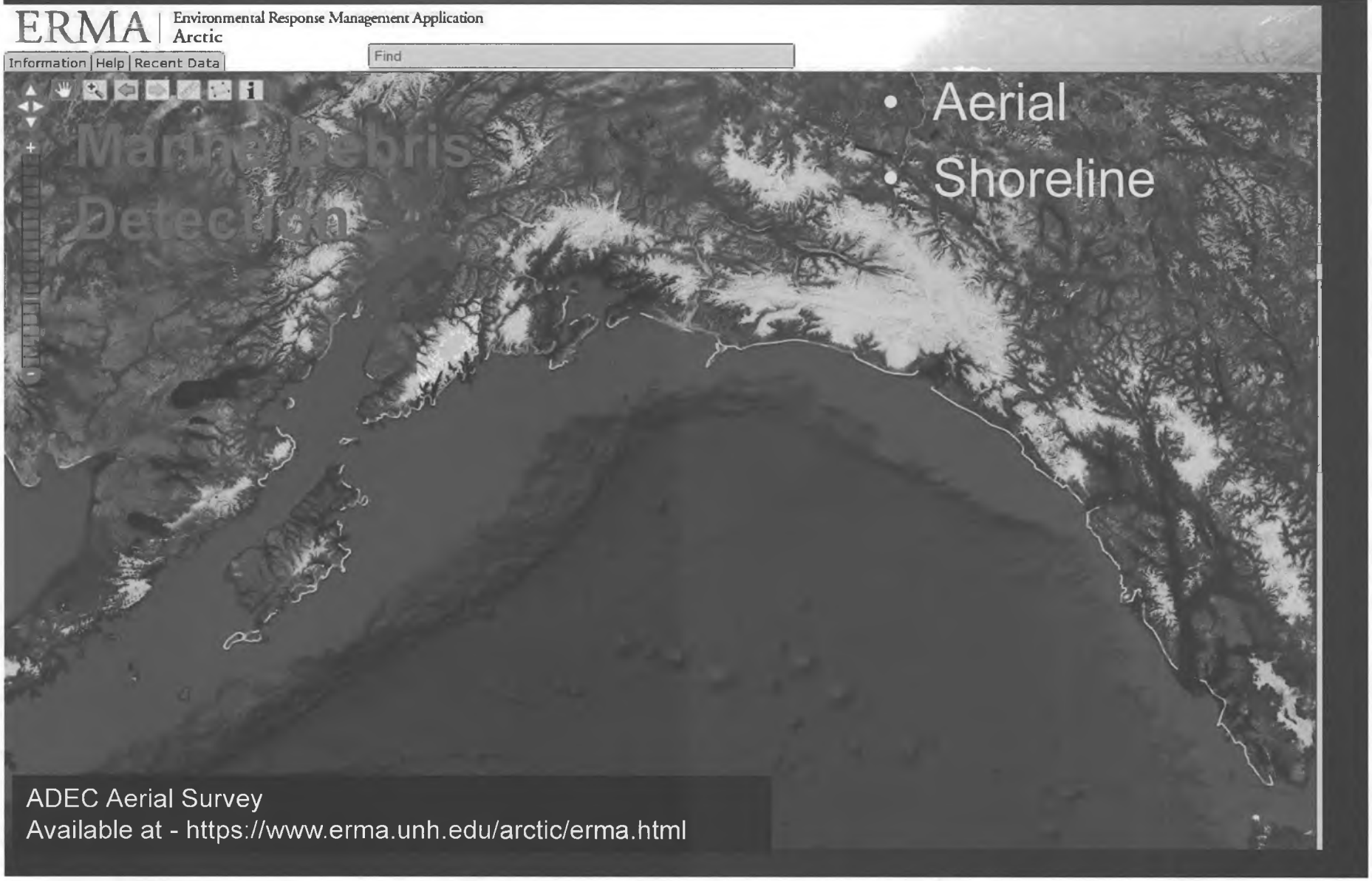

Marine Debris

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Planning / Preparedness

- Regionally Based Planning
  - 5 States – AK, WA, OR, CA, HI
- Inclusive Process
  - Federal, State, Native, MD Community inputs
- Alaska
  - Federal Framework
  - Prioritization

Tsunami Marine Debris – What we know

- Tsunami debris **added to an existing problem**
- Likely much of the **debris sank near shore off Japan coast.**
- **Debris is dispersed** and not in large concentrations or fields.
- **Radioactive debris?**
  - Consensus that contamination of debris is highly unlikely
- **Sightings**
  - Twenty sightings of confirmed JTMD (as of 01/24/13), many more unconfirmed
  - Presence of confirmed debris means JTMD is present, but individual items can rarely be "fingerprinted" back to their origin.
  - Noted increase in styrofoam, buoys and high-floating debris during 2012 field season.
- Planning
  - Planning and preparation is being managed at state-by-state level.

Thank You

Thanks to: US Coast Guard, National Park Service, US Fish and Wildlife Service, US Forest Service, US EPA, NOAA NWS-VOS, NMFS, State of Alaska DNR, NOAA NESDIS, NGA, ADEC, DF&G, Gulf of Alaska Keeper, Marine Conservation Alliance Foundation, Island Charters, Island Trails Network, Sitka Sound Science Center, Center for Alaskan Coastal Studies, and many others!

Peter Murphy

peter.murphy@noaa.gov

marinedebris.noaa.gov

Report JTMD Sightings to:

disasterdebris@noaa.gov

Tsunami Debris Docks provide Unique Opportunity for Scientists

By Annie Feidt, APRN - Anchorage | January 23, 2013 - 5:26 pm

Photo courtesy of GoAK.

Tsunami debris from Japan is fouling shorelines all along the west coast of the United States. It's also providing a unique research opportunity for scientists studying invasive species. At the Marine Science Symposium in Anchorage this week, Oregon State University associate professor Jessica Miller gave an update on her research work on the two massive docks that washed up in Oregon and Washington last year. APRN's Annie Feidt reports:

It's rare for scientists to find perfect field experiments right in their backyard. But that's what happened last summer to Jessica Miller.

"There was a little bit of buzz in the hallway at work on the 5th of June that hey, something pretty big is on the beach."

The beach, was just four miles from Miller's office. And that "something" turned out to be a giant dock, that had been ripped lose in the 2011 Japanese Earthquake and Tsunami. When she first saw it, Miller says she was flabbergasted by just how huge it was- 66 feet long. That night, she called a few colleagues and they agreed to meet there the next morning with buckets and shovels:
"Given the situation, we were fairly systematic, but it's not like we we had a whole sampling design for a dock, we were just going 'wow', I think we need to get these samples. So we tried to sample all the sides of the dock and probably got 30 five gallon bags, and went back to the lab to begin figuring out what was there."

The scientists quickly realized several of the species were potentially aggressively invasive. So a team from the state of Oregon scraped off all of the living debris, took a blow torch to the dock and then buried two tons of organisms several feet down higher up on the beach. Then the research began. So far, Miller's team has documented 117 species that likely made the entire trip from Japan to Oregon.

"And it really appears given this diversity of animals, the reason some of them could survive on this dock for so long was that some of them were feeding on other ones on the dock. Sort of an island in the ocean crossing the Pacific."

Miller says 11 of the species could be invasive, including the European blue mussel, the Japanese sea star and the Asian pink barnacle. Miller says it's hard to predict how likely they are to become invasive. But if any do take hold, it will be a unique opportunity to study an invasive species from the moment of its arrival. One of the species Miller is most worried about is an Asian seaweed:
"Ondarea is a brown alga that was incredible abundant on the dock and reproductive at the time. And its already established in California. And it's on one of the 100 worst invasive species list already."

In late December, another dock washed up on a beach on Washington's Olympic Peninsula. It was from the same port in Japan and carried a similar mix of creatures with it across the ocean. Miller's team took samples from that dock as well. But she says invasive species aren't just arriving on huge objects, like docks.
"A buoy just came up into the Columbia river region. The large black buoys several people are reporting with chiton, a couple species of chitons, mussels and I think an Oyster on it, so you really can have some of the smaller objects bringing in non native species."

That has implications for Alaska. No large docks have washed on shore in the state. But millions of pounds of debris are piling up on Alaska's beaches. So far, the state hasn't documented any invasive species from the debris. Chris Pallister, with Gulf of Alaska Keeper, helped clean about 6 tons of tsunami debris from the southeast Kenai Peninsula this summer. He says he worried about invasive species, but he's more worried about toxins from the debris:
"I mean you're talking thousands of miles of coastline that have been impacted by every type of plastic you can imagine and drums and containers of everything from nasty industrial chemicals to household cleaning products that are being scattered all up and down the inter-tidal environment."

Last summer, the state commissioned a aerial survey to document how much tsunami debris was washing up and where it was concentrating. The survey shows the debris stretches from the Southern tip of Southeast all the way around the Gulf of Alaska and at least part way down the

Alaska Peninsula. Montague Island, Kayak Island, south of Cordova and Shuyak Island near Kodiak were identified as hot spots. But so far no state funding and only a tiny amount of federal funding has been appropriated to begin cleaning it up.

Listen to the full story

Smithsonian Institution

KACHEMAK BAY
RESEARCH RESERVE
A Unit of the National Estuarine Research Reserve System

Guide to Some Common
Fouling Invertebrates of Alaska
with focus on known and potential invasives

Introduction

Invasive species are a concern in many parts of the world, but nowhere is the threat more evident than in the state of Alaska. With 30-40 thousand miles of pristine coastline and commercial fisheries worth billions of dollars annually, introductions to Alaskan waters have the potential for great impact, both environmentally and economically. To meet this threat, a citizen science monitoring network called Plate Watch was established in 2007 (http://platewatch.nisbase.org/) to help monitor for invasive marine invertebrates in Alaska. The invertebrate fauna of the Pacific Northwest is varied and diverse and can provide challenges to identification, thus the idea of a field guide was born, to ensure that monitors could distinguish Alaskan native species from non native invasives. This work is the result of a collaboration of the Smithsonian Environmental Research Center and Kachemak Bay Research Reserve. Many thanks to Ann Eissinger of the Puget Sound Marine Invasive Species Volunteer Monitoring Program (MISM) and Ray McNally at the Puget Sound Partnership, for giving us access to the Marine Invasive Species Guide for the Puget Sound Area which provided the basic framework for our Guide. As much as possible, the species descriptions include key features discernable with the naked eye, to help separate them from similar species without the aid of a microscope. Distributional information is focused primarily on the west coast.

For questions or further information about the field guide, contact Linda McCann mccannl@si.edu or Catie Bursch catie.bursch@alaska.gov. Work on the Guide is ongoing, so check the websites for updates!

Cover Photos: Botryllid juvenile: Linda McCann, *Molgula* tunicate: Catie Bursch, Plate covered with *Ciona* spp: Chela Zabin, *Distaplia alaskensis*: Heather Meuret Woody. Photo this page: *Ciona* sp. fouling aquaculture cages. http://www.whoi.edu/cms/images/oceanus/seasquirt2_n1_41620.jpg

This Field Guide can be downloaded from the Plate Watch and KBRR websites at: http://platewatch.nisbase.org and http://www.adfg.alaska.gov/index.cfm?adfg=kbrr_educationResources.home.

Field Guide Species List

Marine Fouling Invertebrates

Phyla

Tunicata

Taxonomic Name	Common Name	Status Pacific NW
Aplidium californicum	sea pork	Native
Aplidium coei		Native
Ascidea callosa	sea blister	Native
Ascidea columbiana	sea blister	Native
Boltenia villosa	spiny headed tunicate	Native
Botryllus schlosseri	golden star tunicate	NIS
Botrylloides violaceus	chain or sheath tunicate	NIS
Ciona intestinalis	vase tunicate	NIS
Ciona savignyi	vase tunicate	NIS
Corella inflata	brooding transparent tunicate	Native
Corella willmeriana	transparent tunicate	Native
Dendrodoa pulchella		Native
Didemnum vexillum	marine or sea vomit	NIS
Didemnum carnulentum	White crust tunicate	Native
Tridemnum spp		Native
Distaplia alaskensis	compound tunicate	Native
Distaplia occidentalis	mushroom compound tunicate	Native
Halocynthia aurantium	sea peach	Native
Halocynthia igaboja	Hedge hog tunicate	Native
Molgula citrina	sea grape	Native?
Molgula manhattensis	sea grape	NIS
Molgula pacifica	sea grape	Native
Molgula retortiformis	sea grape	Native
Styela clava	club tunicate	NIS
Synoicum irregulare	Gnomes toes	Native
Synoicum jordani	sea pork	Native
Cnemidocarpa finmarkiensis	broad base tunicate	Native

Decapoda

Carcinus maenas	European green crab	NIS
Metacarcinus magister	Dungeness crab	Native

Bryozoa

Taxonomic Name	Common Name	Status Pacific NW
Watersipora subtorquata		NIS
Schizoporella japonica		NIS
Bugula neritina		NIS

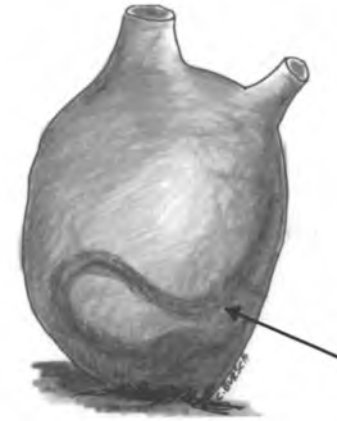
Macroalgae

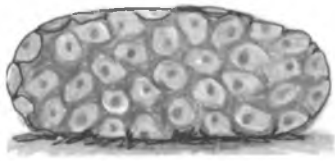
Phaeophyta

Undaria pinnitifida	Japanese kelp	NIS

Key Features

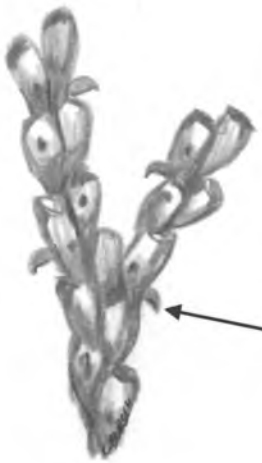
Tunicata

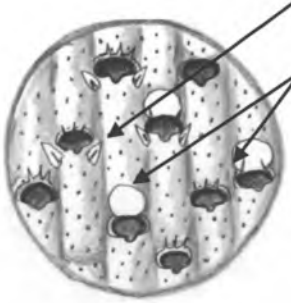




- Solitary or Colonial
- Firm or spongy
- Position of siphons lateral, terminal
- Tunic smooth, hairy or bumpy
- Presence of spicules (microscopic)
- Shape of gut

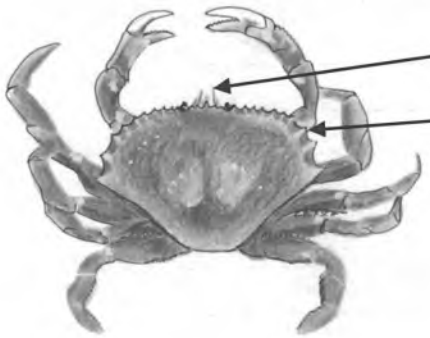
Bryozoa





- Erect or Encrusting
- Soft or Calcareous
- Color
- Presence of spines
- Presence of avicularia
- Presence of ovicells

Decapoda



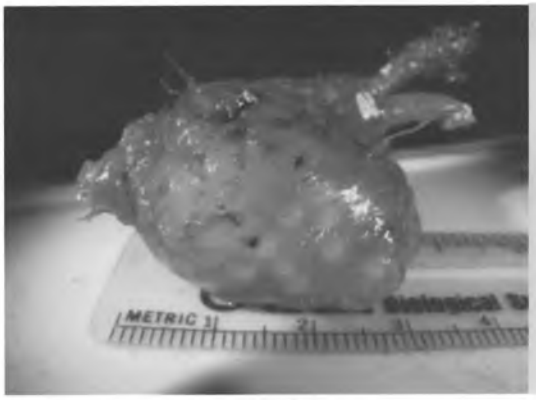
- Presence of 10 legs
- Number of spines between eyes
- Number of spines laterally
- Swimming or walking legs
- Shape and color of claw

Macroalgae

- Brown, Red or Green Alga
- Presence of midrib
- Blade divided or whole
- Presence of sporophyll
- Presence of swim bladders

Tunicate (colonial) - *Aplidium californicum*

DESCRIPTION	This colonial tunicate, commony called Sea Pork, is very smooth, round and often glossy. Sometimes sand is in folds of the tunic, but never embedded. Form is extremely variable including mounds, lobes or sheets.
RANGE	Alaska to southern California
SIZE	1- 3 cm tall, to 20 cm in diameter.
STATUS	Native
COLOR	Variable, white, pink, peach or brown with yellow to orange spots within the tunic, to nearly colorless.
HARITAT	Intertidal to subtidal, rocks, sand and common on man-made substrates to 85 m.
TIDAL HEIGHT	Lower intertidal, subtidal to 85 m.
SALINITY	25.4 to 35 ppt
TEMPERATURE	-0.4 to 16.2 °C
SIMILAR SPECIES	Glossy surface distinctive. Species is highly variable in form and can look similar to *A. solidum* , but the latter is generally much larger and has 5 lobes on the atrial siphon, whereas *A. californicum* has none.



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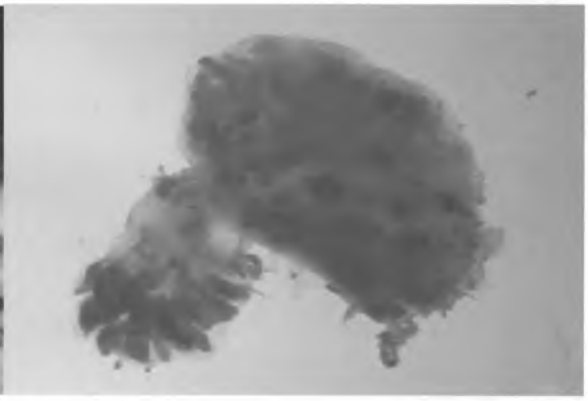
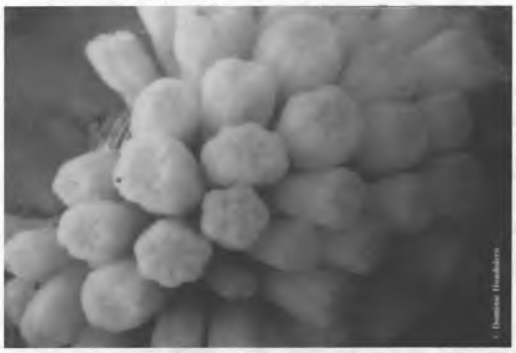


©SERC San Diego

Tunicate (colonial) - *Aplidium coei*

DESCRIPTION	Colonial tunicate with 1-4 enlarged lobes arising from a common base. The top of lobes are gathered looking, with the zooids columnar like *Distaplia* .
RANGE	Alaska: Ritter described and collected them on Kodiak Island during the Harriman expedition (Ritter, 1901). Gretchen Lambert identified them again in Kodiak in 2001 and reported that they were fairly common in the low rocky intertidal. They were also seen in Kachemak Bay in low rocky intertidal and in Scow Bay, near Sitka.
SIZE	Lobes to 5.5 cm tall. Colonies photographed ~ 15 cm wide or less.
STATUS	Native
COLOR	Bright yellow or orange.
HABITAT	Sand and rock, on the latter sometimes under dense kelp cover.
TIDAL HEIGHT	Low intertidal and subtidal.
SALINITY	15.2 to 33.3 ppt. (Homer & Seldovia Harbor range)
TEMPERATURE	-2.3 to 14.9 °C (Homer and Seldovia Harbor range)
SIMILAR SPECIES	Can be confused with *Distaplia* spp which do not have a puckered top to the lobes. There are many *Aplidium* and *Synoicum* spp. *As well* as other compound tunicates in the Pacific Northwest that can be difficult to tell apart without a microscope.



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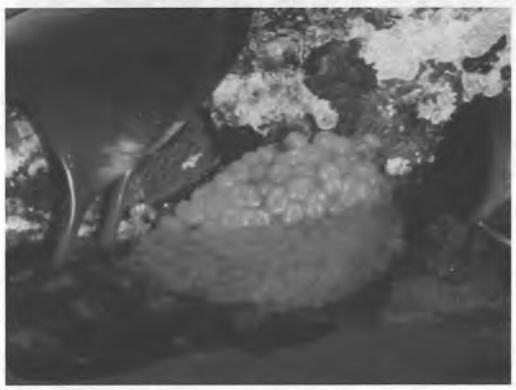


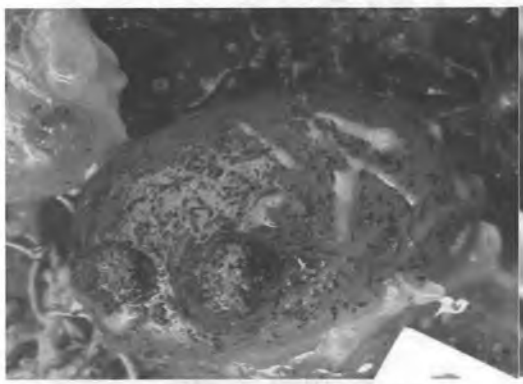
©K. Stanley

Photos 1-3 from Kachemak Bay

©P. Norwood Sitka

Tunicate (solitary) - *Ascidia callosa*

DESCRIPTION	This solitary tunicate is soft, hairless, ~1-2 mm thick and easily torn. Its body is wider than it is tall with a somewhat flattened appearance. The tunic margins are rounded and in old individuals looks wrinkled. Since this animal is lying mostly on its left side, the oral siphon is at the extreme anterior end of body, the atrial siphon is close to it but slightly posterior. Both siphons 6 lobed.
RANGE	Circumboreal in northern seas. In North America it's found from Alaska to Puget Sound, Washington. In Alaska it is found in Homer, Cordova, and Chenega.
SIZE	Body length up to 5 cm. ~3 cm in diameter.
STATUS	Native
COLOR	Clear, white to orange. More transparent when young.
HABITAT	Attaches to firm substrates, rocks in the intertidal and floats and ropes in harbors.
TIDAL HEIGHT	Low intertidal and sub-tidal to 146 m.
SALINITY	15.2 to 33.3 ppt. (Homer & Seldovia Harbor range)
TEMPERATURE	-2.3 to 14.9 °C (Homer and Seldovia Harbor range)
SIMILAR SPECIES	It can be distinguished from *Ascidea columbiana* by the lack of a dense circle of papillae around the siphons. Rather, its siphons look a bit like those of *Cnemidocarpa finmarkiensis* , in that they cramp up when shut and have smooth edges. Also, the edges of its tunic are rounded and may roll up whereas the tunic of *A. columbiana* is wide and sheet-like at the base. Locally it could be confused with *Molgula* but is flatter and attached on it's side.



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©Chela Zabin

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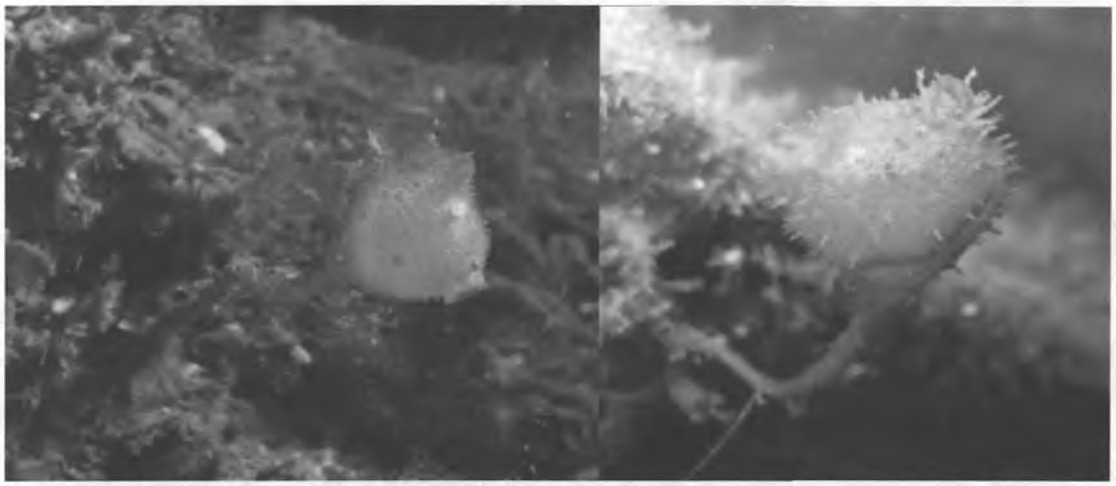
Tunicate (solitary) - *Boltenia villosa*

DESCRIPTION	Small solitary tunicate with stalked, hairy body. The stalk can be long relative to size of tunicate
RANGE	Alaska and British Columbia to San Diego, CA
SIZE	up to 3 cm wide and 10 cm long
STATUS	Native
COLOR	orange, red or brown and aperaturs often red
HABITAT	Among colonies of tubeworms that grow on submerged man-made structures or hard substrates.
TIDAL HEIGHT	Alaska and British Columbia to San Diego, CA
SALINITY	28.0-33.3 ppt Seldovia Harbor
TEMPERATURE	0-12.4 °C Seldovia Harbor
SIMILAR SPECIES	*Halocynthia igaboja*, but the latter is not stalked, is more densely covered with long spines and can get quite large. Another species of the genus, *B. ovifera* which does not have the spiny tunic, is circumpolar and may be in Alaska but we have no records at present.



©ADF&G - Shawn Harper Kachemak Bay ©Janna Nichols Washington state

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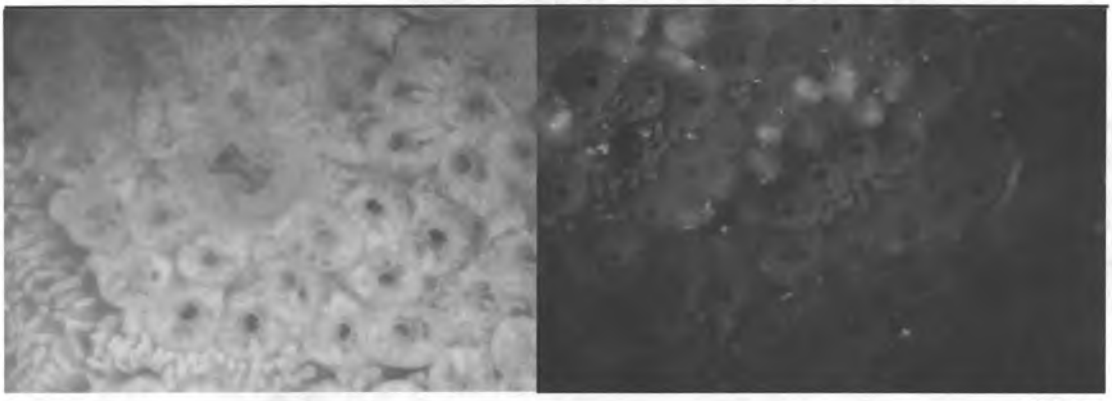
Tunicate (colonial) - *Botrylloides violaceus*

DESCRIPTION	This colonial tunicate is thin and lobe-like with zooids forming long double rows or chains. Short chains sometimes look similar to the flower-like pattern in *B. schlosseri*. The tunic is relatively tough and leathery to the touch.
RANGE	Alaska to California. It was first noted on the west coast in San Francisco, CA in the early 1970's. Native to Japan and China, it has become abundant in Sitka and Ketchikan, AK over the last decade.
SIZE	Colonies can be large, up to 0.3 m diameter
STATUS	Invasive; see the full record at http://invasions.si.edu/nemesis/
COLOR	Solid color, variable - often orange but can be red, yellow, purple, or tan, occasionally brown or lavender.
HABITAT	It generally grows subtidally in protected areas on a variety of surfaces such as docks, boat hulls, buoys, ropes, pilings, on top of and underneath rocks, on mussels and solitary sea squirts, seaweeds (see photo) and eelgrass.
TIDAL HEIGHT	Shallow subtidal, < 50m, but can be found in the intertidal in protected areas
SALINITY	18-40 ppt
TEMPERATURE	-0.6 -25°C but generally found above 8°C
SIMILAR SPECIES	*Botrylloide diegensis* is two toned with a light colored ring around the siphons and darker test. *Botrylloides spp*. do not form the star-like pattern found in *Botryllus schlosseri*, rather the zooids form long chains or ladders. Also distinctive, *Botrylloides violaceus* has numerous very large ampulae that are visible in the lower left hand corner in the first photo to the left.



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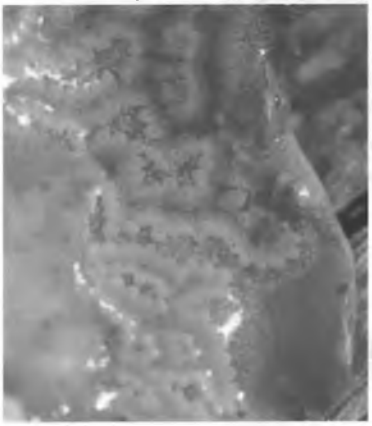

©Gary Freitag note meandering rows

on algae ©Heather Meuret Woody

Tunicate (colonial) - *Botryllus schlosseri*

DESCRIPTION	The zooids in this colonial tunicate are organized in a star pattern (usually conspicuous). Colonies are flat, but can develop lobes as they mature.
RANGE	Alaska to California. First noted in California and Washington in the 1970's. Native to Europe, and the Mediterranean. Now abundant in Sitka and recently found at one locality in Ketchikan but no clear evidence of establishment yet.
SIZE	Forms flat irregular sheets 3-4 mm thick, and up to around 15 cm.
STATUS	Invasive, see the complete record at http://invasions.si.edu/nemesis/
COLOR	Often two-toned, the color patterns are extremely variable, white, purple, orange or brown to almost black.
HARITAT	Docks, boat hulls, buoys, ropes, pilings, on top of and underneath rocks, on mussels and solitary sea squirts, seaweeds and eelgrass.
TIDAL HEIGHT	Subtidal to 200 m, occasionally found in lower intertidal
SALINITY	<14-44 ppt. Found in marine and estuarine habitats.
TEMPERATURE	Species dies below 3°C and needs at least 11°C to reproduce
SIMILAR SPECIES	*Botyrlloides* has long rows of zooids, numerous large ampulae along the exterior margins of the colony, and much larger larvae.

©H. Meuret-Woody

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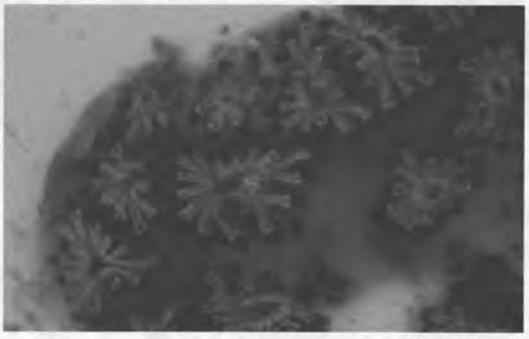

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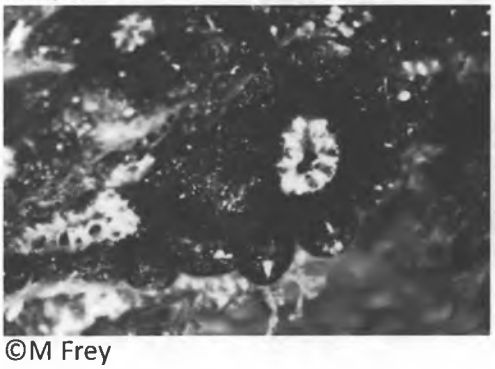

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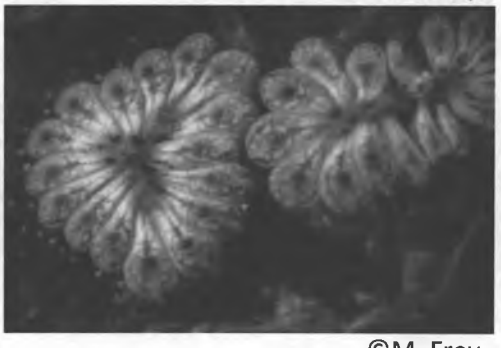

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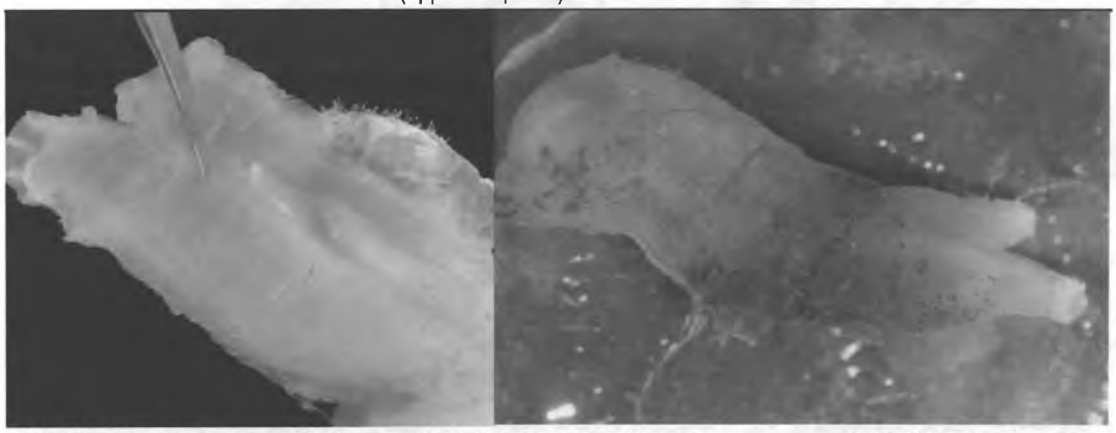
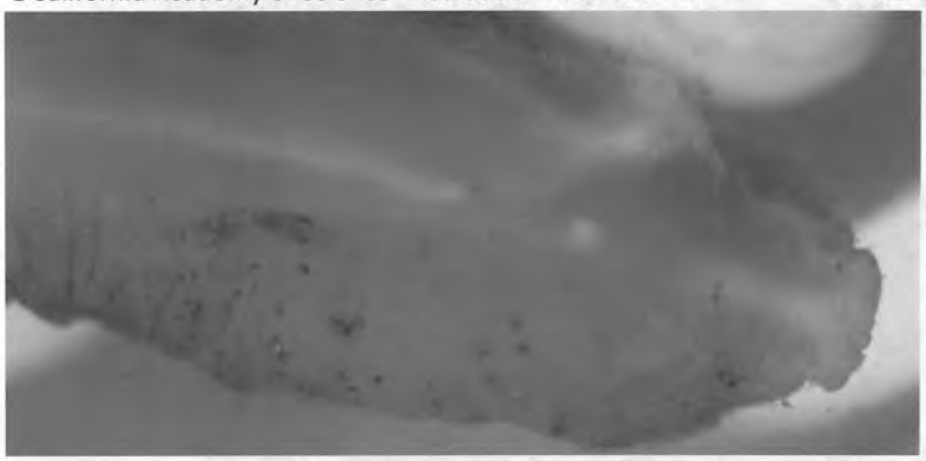
Tunicate (Solitary) - *Ciona intestinalis*

DESCRIPTION	This solitary tunicate is long and transparent with orange to red dots on the scalloped edges of the siphons. The body is easily torn. They can form large groups.
RANGE	Puget Sound, Washington to San Diego, California. Native to the Atlantic and the Mediterranean. They were first reported on the west coast in San Diego in 1897.
SIZE	to 15 cm.
STATUS	Invasive (find the complete record at http://invasions.si.edu/nemesis/index.html)
COLOR	Body yellowish, often transparent, with orange dots on the top edges of the siphon
HABITAT	They are found in protected harbors and marinas growing on docks, boat hulls, buoys, ropes, pilings, but also on natural substrates such as rocks, shells and boulders.
TIDAL HEIGHT	Subtidal, but sometimes in low intertidal
SALINITY	11-50 ppt. Highly tolerant species that can reproduce up to 40 ppt
TEMPERATURE	cold temperate to tropical, 10-30°C, but can withstand temperatures as cold as -1°C for months at a time
SIMILAR SPECIES	*Ciona savignyi* has a more fragile tunic than *C. intestinalis* with much brighter yellow markings on the siphon edges and a white rather than a red dot on the vas deferens (upper left photo).



©California Academy of Science Red dot on vas deferens. © Melissa Frey



© Melissa Frey

Tunicate (Solitary) - *Ciona savignyi*

DESCRIPTION	This solitary tunicate is long and transparent with orange dots and broad yellow markings on the scalloped edges of the siphons. The body is fragile and easily torn. They can form large groups.
RANGE	Puget Sound, Washington to southern California. They are native to Japan and were first reported on the west coast in 1985 in Long Beach California.
SIZE	Body long, up to 15 cm.
STATUS	Invasive. See the full record at http://invasions.si.edu/nemesis/
COLOR	Pale yellow, often transparent with white and yellow dots in body cavity. The tip of vas deferens is white.
HABITAT	Often found on docks and manmade structures such as boat hulls. They can form dense aggregates.
TIDAL HEIGHT	Subtidal to 60m.
SALINITY	18-35 ppt
TEMPERATURE	Broad temperature range, 11-27°C
SIMILAR SPECIES	In California *Ciona intestinalis* is distinguished by its red/orange dots on the siphon edges (*C savignyi* has bright yellow streaking on the siphon edges as in photo below), and the red dot on the vas deferens seen through the body wall. The tunic also gets tougher and browner in *C. intestinalis* . Genetic analyses is showing that these patterns may be regional.

© Janna Nichols

Tip of siphon showing bright yellow lines ©M. Frey

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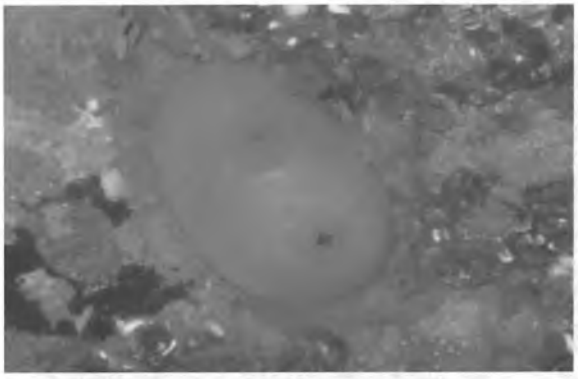
Tunicate (solitary) - *Cnemidocarpa finmarkiensis*

DESCRIPTION The tunic is opaque and smooth, the body is low and dome-shaped to flattened, and broadly attached to the substrate. The tunic is thin but tough and shiny. When out of water, siphons can fully retract and siphons look like small crosses making identity as a tunicate difficult. There are 5 to 12 tubular, hermaphroditic gonads in the atrial wall on each side, but there are usually more on the right side.

RANGE	Circumpolar. Western distribution Japan, and Alaska to California.
SIZE	up to 5 cm in diameter.
STATUS	Native
COLOR	Red, orange, rose or pinkish-red. White when juvenile.
HABITAT	Rocks and hard substrates in areas with moderate to high wave action. Uncommon on artificial substrates.
TIDAL HEIGHT	Low intertidal to at least 50m.
SALINITY	25.4 to 33.3 ppt. (Homer & Seldovia Harbor deep sonde range)
TEMPERATURE	-0.4 to 12.4 °C (Homer & Seldovia Harbor deep sonde range)
SIMILAR SPECIES	*Halocynthia aurantium* is similar with a smooth orange tunic but it is taller than wide.



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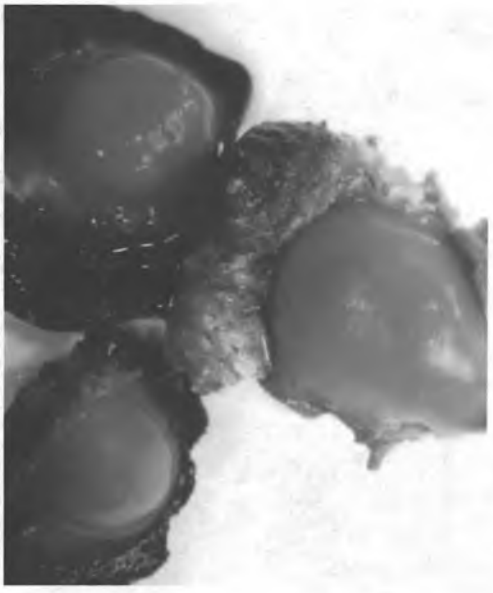

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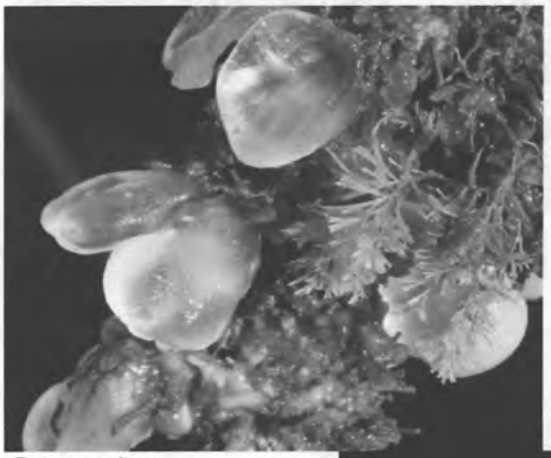
Tunicate (solitary) - *Corella inflata*

DESCRIPTION	This solitary tunicate has an oblong-oval body, with a bumpy surface. Its atrial chamber is greatly enlarged into a brood chamber, giving it a roughly cubical outline. The tunic is translucent and it has poorly developed siphons.
RANGE	Common throughout Alaska. Found to the San Juan Islands, Washington. It has recently extended its range south to San Francisco, Ca., probably due to boat fouling
SIZE	To 5 cm high.
STATUS	Native
COLOR	Clear and colorless, often with flecks of white, gold or orange.
HARITAT	On rocks and floats and other man-made structure.
TIDAL HEIGHT	Low intertidal zone to sub tidal depths of 20 m.
SALINITY	Minimum 27 ppt
TEMPERATURE	-2.3 to 14.9 °C (Homer and Seldovia Harbor range)
SIMILAR SPECIES	*Ciona intestinalis* is several times taller than wide and has visible longitudinal muscle bands. *Corella willmeriana* is very similar to this species but has a rectum more than 3/4 the length of the body and its atrial siphon is not expanded into a brood chamber (bottom photo).
MORE FACTS	This tunicate is more than 99 percent water, yet it is preyed upon by several animals, including the morning sun star.



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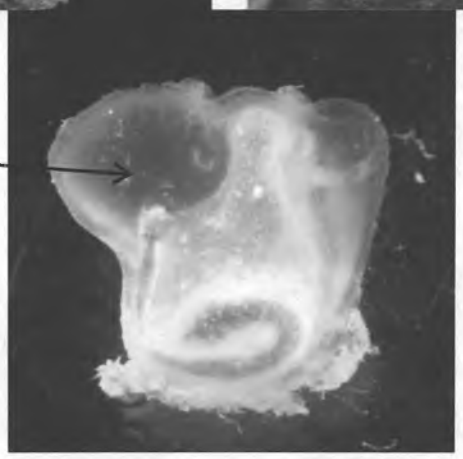

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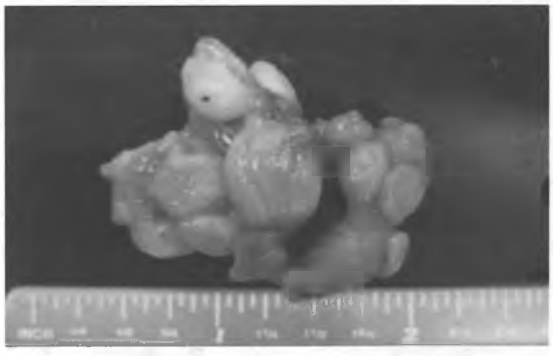
Tunicate (solitary) - *Dendrodoa pulchella*

DESCRIPTION	Solitary tunicate but grows together in clumps. Tunicate globular, tough and wrinkled. Siphons can be pale red or pink in contrast to the rest of the tunicate.
RANGE	Circumpolar Arctic species, in the Pacific from Kamchatka to the Bering Strait. In Alaska, found in Nunivak Island and Kachemak Bay
SIZE	To 2.5 cm in diameter.
STATUS	Native
COLOR	Grey, orange to pinkish.
HARITAT	Muddy sand. In Kachemak Bay seen washed up on beach after storms and on lines in harbors.
TIDAL HEIGHT	Subtidal to 100m.
SALINITY	25.4 to 33.3 ppt. (Homer & Seldovia Harbor deep sonde range)
TEMPERATURE	-0.4 to 12.4 °C (Homer & Seldovia Harbor deep sonde range)
SIMILAR SPECIES	Distinguished from other species of the genus by the numerous oral tentacles (only visible in water) and the3 branched gonad (requires dissection).



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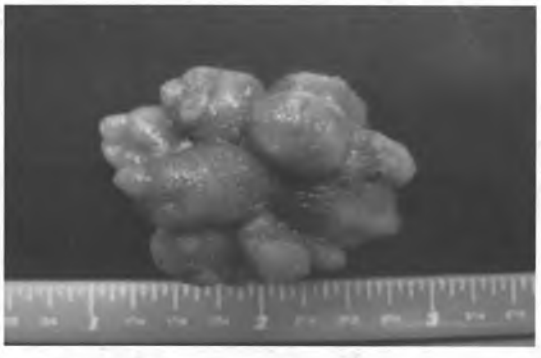

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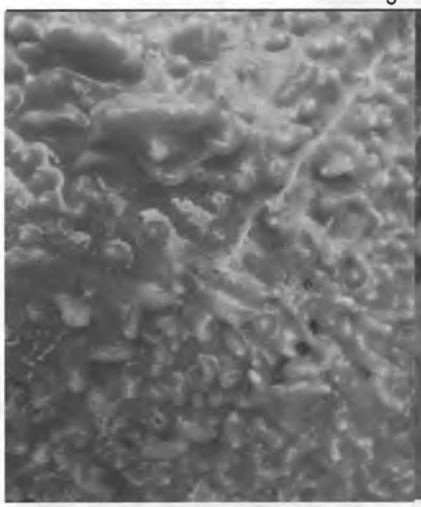
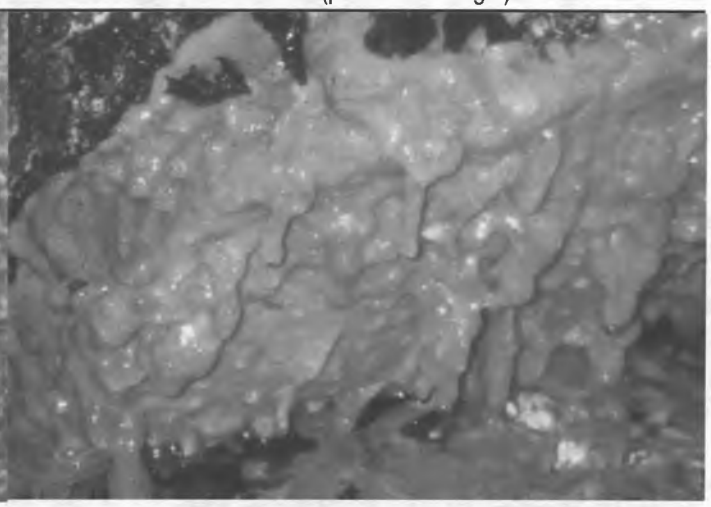
Photos from Kachemak Bay, AK

Tunicate (colonial) *Didemnum vexillum*

DESCRIPTION	Extremely variable in form, the colony can be sheet like, leathery, lobed, or hang in droopy, pendulous extensions. The tunic contains distinctive spike or star shaped spicules that are visible only under a microscope.
RANGE	Considered a native of Asia, the specie has been introduced all over the world. First described on the west coast in 1993 in San Francisco, it is now present from CA to British Columbia, and most recently in Sitka, Alaska.
SIZE	Can form extensive matts, meters across.
STATUS	Invasive, see the complete record at http://invasions.si.edu/nemesis/
COLOR	variable, pale tan to orange.
HABITAT	colonizes most hard surfaces, both natural and man-made, but common at aquaculture facilities. Will grow over most species and can smother organisms, forming vast sheets.
TIDAL HEIGHT	low intertidal to about 81 m
SALINITY	18-40 ppt, but survives best between 26-30 ppt
TEMPERATURE	-2 - 24°C, needs temperatures > 9°C to reproduce
SIMILAR SPECIES	Native *Didemnum* and *Tridemnum* species can be hard to distinguish from this species without dissection, but they do not form the extensive matts, nor the drip-like dangles that often occur in *D. vexillum* (photo bottom right).



© Linda Shaw subtidal



intertidal ©Heather Meuret Woody

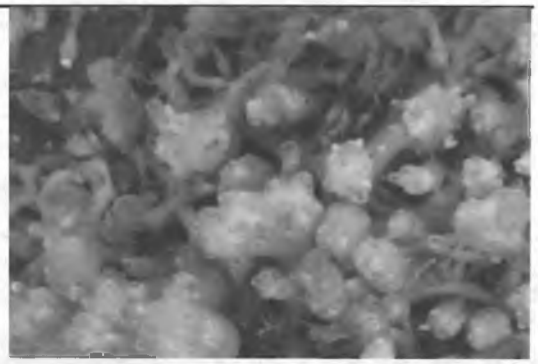
©Ian Davidson

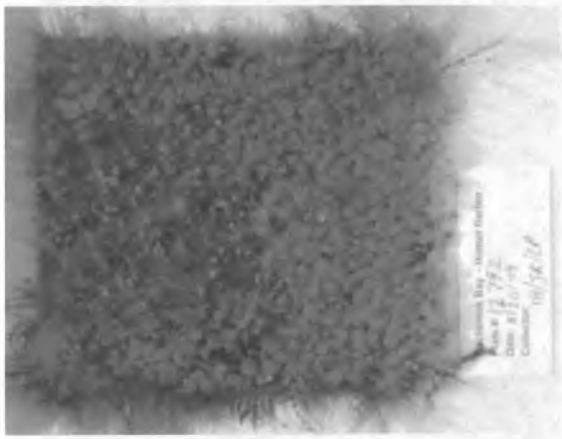
"dangle" ©Marnie Chapman

Pictures all from Whiting harbor, Sitka, Alaska

Tunicate (colonial) - *Distaplia alaskensis*

DESCRIPTION	Colonies consist of several cone-shaped lobes generally narrowing from the top to the base with a small area of attachment. The lobes are elongated and flat-topped. Lateral offshoots can sometimes cover settling plate surface without many lobes
RANGE	This species was undescribed until 2001 and was only found on manmade structures in Homer Harbor and Cordova Marina.
SIZE	Colonies up to 5 cm in length always subdivided into numerous lobes < 3 cm in diameter.
STATUS	Unknown origin
COLOR	Orange, peach or yellow to tan. Translucent, shiny tunic.
HARITAT	Preferred habitat is sheltered surfaces, rocks and crevices. In shallow water, but never exposed at low tide. Situated away from very much light. Found on harbor pilings, ropes and settling plates. Overgrows molgulas, mussels and has been seen on decorator crabs.
TIDAL HEIGHT	Shallow sub tidal.
SALINITY	15.2 to 33.3 ppt. (Homer & Seldovia Harbor range)
TEMPERATURE	-2.3 to 14.9 °C (Homer and Seldovia Harbor range)
SIMILAR SPECIES	*Distaplia occidentalis* is often purple or pinkish and is much shorter and mushroom-like in growth form.
OTHER FACTS	Common names; Sea peach. Another tunicate in this family is cultivated for human consumption in Japan and Korea. The tunic is removed before it is eaten. Along Alaskan coasts they are prey to predatory snails, nudibranchs, sharks and skates, crab, sea stars and bottom fish.

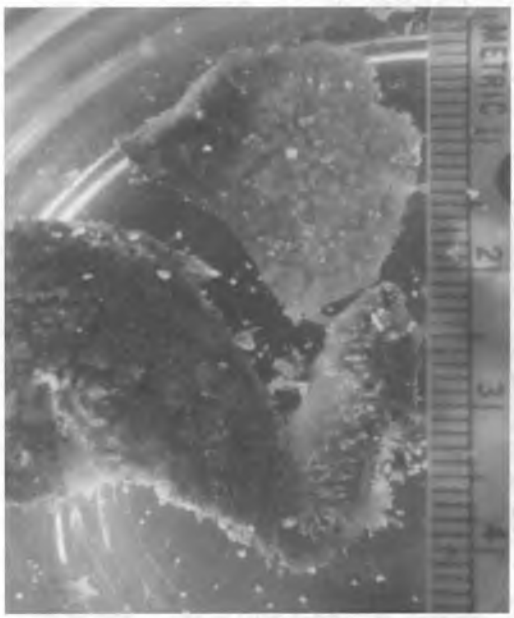




All photos ©ADF&G - KBRR

Tunicate (colonial) - *Distaplia occidentalis*

DESCRIPTION	This colonial tunicate, commonly called the mushroom ascidian, is globular (sometimes flat) with a short, narrow attachment stalk. The mushroom-like globe can be pale orange, yellow, pink, dark purplish-red, or brown. Each zooid has its own incurrent siphon and pharynx, but share a slightly raised common excurrent siphon and atrial cavity.
RANGE	Alaska to Southern California. In Alaska it has been seen in Prince William Sound, Kodiak Island and in the Sitka area.
SIZE	Most colonies are less than 2 cm in diameter, though they can be as large as 10 cm.
STATUS	Native
COLOR	Variable, pale orange, yellow, pink, dark purplish-red, or brown
HABITAT	rocky shore, and man-made structures.
TIDAL HEIGHT	Intertidal to 50 m.
SALINITY	High salinity species
TEMPERATURE	Cold water species
SIMILAR SPECIES	*Distaplia alaskensis* can be distinguished from this species by its more columnar lobes.



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Tunicate (solitary) - *Halocynthia aurantium*

DESCRIPTION	A large, solitary tunicate with a barrel shaped body that is directly attached to the substrate. Two uneven, large siphons on top. Tunic can be smooth or slightly wrinkled. Often found in groups.
RANGE	Occurs from the Arctic, throughout the Bering Sea, and south to Puget Sound. Common north of the Alaska Peninsula. the SE Bering, NE Bering, and SE Chukchi Seas.
SIZE	<18 cm
STATUS	Native
COLOR	Bright orange-red, often unfouled and may appear shiny. Looks like a peach.
HARITAT	Attachs to rocks. Often seen washed up on beach or comes up on hook when fishing for bottom fish.
TIDAL HEIGHT	0 to 100 m deep. Most common in depths of 40-100 m in the SE Bering, NE Bering, and SE Chukchi Seas.
SALINITY	28.0-33.3 ppt Seldovia Harbor
TEMPERATURE	0-12.4 °C Seldovia Harbor
SIMILAR SPECIES	*Cnemidocarpa finlandiensis* is similar in color and has the same smooth tunic, and can look the same out of water, but it is much more broad and squat. There is another species in the same genus in Alaska, *H. hispida* (previously *hilgendorfi or igaboja*), but the latter is tan and covered with spines.
OTHER FACTS	Common names; Sea peach. Another tunicate in this family is cultivated for human consumption in Japan and Korea. The tunic is removed before it is eaten. Along Alaskan coasts they are prey to predatory snails, nudibranchs, sharks and skates, crab, sea stars and bottom fish.

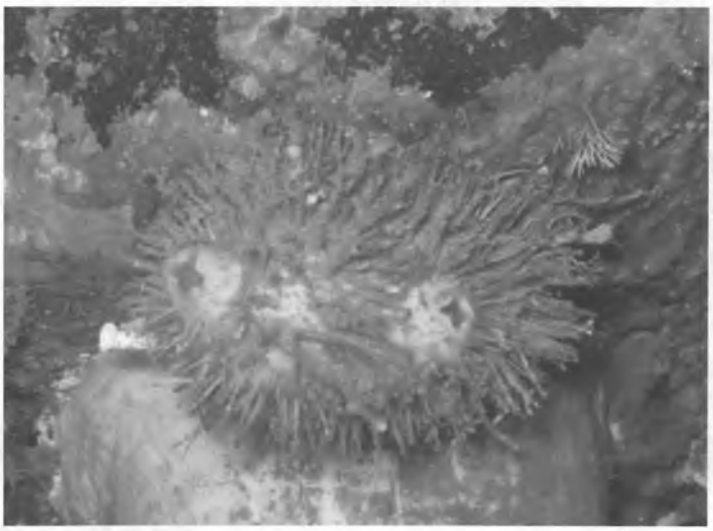
©Dominic Hondolero

©Paul Norwood Sitka

Tunicate (solitary) - *Halocynthia igaboja*

DESCRIPTION Common name: Sea hedgehog. Body unstalked, stout. Distinctive flexible bristles. Bristles sometimes completely covered in silt making the animal hard to detect.

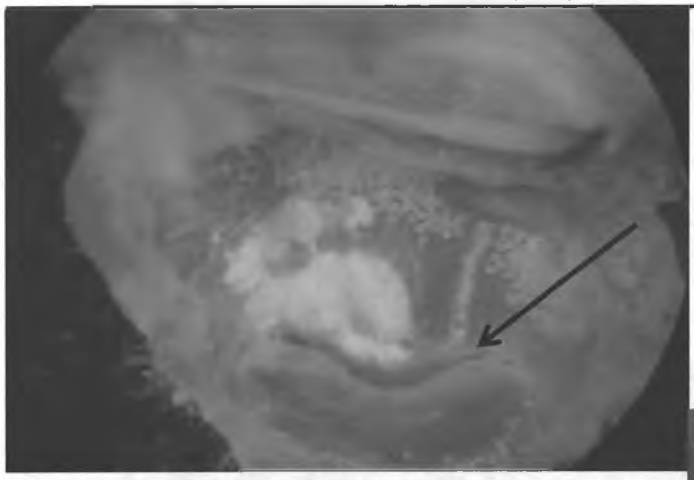
RANGE	Japan, Aleutian Islands, and Alaska south to southern California.
SIZE	5 cm across to 10 cm tall
STATUS	Native
COLOR	Dark brown tunic under bristles: siphons red or orange.
HABITAT	Rocky or gravel areas. Usually near current.
TIDAL HEIGHT	Intertidal to 175m.
SALINITY	25.4 to 33.3 ppt. (Homer & Seldovia Harbor deep sonde range)
TEMPERATURE	- 0.4 to 12.4 °C (Homer & Seldovia Harbor deep sonde range)
SIMILAR SPECIES	This may be one species or a group of cryptic species under several names including *Halocynthia hispida* , *H hilgendorfi, H. hilgendorfi hilgendorfi, H hilgendorfi igajoba* and *H. igaboja* , depending on the publication. If they are all the same species, the spines make it very distinctive, though *Pyura haustor* , which is warty and often has many things growing on it, can look similar at first glance.



©K. Iken, Kachemak Bay, AK

Tunicate (solitary) - *Molgula citrina*

DESCRIPTION	This small, round to oval tunicate has 6 lobes on the oral (incurrent) siphon and a flattened, u-shaped gut oriented horizontally. The siphons are sometimes ringed with spines. The tunic can be bare, to hairy or sediment covered. Larvae with a tail and brooded
RANGE	Current distribution is the Atlantic Arctic and Seldovia, Alaska, however there are other Pacific records from early Museum collections thar are yet to be confirmed; Circumpolar species.
SIZE	Body length usually 6-8 mm but can reach 2.3 cm.
STATUS	Unknown: introduced or a range extension
COLOR	Clear to dull greenish or olive green
HABITAT	Attaches to firm substrates such as rocks.
TIDAL HEIGHT	Low intertidal and sub tidal to offshore
SALINITY	15.2 to 33.3 ppt. (Homer & Seldovia Harbor range)
TEMPERATURE	-2.3 to 14.9 °C (Homer and Seldovia Harbor range)
SIMILAR SPECIES	Unlike *Ascidea* which is attached on its side, it is attached at its base. *Molgula citrina* is smaller than other Molgulids, has the flattened, u shaped gut (less flattened in *M. manhattensis*), has 7 branchial folds (requires dissection), broods its larvae and has distinctively long, slender oviducts (requires dissection, marked with the arrow in first photo).



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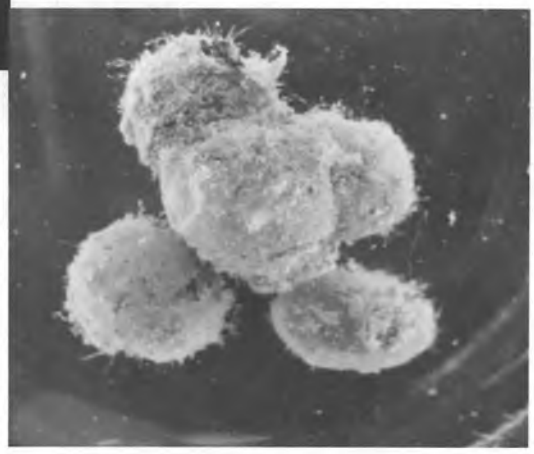
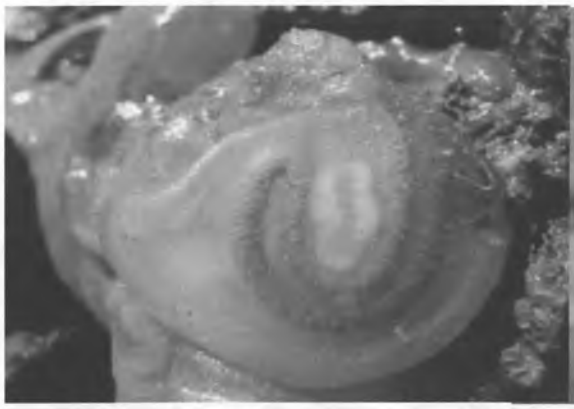


© Gretchen Lambert

Tunicate (solitary) - *Molgula manhattensis*

DESCRIPTION	grape-like tunicate, sometimes laterally flattened, with 6 lobes on the oral (incurrent) siphon, thick tunic, often with some papillae (hair-like projections). Larvae with a tail
RANGE	Mexico to British Columbia; First recorded on the west coast in Tamales Bay, CA in 1949, it's introduced around the world. Native to the Atlantic coast of North America
SIZE	Body length to 1-5 cm.
STATUS	Invasive
COLOR	Clear, grey with a 'u' shaped intestine sometimes visible through the body wall, oriented vertically, body often sediment covered.
HARITAT	Attaches to firm substrates, such as rocks, boulder, shell and cobble as well as man-made structures. Can be found on sands as well. Tolerates pollution.
TIDAL HEIGHT	Low intertidal, but generally subtidal to 90 meters depth.
SALINITY	5-40 ppt: estuarine to marine
TEMPERATURE	tolerates a broad temperature range
SIMILAR SPECIES	Unlike *Ascidea* which is attached on its side, it is attached at its base. To identify *M. manhattensis* from other Molgulids can be difficult: look for the u shaped gut (see pictures), tadpole larvae (unlike *M. citrina*) and 6 branchial folds (requires dissection) as opposed to the 7 found in *M. retortiformis* , *M. pacifica* and *M. citrina* . Siphons are long and similar in length (unlike *M. retortiformis* and *M. pacifica*).



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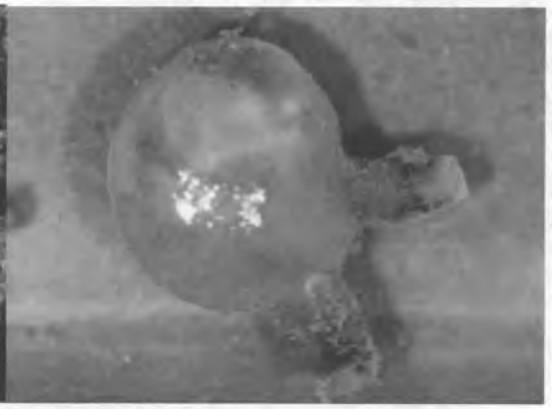

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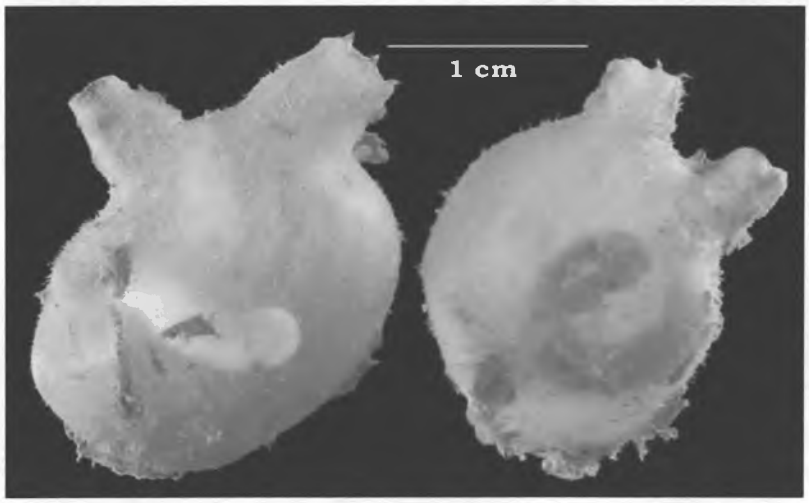

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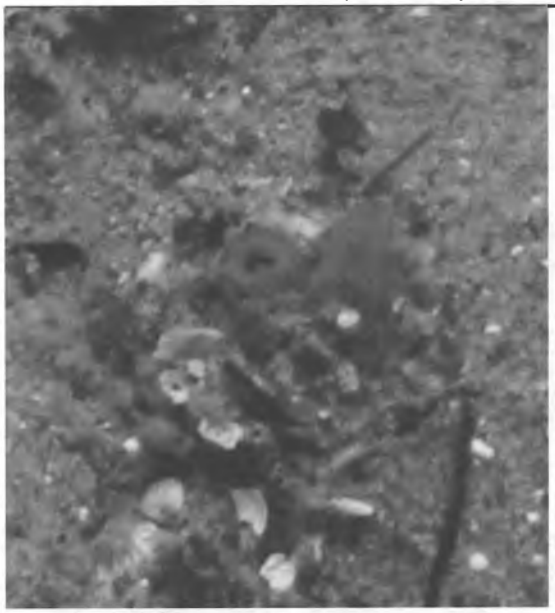
Tunicate (solitary) - *Molgula pacifica*

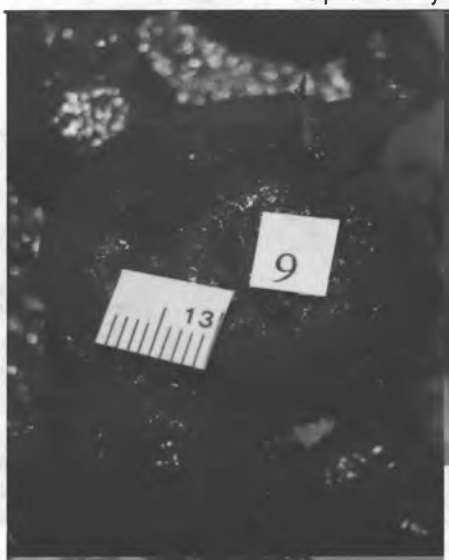
DESCRIPTION	small, grape-like tunicate with one siphon (atrial) extending upwards about twice as high as the the other, often covered with debris. Siphons appear orange.
RANGE	Alaska and Washington
SIZE	Body length to 2.5cm
STATUS	Native
COLOR	Clear, with 's' shaped intestine visible through the body wall, though body often covered with foreign materials, including algae. Siphons are pink to orange
HABITAT	Attaches to firm substrates, rocks intertidally. In harbor; floats, ropes. One of the most common species in Arctic waters.
TIDAL HEIGHT	Low intertidal and sub tidal to offshore
SALINITY	
TEMPERATURE	
SIMILAR SPECIES	Unlike *Ascidea* which is attached on its side, Molgulas are attached at its base. Differs from other *Molgula* species in the orange siphons, one twice as long as the other, and the often accessive amount of debris attached to the body. It is also unique in having no tadpole larvae.



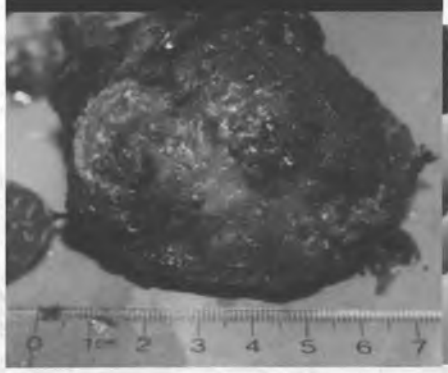
©Billie Swalla, University of Washington

Tunicate (solitary) - *Molgula retortiformis*

DESCRIPTION	This grape-like tunicate is one of the largest Arctic ascidians. It is oval with a thick and firm tunic that is clear but often covered in debris. When cleaned the tunic appears rough or wrinkled. The two siphons are unequal with the atrial siphon being the longest, usually equal in length to the diameter of the body. The oral siphon is 1/4 as long as the atrial and has 4 lobes.
RANGE	Alaska and Washington, circumpolar species
SIZE	Body length to 10 cm
STATUS	Native
COLOR	Clear tunic, with an s shaped intestine visible through the body wall, oriented horizontally. Overall the body appears light olive or grayish green.
HABITAT	Attaches to firm substrates, rocks and man-made structures.
TIDAL HEIGHT	Low intertidal and sub tidal to offshore to 80m
SALINITY	15.2 to 33.3 ppt. (Homer & Seldovia Harbor range)
TEMPERATURE	-2.3 to 14.9 °C (Homer and Seldovia Harbor range)
SIMILAR SPECIES	Unlike *Ascidea* which is attached on its side, it is attached at its base. It differs from other *Molgula* species mainly in the much larger size, in having the flattened, horizontally oriented gut, and 4 rather than 6 lobes on the oral siphon and one siphon is very long (upper right and left picture respectively)



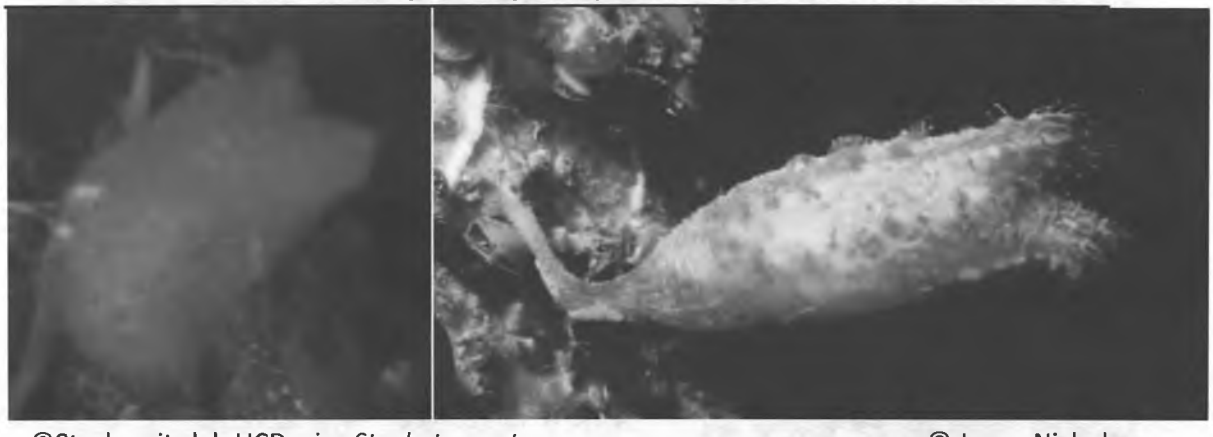
right photo ©SERC note 4 lobes on oral siphon
left photo © Joni Johnson Petersburg, AK



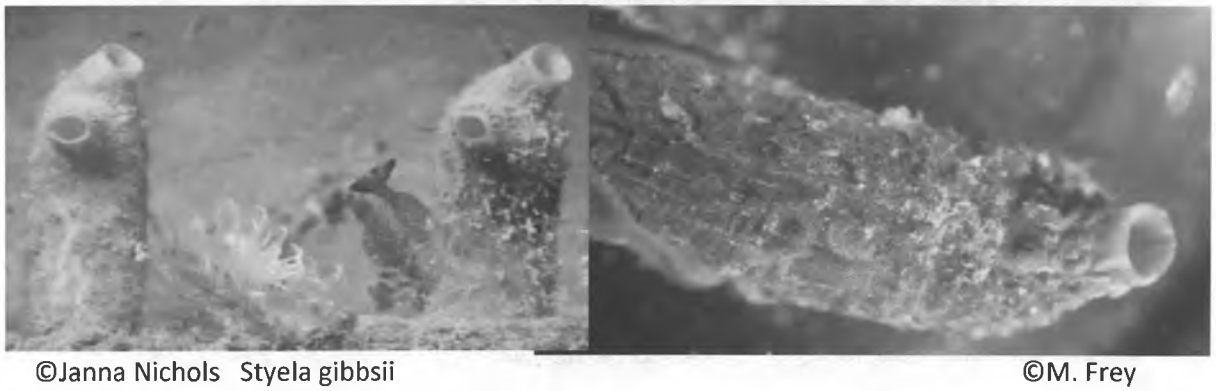
© Paul Norwood Sitka, AK © ADFG Homer, AK

Tunicate (Solitary) - *Styela clava*

DESCRIPTION	This solitary tunicate has a leathery, bumpy and creased tunic. Its body is cylindrical or club-shaped narrowing to a stalk that is anchored to the substrate by a disk shaped holdfast. The wrinkled stalk is often 20-50% of the total body length.
RANGE	It is native to China, Japan and Korea and introduced to both coasts of North America and to Europe, Australia and New Zealand. It was first reported on the west coast in 1933 in Newport, Oregon and can now be found from British Columbia to Southern California.
SIZE	Body usually 8-12 cm. long, but up to 20 cm. Stalk about 1/3 total length
STATUS	Invasive; see the complete record at http://invasions.si.edu/nemesis/browseDB/SpeciesSummary.jsp?TSN=159337
COLOR	Colors can range from yellowish to reddish to brownish. Sometimes they are yellow white stripes on the siphons. The juveniles often pale orange.
HARITAT	Found in protected harbors and marinas growing on docks, boat hulls, buoys, ropes, pilings, but it also grows on natural substrates such as rocksand shell.
TIDAL HEIGHT	Low intertidal to shallow subtidal
SALINITY	18-35 ppt. Found in marine and estuarine habitats.
TEMPERATURE	11-27°C , found to -2 °C but need at least 15 °C to reproduce
SIMILAR SPECIES	*Styela truncata* (pictured below top left) and *Styela gibbsii* (native, bottom photo) may have stripes on the siphons, but they are not stalked. The most similar species, *Styela montereyensis* is longer (up to 30 cm), with a longer stalk relative to the body size, distinctive stripes the entire length of the body, the oral siphon opens laterally rather than upward, and the tunic is smooth rather than wrinkled. The latter grows in high energy areas



©Stachowitz lab UCDavis *Styela truncata* © Janna Nichols



©Janna Nichols Styela gibbsii ©M. Frey

Tunicate (colonial) - *Synoicum irregulare*

DESCRIPTION	This colonial tunicate is sometimes called "Gnomes toes" due to its tough and wrinkly texture. The colonies can be large or small, maybe only a few pieces.
RANGE	Range not well known. Originally collected from the Pribilof Islands, Ritter, W. E. 1899. Commonly seen on the beaches of Kachemak Bay.
SIZE	Usually <10 cm in colony diameter.
STATUS	Native
COLOR	Bright orange or pinkish when fresh.
HARITAT	Unknown, often seen when washed up on beaches.
TIDAL HEIGHT	Subtidal to 115 m Depth.
SALINITY	25.4 to 33.3 ppt. (Homer & Seldovia Harbor deep sonde range)
TEMPERATURE	-0.4 to 12.4 °C (Homer & Seldovia Harbor deep sonde range)
SIMILAR SPECIES	Many species of the family Polyclinidae, such as *Aplidium* and *Synoicum* look similar. They often require microscope work to tell them apart. Species of these groups are sometimes mistaken for a sponge.

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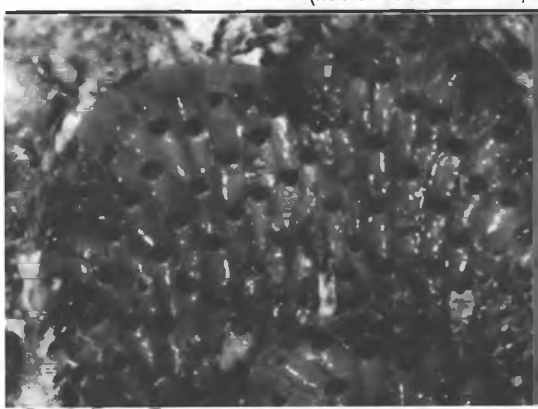
Bryozoa (encrusting) - *Watersipora subtorquata*

DESCRIPTION	This encrusting bryozoan is sheet-like to erect and the zooids are bright orange outlined in black with black opercula clearly visible to the naked eye.
RANGE	From Baja California to Coos Bay, Oregon. First record on the west coast in Cabo San Lucas, Mexico in 1937 based on collecting in 1888. Considered an Atlantic and Carribean species, it is now invasive worldwide.
SIZE	Zooids with slight mid expansion, but basically rectangular, alternating and regularly spaced. Can form large, upright, chip-like growths that form colonies up to 25 cm tall
STATUS	Invasive
COLOR	bright orange with black opercula, zooids outlined in black.
HABITAT	Often found on docks and man made structures including aquaculture infrastructure. Its resistence to copper based paints allows it to colonize boat hulls and provide substrate for other invading species.
TIDAL HEIGHT	lower intertidal to subtidal
SALINITY	20-50 ppt
TEMPERATURE	12 - 28 C
SIMILAR SPECIES	*Schizoporella japonica* , another invasives species in Alaska, and *Tegella aquilirostris* (native) are also orange and look very similar at first glance, but neither of these speces has the black operculla or black outline around each zooid. There are 2 other *Watersipora* speces that may be confused with it, *Watersipora arcuata* (opercula has a distinctive arch proximally) and *Watersipora edmonsoni* (has a much narrower, longer opercular sinus).



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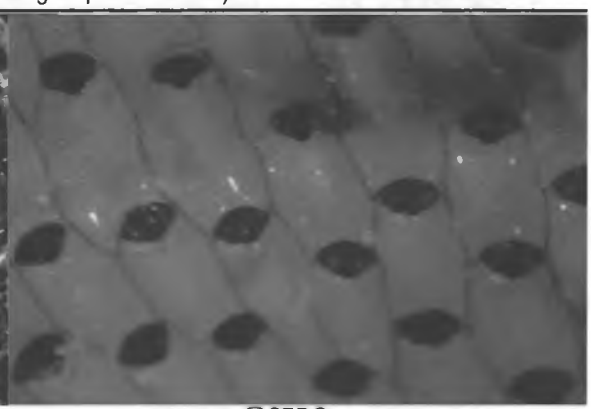

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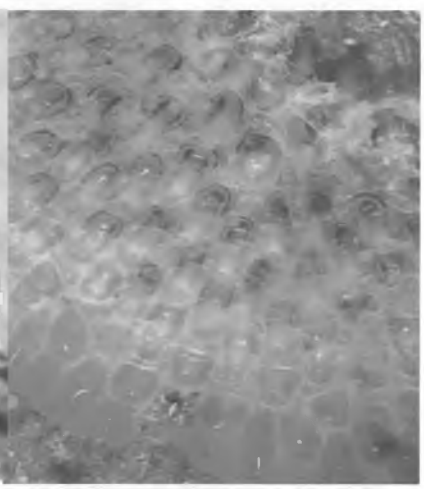
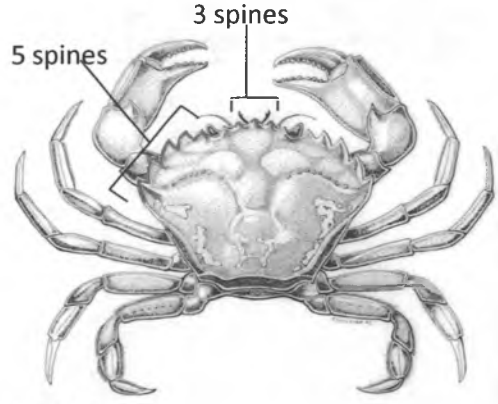


©Linda McCann *Tegella aquilirostris*

European Green Crab - *Carcinus maenas*

DESCRIPTION	Pagurid marine crab with 5 spines on each side of the eye stalk and 3 between.
RANGE	San Diego, CA to British Columbia. Native to Europe, they are now as far north as the northern end of Vancouver Island in BC.
SIZE	A small species, adults up to 10 cm across carapace.
STATUS	Invasive
COLOR	mottled greens and browns, older specimens becoming very orange, especially on the ventral side
HABITAT	rocky shores, cobble beaches, sand flats, eel grass beds and salt marshes.
TIDAL HEIGHT	low intertidal to about 6 m
SALINITY	6-35 ppt, estuarine and marine
TEMPERATURE	tolerant of a broad range of temperatures from below freezing to 35°C, though larvae do not survive below 10°C
SIMILAR SPECIES	Other similar crabs include Dungeness (*Metacarcinus magister*) and the Red Rock Crab (*Cancer productus*), but they have 10 spines on each side and can be much larger, Pygmy Cancer crabs (*Cancer oregonensis*), which have black tipped claws and a more circular shell, and the Helmet or horse crab (*Telmessus cheiragonus*) which has large spines on the edge of it's more round carapace and is covered with stiff hairs.



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©Lina Ceballos

© Janna Nichols Dungeness crab

Red Rock crab
©www.wallawalla.edu/academics/departments/biology/rosario/inverts

Dungeness crab - *Metacarcinus magister*

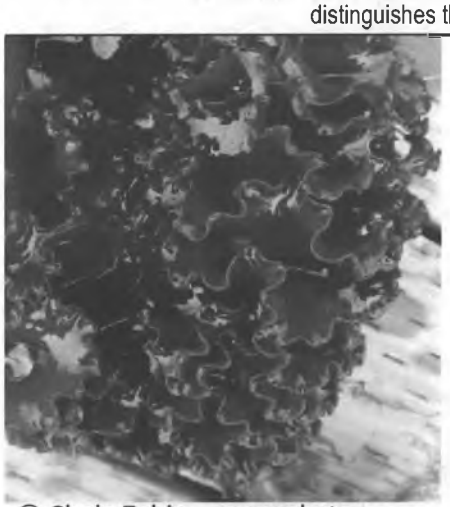
DESCRIPTION	This crab has white-tipped pinchers on the claws, and the top edges and upper pincers are sawtoothed with dozens of teeth along each edge. The last three joints of the last pair of walking legs have a comb-like fringe of hair on the lower edge. Also the tip of the last segment of the tail flap is rounded as compared to the pointed last segment of many other crabs.
RANGE	Alaska's Aleutian Islands south to Pt Conception in California
SIZE	Carapace width to 25 cm (9 inches), but typically less than 20 cm
STATUS	Native; see the full record at http://www.dfg.ca.gov/marine/dungeness_crab.asp
COLOR	Light reddish brown on the back, with a purplish wash anteriorly in some specimens. Underside whitish to light orange.
HABITAT	Rock, sand and eelgrass
TIDAL HEIGHT	Subtidal to offshore
SALINITY	Normal range 10–32ppt; 15ppt optimum for hatching
TEMPERATURE	Normally found from 3–19°C
SIMILAR SPECIES	Unlike the green crab, it has 10 spines on either side of the eye sockets and grows much larger. It can be distinguished from *Metacarcinus gracilis* which also has white claws, by the carapace being widest at the 10th tooth vs the 9th in *M. gracilis*. Unlike the red rock crab it has a tooth on the dorsal margin of its white tipped claw (this and other similar Cancer crabs have black tipped claws).

©Paul Norwood

© bioweb.uwlax.edu red rock crab - note black tipped claws

Macroalgae (Brown) - *Undaria pinnitifida*

DESCRIPTION	brown kelp with long blades, a midrib and 'ruffled' reproductive structure or sporophyll at base, attaches by a root-like holdfast. No swim bladders and stipe (stem) is short relative to the rest of the plant.
RANGE	Islas de Todos, Mexico (Baja) to San Francisco Bay, Ca. Native to Japan, first record on the west coast from Long Beach and Los Angeles, California, 2000.
SIZE	Body from 1-3 m long, but typically up to 1.5 m
STATUS	Invasive, see complete record at http://undaria.nisbase.org
COLOR	appears yellow green to dark brown colored when you remove from the water
HARITAT	Often found growing on hard surfaces, both natural and man-made structures such as docks and boat hulls. Can form dense kelp forests in sheltered areas.
TIDAL HEIGHT	low intertidal to 25 m, but most common at 1-3 m
SALINITY	20-38 ppt, but grows best above 27ppt
TEMPERATURE	0-27C, but grows best below 12C
SIMILAR SPECIES	Can be confused with other kelps such as *Alaria fistulosa* (see picture), *Egregia menziesii* (has swim bladders and small paddle like blades unlike *Undaria)* and several native *Laminarias* , but the midrid and distinctive ruffled sporophyte distinguishes the species.

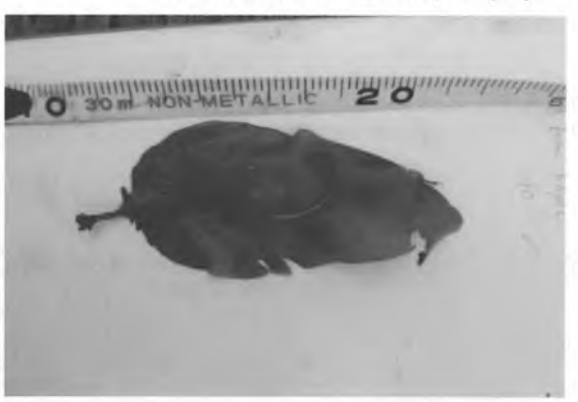


© Chela Zabin sporophyte

Chela Zabin / Smithsonian Institute

mature *Undaria* with sporophyte

©Chela Zabin *Alaria fistulosa*



©Chela Zabin juvenile Undaria pinnitifida

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Pictures and locality records for east coast species
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http://www.salemsound.org/SSCW_MIS_Monitoring_Guide.pdf A good resource for citizen monitors.
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