SCOMM

156:9

Economic Significance of Sport Fishing in Alaska

Sport fishing contributes money and jobs to the Alaskan economy.

The economic contribution of sportfishing in Alaska is an important consideration for natural resource managers who must evaluate fishery projects, assist in planning for land and water resource management, and provide input to regulatory or policy decision-makers regarding management or allocation of aquatic resources. Recognizing that there is a need for detailed economic information on sportfishing in Alaska, ADF&G has periodically contracted both economic impact and valuation studies to estimate the economic effects of sportfishing in Alaska at the statewide, regional, and fishery levels.

The most recent statewide assessment of the economic contribution of sportfishing in Alaska was conducted for ADF&G by Southwick Associates, Inc in 2007. This study estimated that 475,534 resident and nonresident licensed anglers fished 2.5 million days in Alaska and spent nearly $1.4 billion on licenses and stamps, trip related expenditures, pre purchased packages, and equipment and real estate used for fishing. The $1.4 billion of angler spending in Alaska in 2007 resulted in economic activity that supported 15,879 jobs in Alaska, provided $545 million of income, and resulted in $123 million in state/local tax revenues. Nonresident angler spending in Alaska in 2007 (economic impact) was $653 million, and this supported 9,437 jobs and $67 million in state/local tax revenues.

The regional distribution of spending by anglers generally follows the distribution of total days fished in Alaska, with most angler spending occurring in the Southcentral region (72%), followed by the Southeast and the Interior regions with 20% and 7% of total angler spending respectively. Total expenditures on guided sportfishing activities in 2007 totaled $416 million, which resulted in $641 million in total economic activity and supported 7,183 jobs. Resident anglers spent an average of $150 per day of sportfishing activity on trip-related expenses in 2007, while nonresident anglers spent an average of $448 per day in Alaska on trip-related expenses in 2007.

Previous statewide economic assessments of sportfishing in Alaska were conducted in 1993 by the Institute of Social and Economic Research at the University of Alaska Anchorage, and in 1986-87 by Jones & Stokes, Inc. Although the methodologies of these studies differ in some respects, collectively the results suggest that during the past fifteen years, the economic significance of sport fishing in Alaska has increased considerably, in terms of the number of job, wages and salaries, and total economic contribution to the Alaska economy. Those who participate in sport fishing are likely to point out that the opportunity to go fishing in Alaska has a value that is often difficult to measure in dollars. However, sportfishing is also an important part of the Alaska economy and a vital source of income to many in small towns and cities throughout the state.

2007 Study Reports and background

- 2007 Summary Report (PDF 2.9 Mb)
- 2007 Technical Report (PDF 5.4 Mb)
- Project Background

2008 Mat-Su Basin Salmon Science & Restoration Symposium

October 15-16, 2008

Mat-Su salmon PARTNERSHIP

U.S. FISH & WILDLIFE SERVICE

The Nature Conservancy
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Agenda

OCTOBER 15, 2008 - DAY ONE

8:30 - 9:00 a.m.	Registration & Continental Breakfast
9:00 a.m.	Welcome *Frankie Barker, Matanuska-Susitna Borough* *John Duffy, Matanuska-Susitna Borough* *Corinne Smith, The Nature Conservancy* *Valerie Hansen, U.S. Corps of Army Engineers* *Sarah Barton, RISE Alaska*
9:40 a.m.	One Fish, Two Fish – Why are we here?
10:00 a.m.	Presentations *Kris Abshire, Alaskans for Palmer Hay Flats* *Catherine Inman, Wasilla Soil & Water Conservation District* *Gino Graziano, Alaska Soil and Water Conservation District* *Theresa Tanner, U.S. Fish & Wildlife Service*
10:45 a.m.	Hot Questions
10:50 a.m.	Morning Break
11:00 a.m.	Presentations *Bill Rice, U.S. Fish & Wildlife Service* *Chuck Kaucic, Mat-Su Borough* *Corinne Smith,The Nature Conservancy* *Brian Winnestaffer, Chickaloon Village Traditional Council*
11:55 a.m.	Hot Questions
12:00 p.m.	Lunch
12:30 p.m.	Afternoon Break & Mapping Exercise
1:00 p.m	Presentations *Jeff Davis, Aquatic Restoration & Research Institute* *Tom Cappiello, Alaska Department of Fish & Game* *Janet Curran, U.S. Geological Survey* *Doug McBride, U.S. Fish & Wildlife Service* *Sue Mauger, Cook Inletkeeper*
1:55 p.m.	Hot Questions
2:00 p.m.	Embrace Your Inner Fish – Going Deeper (Snack)
3:15 p.m.	Announcements/Close *Sarah Barton, RISE Alaska*
4:00 p.m.	Adjourn
4:15 p.m.	***Mat-Su Basin Salmon Habitat Partnership Meeting***
5:15 p.m.	*Adjourn*

Agenda

OCTOBER 16, 2008 - DAY TWO

8:30 - 9:00 a.m.		Registration & Continental Breakfast
9:00 a.m.		Welcome
		Sarah Barton, RISE Alaska
9:15 a.m.		Presentations
		Chris Zimmerman, U.S. Geological Survey
		Ruth Hulbert, AlaskChem Engineering
		Dan Bogan, University of Alaska Anchorage
		Jessica Dryden, Chickaloon Village Traditional Council
10:00 a.m.		Hot Questions
10:05 a.m.		Presentations
		Jeff Davis, Aquatic Restoration & Research Institute
		Monica McTeague, U.S. Geological Survey
		Paul Blanche, Cook Inlet Aquaculture Association
10:40 a.m.		Hot Questions
10:45 p.m.		Twist & Trout – Lots to Talk About
12:00 p.m.		Lunch
12:30 p.m.		Afternoon Break & Mapping Exercise
1:00 p.m		Presentations
		Karen Nelson, U.S. Army Corps of Engineers
		Serena Sweet, U.S. Army Corps of Engineers
		Ralph Hulbert, AlaskChem Engineering
		Jack Hewitt, U.S. Army Corps of Engineers
		Valerie Hansen, U.S. Army Corps of Engineers
		Frankie Barker, Matanuska-Susitna Borough
		Angie Wade, Chickaloon Village Tribal Council
2:20 p.m.		Hot Questions
2:30 p.m.		Break & Snack
2:40 p.m.		Da Vinci Cod – What does it all mean?
3:45 p.m.		Thank You/Close
		Valerie Hansen, U.S. Army Corps of Engineers
		Corinne Smith, The Nature Conservancy
		Sarah Barton, RISE Alaska
4:00 p.m.	Adjourn	

Agenda

Mat-Su Basin Salmon Habitat Partnership Annual Meeting

Update on National Fish Habitat happenings (John DeLapp)
- Update on October National Fish Habitat Board meeting
- National Fish Habitat Action Plan FY09 projects funding

Port of Anchorage mitigation funds (Corinne Smith and Frankie Barker)

Conserving Salmon Habitat in the Mat-Su Basin, the Strategic Action Plan (Tom Brookover and Corinne Smith)
- Completed and available at http://conserveonline.org/workspaces/MatSuSalmon
- Prioritization of objectives and strategies

Steering Committee updates (Corinne Smith)
- Meeting monthly 3rd Tuesday, alternating Palmer and Anchorage
- Two At-large seats on the Steering Committee open in January

Cooperative Conservation Award from Department of Interior (John DeLapp)
- distribution of award certificates to all partners

Q & A about the Partnership

5:15 Adjourn

Abstracts

Palmer Hay Flats: Refuge Jewel in Our Midst

Kris Abshire, Alaskans for Palmer Hay Flats

From Cottonwood Creek at the head of Knik Arm, north, east and southeast along the Talkeetna and Chugach watersheds, fresh water drainages flow through Palmer Hay Flats State Game Refuge. Continued assurance of clean water, undisturbed by human use in these salmon migration rivers and streams is crucial to the long term viability of salmon populations. For the past 3-1/2 years, after decades of neglect, human abuse and pollution, this gem of Alaska's public lands is being healed and restored. On-the-ground partnership efforts in clean-up, repair and restoration projects carried out by ADF&G, Wasilla Soil & Water Conservation District, Mat-Su Borough and Alaskans for Palmer Hay Flats have made tremendous progress. Among these efforts and accomplishments, perhaps the most important element has been the concerted effort to involve our local youth population. Working field trip days have students brushing trail, cleaning up trash along stream beds and revegetation projects; annual on-site grade school education days teach children about healthy water and healthy habitat. All these efforts are at the core of our future plans, which is to teach awareness of the delicate balance of our natural world and the role of humans as an integral part of it. Toward this end, Alaskans for Palmer Hay Flats with support from ADF&G, Mat-Su Borough, other state and federal agencies as well as community partners, proposes to build a Natural Science Education/Community Center. It is anticipated that youth and adult programs provided through partners in this endeavor will serve as the underlying foundation for an intrinsic conservation ethos and widespread community stewardship for generations to come.

Green Infrastructure

Frankie Barker, Matanuska-Susitna Borough

The Mat-Su Borough is implementing green infrastructure concepts through several community initiatives. One is the inclusion of green infrastructure goals as a plan element in all new community comprehensive plans. A second project is a grass-roots effort to recruit a planning team for the Palmer-Wasilla core area to develop a green infrastructure design and map for the central valley. MSB is also working with natural resource agencies, particularly USFWS, to identify and digitally map wildlife resource areas. This fall, we will introduce new interactive technology for converting local and technical knowledge to GIS maps to more accurately inform our green infrastructure initiatives.

Investigation and Evaluation of Sockeye Salmon Production from Lakes in the Susitna River System

Paul Blanche, Cook Inlet Aquaculture Association

Recent sockeye salmon returns to the Northern District of Cook Inlet have been significantly less than expected. There could be a number of causes for this recent trend. There are two broad questions to be asked. The first is whether or not the system is producing juvenile salmon that succeed in migrating to sea. The second question is whether or not a sufficient number of adult fish are failing to reach the spawning the grounds. CIAA is investigating the freshwater rearing environment of this system. Understanding the entire salmon life cycle will

help to identify if rehabilitation is warranted and which strategies seem to offer the most promise. The investigation involves studies on seven lakes Four of the lakes are along the mainstem Susitna River and Talkeetna River (Larson, Stephan, Swan, and Byers Lakes); and three are on tributaries of the Yentna River (Judd, Shell, and Chelatna Lakes). The studies include the enumeration of adult salmon escapement and smolt emigrations at each lake. Adult sockeye salmon and smolts are sampled for age, weight, and length throughout the enumeration. Further investigations include limnological sampling (water chemistry and zooplankton) and the collection of dissolved oxygen, light, and temperature profiles within each lake.

Biological Assessment Indices for Streams in the Cook Inlet Basin

Dan Bogan, University of Alaska Anchorage

Biological monitoring and assessment index development for wadeable streams in the Cook Inlet Basin has been on-going for over 10 years. I will discuss our latest research in this area and present the results of the recalibration of the Alaska Stream Condition Index for Cook Inlet using the benthic macroinvertebrate assemblage and the newly calibrated diatom assemblage index. I will also mention other projects we have on-going in the area, including an assessment project on Montana Creek.

Instream Flow Protection in the Mat-Su Basin

Tom Cappiello, Alaska Department of Fish and Game

The goal of this project is to collect the hydrological data necessary to protect instream flows in waters important to the production of salmon in the Mat-Su Basin. The streams identified for the purposes of this project are Meadow Creek, Fish Creek, Moose Creek, and Wasilla Creek. The Mat-Su Basin Salmon Habitat Partnership developed a strategy and planning process aimed at conserving salmon habitat. One of the priority actions identified in this Partnership's strategic plan is instream flow protection. Continuous flow data are also essential for scientists and natural resource managers to make well-informed decisions regarding water developments and land-use practices that have the potential to impact water quantity and quality, salmon populations and their habitat. The Alaska legislature amended the Water Use Act (AS 46.15) in 1980 in recognition of the economic, social, and other benefits of retaining water in rivers and lakes. This amendment or "instream flow law" provides the opportunity for the private sector and government agencies to legally acquire water rights to maintain instream flow rates in rivers or water levels in lakes for a variety of purposes, including the protection of fish and wildlife habitat, migration, and propagation. Continuous recording gaging stations in combination with periodic discharge measurements will be used to obtain the stream flow data necessary for quantifying instream flow needs of salmon and their habitat. These hydrologic data will be used to file new or update existing applications for a reservation of water pursuant to the Alaska Water Use Act. Basic water quality information will also be collected at these sites to determine baseline seasonal water quality variability.

Matanuska River Geology, Geomorphology and Erosional Processes

Janet Curran, U.S. Geological Survey

Many of the erosional processes present along the Matanuska River can be related to the geology and glacial history of the Matanuska Valley. The river flows through a confined valley consisting of sedimentary and volcanic rocks above Palmer and an unconfined area filled with

glacial and riverine sediments downstream from Palmer. The confined valley includes a broad glacial valley floor at about 1000 ft in elevation and other evidence of the pre-historic glacier that was hundreds of feet thick, but the valley and river owe their orientation and location to regional geology. The valley and river parallel northeast-southwest trending faults, and the modern river is incised into the broad glacial valley floor. Narrow, non-braided reaches are generally governed by the presence of resistant bedrock. The valley bottom contains mostly fluvial terraces, fans, and the river's braid plain, or the area over which the braided river moves frequently. In the unconfined valley downstream from Palmer, geologic controls are less obvious, although the river is locally constrained by bedrock outcrops. Historical photo analysis shows active braiding that leaves vegetated bars in the braid plain in the confined and unconfined valleys stable for only years to decades.

Assessment of Juvenile Salmon Habitat -- Stream Water Temperatures & Fish Distribution

Gay and Jeff Davis, Aquatic Restoration & Research Institute

Water temperatures have a large influence on most biotic processes occurring within stream systems. Water temperatures influence rates of primary production, decomposition, invertebrate growth and development, and the behavior and metabolism of fish. However, we have limited water temperature data for streams within Southcentral Alaska. Stream water temperatures vary with regional climate, elevation, vegetation cover, channel shape, ground water input, and other physical features, which differ widely among streams within the ecoregion. We collected stream water temperature data within the Matanuska-Susitna Borough from multiple stream types and evaluated the range of stream temperatures, the factors influencing that variability, and the relationship to State Water Quality Standards. Three groups of streams were identified based upon this evaluation: cold water streams which included small and moderate sized streams draining forested regions of the Talkeetna Mountains; temperate streams which included the lower portions of larger clear water and semi-glacial streams, and both large and small lowland wetland streams; and warm water streams, which included streams draining small and large lakes. In 2008 we compared the capture rate and fitness of juvenile salmon between small wetland and small upland streams. Fish were captured in mid to late May, mid July, and September.

Biotic Evaluation of Road Crossing Structures

Gay and Jeff Davis, Aquatic Restoration & Research Institute

Roads, railroads, and other transportation structures often cause barriers to fish migration at stream crossing locations. Stream crossing structures affect the movement of fish and other aquatic life by altering the stream physical characteristics. The construction of migration barriers can have significant effects to fish production as access to large areas of spawning or rearing habitat can be eliminated or reduced. For this reason, considerable work has been done to assess fish passage and restore migration barriers. Fish passage assessment has focused on comparisons between laboratory measures of fish swimming ability and the physical conditions at crossing locations, primarily water velocity and depth. Fish swimming ability, both prolonged and burst, has been assessed under varying conditions of velocity, buoyant forces, and water temperature (summaries and equations within the FishXing V3 2006) which affect physical water properties and fish physiology. While considerable work has been done modeling fish passage based upon stream physical characteristics and fish swimming ability, we are not aware of any work comparing the fish community composition above and below crossing

structures as a method for evaluating fish passage or augmenting model derived results. The life history of Pacific salmon provides a biological method of fish passage assessment. In 2006 and 2007 we evaluated fish passage at multiple sites using physical culvert and stream measures, direct measures of water velocity, fish passage models, and upstream to downstream fish abundance. Fish passage models did not accurately predict water velocities within culverts and so were determined to be poor predictors of migration barriers. Water velocity measures derived from the flow time of dissolved solutes coupled with direct measures of water velocity at the inlet and outlet was determined to be the best indicator of juvenile salmon barriers. We found greater numbers of salmon below crossings that were barriers if upstream spawning habitat was limiting; however, there were no differences at sites that were obvious juvenile barriers but with extensive upstream spawning and rearing habitat. In 2008, we expanded biotic measures to additional locations. Initial results of spring sampling showed distinct differences in catch rates of salmon above and below crossings on wetland streams with limited upstream spawning habitat. However, the catch rates of coho salmon were higher upstream of crossings that were juvenile fish migration barriers.

Invasive Plants That Threaten Salmon Habitat in Alaska

Gino Graziano, Alaska Department of National Resources, Division of Agriculture

Many invasive plants have the ability to impact habitats related to salmon. Reed canary grass (*Phalaris arundinaceae*) and purple loosestrife (*Lythrum salicaria*) are two invaders known to affect aquatic systems that are present in Alaska. White sweetclover (*Melilotus alba*), European bird cherry (*Prunus padus*) are currently invading rivers and riparian areas in Alaska and their impacts to salmon are under investigation. A host of other weeds such as Eurasion watermilfoil (*Myriophylum spicatum*) and Himalayan blackberry (*Rubus discolor*) are not known in salmon habitat in Alaska, however, could have profound impacts if they become widespread.

The Commercial Mitigation Banks

Jack Hewitt, US Army Corps of Engineers, Alaska District

We will provide information on the newly formed commercial mitigation banks located in the Mat-Su Valley. What are the mitigation banks, how will they be operated, how will credits and debits be calculated, what are there service areas, and other regulatory-related information will be provided.

Palmer's Wastewater

Ralph Hulbert, AlaskaChem Engineering

Treated wastewater has been discharged to a small Matanuska side channel since the 1940s. The discharge permit was recently amended by EPA to severely reduce ammonia, due to presumed toxicity to salmon. The salmon in this creek are apparently thriving in relation to other streams, perhaps enhanced by the discharge. There are no affordable means to reduce the ammonia enough to meet future discharge limits for this creek. Research status and options for upgrading Palmer's wastewater treatment plant to meet new regulations will be presented.

Spawning Counts in Four Matanuska Side Streams

Ruth Hulbert, AlaskaChem Engineering

Spawning salmon were counted in September 2008 in four small streams flowing into the lower Matanuska River. These streams are unnamed, mostly uncataloged by ADFG, and have no

previously recorded spawning counts. Each streambed has been either created or significantly altered in the past twenty years. Carcasses and live salmon were counted while walking the streams, and species roughly estimated. A section 1.2 miles long of one creek had over 5,500 spawners, and the late Coho had not yet arrived.

Restoration and Education

Catherine Inman, Wasilla Soil and Water Conservation District

Wasilla Soil & Water Conservation District combines community education with salmon habitat restoration work. Providing area students, adult volunteers, and youth groups with hands-on stewardship projects helps citizens develop a strong conservation ethic. Natural resource science education is worked in through classroom lessons and on-site watershed health studies. We work with a wide range of agency and community partners. This presentation shows examples of habitat assessment and revegetation work on Mat-Su's streams, trails, and wetlands, and the ways education can be an important part of restoration projects.

Replacing Mat-Su Culverts at Colter Creek, Government Creek, & Kime Lane

Chuck Kaucic, Matanuska-Susitna Borough

The Matanuska-Susitna Borough Public Works Department has replaced culverts on the Borough road system to improve fish passage on prioritized road crossings. These projects are based on U.S. Fish and Wildlife prioritization in collaboration with Public Works priorities. Thirty sites with significant fish barrier characteristics were identified and prioritized for initial funding out of 130 Borough sites assessed. Project viability, value of positive impact on natural resources, watershed analysis, potential partners and dedicated MSB funding are considered in determining the crossings to be addressed. In 2008, MSB Public Works oversaw the replacement of culverts on Colter Creek and Government Creek, both tributaries to the Little Susitna River, and at Kime Lane at Nancy Lake.

Stream Temperature Monitoring Network for Mat-Su Basin Salmon Streams

Sue Mauger, Cook Inletkeeper

In the summer of 2008, Cook Inletkeeper and its Partners began implementing a Stream Temperature Monitoring Network to collect consistent, comparable temperature data for Mat-Su Basin salmon streams. Water and air temperature data loggers will be retrieved from 20 sites in October and GIS maps will be produced to illustrate temperature patterns, temperature exceedances and potential thermal refugia. The Stream Temperature Monitoring Network will allow fisheries managers and land-use planners to identify watershed characteristics with the greatest potential to buffer stream temperatures from climate and land-use change, and provide the knowledge and data needed to prioritize sites for future research, protection and restoration actions.

Spawning Distribution of Salmon in the Matanuska River Watershed

Doug McBride, U.S. Fish and Wildlife Service

As the human population in the Mat-Su Borough continues to grow, residential and urban development threatens salmon habitat in the Matanuska River watershed. The U.S. Fish and

Wildlife Service and our partners, the Chickaloon Native Village and the Alaska Department of Fish and Game, initiated a project to describe baseline run timing and spawning distribution of sockeye, chum, and coho salmon in the Matanuska River watershed. We used a fishwheel to capture migrating salmon from late July through September. Radio transmitters (n = 300) were deployed and tagged fish were tracked through the watershed with active searches and remote data loggers. As of 4 September, 355 sockeye, 191 chum, and 442 coho salmon were captured at the fishwheel with a mean catch per effort for salmon of 3.5 fish/hr. Other species captured included Chinook and pink salmon, Dolly Varden, rainbow trout, round whitefish, and longnose sucker. Telemetry searches are still being conducted. Results of the project will identify habitat important for sockeye, chum, and coho salmon, which will allow local land managers and planners to better protect and conserve important salmon habitat from current and future development activities in the Matanuska River watershed.

Clearwater Side Channels of the Matanuska River as Salmon Habitat

Monica McTeague, U.S. Geological Survey

The United States Geological Survey Alaska Science Center and Chickaloon Village have partnered to study the extent and conditions of clearwater side channel systems of the mainstem Matanuska River as potential salmon spawning habitat. Rapid movement of the braided Matanuska River results in abandoned channels that fill with clearwater from tributary or ground water sources. We traced these clearwater channels using aerial photography from 1949, 1960, 2004, and 2006 to understand persistence and quantity of side channels. Initial results of temporal analyses suggest that side channels persist for years to decades in a single location. This decadal scale formation of side channels suggests that although side channels may only persist at a particular site for several years, the quantity of side channels at a reach level appears to be fairly stable and this long-term stability of side channels at the reach level may provide suitable habitat for salmon spawning sites of coho, chum, and sockeye salmon.

Introduction of the Mat-Su Regulatory Field Office

Karen Nelson, US Army Corps of Engineers, Alaska District

The U.S. Army Corps of Engineers (Corps) has regulatory responsibilities for work in waters of the United States. Corps will discuss regulated activities, Corps jurisdictional boundaries, and permitting processes. In addition, Corps will introduce the new Mat-Su Field Office located in Wasilla.

Overview of Fish Passage and Projects in the MatSu

Bill Rice, U.S. Fish and Wildlife Service

Providing fish passage at road crossings is an integral part of maintaining sustainable salmon populations. Over 300 culverts have been assessed over the past 5 years in MatSu and more than half of them need improvements for fish passage. Over the past 10 years about 24 culverts have been replaced by partnership between US Fish and Wildlife Service, Mat-Su Operations and Maintenance Department (O&M), and private landowners. O&M has also replaced a number of other culverts during this time period while performing road improvement projects. Alaska Department of Transportation also has an active program of replacing culverts when replacing or improving roads in coordination with ADFG. In 2008, efforts were placed in two focus areas – the Little Susitna and Wasilla Creek drainages. The Nature Conservancy and the Chickaloon Traditional Village Council were active in replacing six culverts, and M&O

replaced six culverts, only one of which was outside these two focus areas. Future projects will be based on prioritization efforts and opportunities to create an even more comprehensive approach to habitat access across the Borough.

The Mat-Su Watershed Study – Status Update

Valerie (Hansen) Ringold, US Army Corps of Engineers, Alaska District

This study is unique in that it encompasses an area relatively pristine, but the Matanuska-Susitna watershed is also the fastest growing area of Alaska and among the fastest in the US. As population continues to grow, this area will have more development pressure and more impact on water resources. The watershed is part of the Cook Inlet Salmon Fishery and contains 5 species of native salmon commercially important and economically vital on a regional, national, and international scale. The Matanuska-Susitna Borough and other agencies identified the need for good science-based planning tools to assist in making better decisions regarding future development while preserving the health of natural resources. Begin underway with the study for just about 1 year now, we'll be giving an update on the project.

Wetland Mapping

Valerie (Hansen) Ringold, US Army Corps of Engineers, Alaska District

As part of the Mat-Su Watershed Study efforts and a follow-on to grant work completed by the MSB in 2007, wetland mapping was completed on close to 190,000 acres this summer. A total of 272,000 acres was mapped in 2007 and 2008. We'll tell you what areas have been mapped so far, give some general information on the mapping process and where we plan to head in the future.

Mat-Su Salmon Partnership & Conserving Salmon Habitat

Corinne Smith, The Nature Conservancy

The Matanuska-Susitna Basin Salmon Habitat Partnership formed to address increasing impacts on salmon from human use and development in the Mat-Su Basin with a collaborative, cooperative, and non-regulatory approach that brings together diverse stakeholders. The Partnership developed *Conserving Salmon Habitat in the Mat-Su Basin*, a Strategic Action Plan, to identify long-term goals and strategies and to provide a tool the Partnership can use to prioritize projects related to fish habitat goals in the Mat-Su Basin. The intent of the Strategic Action Plan is to identify long-term goals, strategies, and voluntary actions that the Partnership and others can undertake to conserve salmon habitat. The Mat-Su Salmon Partnership's broad goals are to protect salmon and their habitats in the Mat-Su Basin and Upper Cook Inlet, mitigate potential threats to salmon and their habitats, restore connectivity between salmon habitats, and increase knowledge about salmon and their use of freshwater and marine habitats. Better understanding of salmon's needs throughout the Mat-Su Basin and Cook Inlet would improve management of salmon habitat and implementation of the recommendations in this plan. Three science strategies were highlighted in the plan because the information they will gather will inform multiple focal issues. Additional research and information needs were identified in the plan. This 1st Mat-Su Basin Salmon Science and Restoration Symposium provides a forum to share information on restoration and research projects related to Mat-Su watersheds and salmon habitat conservation and to promote an exchange of ideas about salmon science and restoration in the Mat-Su Basin.

Colter Creek Fish Passage Restoration Project

Corinne Smith, The Nature Conservancy

The Colter Creek Fish Passage Restoration Project will restore juvenile fish passage, improve stream function, and enhance fish habitat on Colter Creek, the second largest tributary along the southern flank of the Talkeetna Mountains to the Little Susitna River, near Wasilla, Alaska. Only four culverts occur on Colter Creek; by the end of this project, all will pass migratory fish and adequately provide for stream flow and process. A perched culvert crossing at Sitze Road constricts the creek and blocks juvenile fish passage. The Matanuska-Susitna Borough (MSB), with technical assistance from the U.S. Fish and Wildlife Service (USFWS) and financial support from The Nature Conservancy (TNC), replaced this culvert with an arched pipe in September 2008. Three culvert crossings upstream on private driveways severely constrict the creek and present velocity barriers to juvenile salmon. TNC worked with the landowners to replace the driveway culverts in June 2008, thus allowing unrestricted migration of both adult and juvenile salmonids within the Colter Creek watershed. The sites were incorporated into an existing environmental education program conducted by the Wasilla Soil and Water Conservation District (WSWCD) for local elementary school children. The Upper Susitna Youth Conservation Corps revegetated the site with willow cuttings and transplanted shrubs, trees, and ferns.

Upcoming Major Projects in the Mat-Su, Including ARRC, ANGDA, and KABATA

Serena Sweet, US Army Corps of Engineers, Alaska District

What is going on it your backyard? This presentation will include briefings on current big projects, including Alaska Railroad Port Mackenzie Rail Spur Project, Alaska Natural Gas Spur Line, KATABA: Knik Arm Bridge, and others. Information will include current status of the projects and plans and research being conducted for each project.

Inventory of Fish Distribution in Mat-Su Basin Streams, Southcentral Alaska, 2008

Theresa Tanner, U.S. Fish and Wildlife Service

Residential and commercial development in the Matanuska-Susitna (Mat-Su) Borough in southcentral Alaska is a threat to fish habitat. Fish habitat protection authorities and planning processes in Alaska are constrained by the extent of current knowledge of fish distributions and their habitats. Some protections provided under AS 41.14.870 only apply to waters specified in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* (AWC). The Anchorage Fish and Wildlife Field Office initiated this project to increase coverage of the AWC for Mat-Su Basin water bodies. We sampled 79 reaches in 29 different streams in 2008, resulting in 18 total nominations for addition to the AWC. Additionally, we reported 10 previously unpublished, unmapped streams, of which four were nominations for addition to the AWC. Coho salmon (*Oncorhynchus kisutch)* and Dolly Varden (*Salvelinus malma)* were the most common species sampled in 2008. Other species captured in 2008 included Chinook salmon (*O. tshawytscha)*, Alaska blackfish (*Dallia pectoralis)*, threespine stickleback (*Gasterosteus aculeatus)*, and sculpin (*Cottus* spp). Most streams sampled in 2008 were small (< 5 m width) 1st and 2nd order streams. This project continues to support the goals and objectives of the Mat-Su Basin Salmon Habitat Partnership and the National Fish Habitat Action Plan.

Matanuska Watershed Ecosystem Based Plan

Angie Wade, Chickaloon Village Traditional Council

The boundaries of the Matanuska River valley range from the Talkeetna Mountains to the north, the Matanuska Glacier to the east, the Chugach National Forest to the south, and the Cook Inlet/Gulf of Alaska to the west. It is extremely rugged and diverse terrain, spanning 10,000 foot mountains and impassable glaciers, numerous rivers, streams, lakes and wetlands, and coastal habitats at sea level. The northern boreal forest, primarily a spruce-birch-aspen mix, covers much of our mid-altitude lands and provides much of our sustenance. Historically harvested resources include salmon, moose, caribou, beluga whale, grizzly, and black bear, Dall sheep, beaver, hare, birch bark, berries, spruce roots, and numerous other animals and plants for food, medicine, tools, and fiber. As one of the few Alaska Native villages on the road system, we live in a culturally integrated community. It is essential that Chickaloon Native Village acts as a steward of its own land, and advocates for appropriate, non-damaging activities on adjacent lands. The Ecosystem Based Plan focuses on lands currently owned by Chickaloon Native Village, but encompasses the entire Matanuska Valley, which are ecologically inseparable. *We recognize that ecosystems don't follow land ownership boundaries.* As a result, this project is designed to help bridge the gap between Native and non-Native communities by serving both the Tribal community of Chickaloon Village and the larger community of the Matanuska Valley.

Wasilla Creek Fish Passage Restoration

Brian Winnestaffer, Chickaloon Village Traditional Council

The Wasilla Creek watershed contains some of the most spectacular wetlands in Southcentral Alaska with productive salmon streams, diverse wildlife habitats and wild, dynamic biotic systems. Within the watershed are residential communities that are the fastest developing areas of the state and some of the fastest growing in the country. This project built upon efforts from the previous Chickaloon Native Village Upper Wasilla Creek Project in 2007, which analyzed the three main impacted culverts on Upper Wasilla Creek, and replaced the culvert furthest downstream with a culvert which passes both adult and juvenile salmon. This NFHAP 2008 project focused on replacing the remaining two impaired culverts within the upper Wasilla Creek drainage area associated with Murphy Road.

Thermal Variability and Incubation of Salmon in the Matanuska River, Alaska

Chris Zimmerman, U.S. Geological Survey

Water temperature and dissolved oxygen play an important role in determining the developmental timing and survival of salmonid eggs and alevins. Due to variation in the source of inter-gravel water (e.g., down-welling surface water, up-welling ground water) inter-gravel water temperature can vary greatly over small spatial scales. In some locations, salmon select for a suite of inter-gravel conditions that maximize developmental timing and survival. We are examining the variability in inter-gravel temperatures in side-channels used by spawning salmon in the Matanuska River. We are mapping inter-gravel water temperatures across spawning areas by taking point measurements. Recording thermisters will be deployed to measure water temperature during the incubation period. Accumulated thermal units will be calculated to determine potential developmental timing in spawning areas. These data will be useful in determining habitat selection and survival of salmon.

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SCIENCE NEEDS from *Conserving Salmon Habitat in the Mat-Su, the Strategic Action Plan of the Mat-Su Salmon Partnership*

The Mat-Su Salmon Partnership's broad goals are to protect salmon and their habitats in the Mat-Su Basin and Upper Cook Inlet, mitigate potential threats to salmon and their habitats, restore connectivity between salmon habitats, and increase knowledge about salmon and their use of freshwater and marine habitats. Better understanding of salmon's needs throughout the Mat-Su Basin and Cook Inlet would improve management of salmon habitat and implementation of the recommendations in the strategic action plan. Three science strategies are highlighted in the plan because the information they will gather will inform multiple focal issues for salmon and salmon habitat in the Mat-Su Basin.

The full plan is available at http://conserveonline.org/workspaces/MatSuSalmon.

Overarching Science Strategies

Objective 1.1: Anadromous Waters Catalog
By 2020, all anadromous fish habitat in the Mat-Su Basin will be included in the Anadromous Waters Catalog and thus given basic protections afforded under state law. Efforts to catalog anadromous fish should also document non-anadromous fish.

> **Strategic Action 1.1.1: Complete Anadromous Waters Catalog**
> Develop a cooperative, long term implementation and funding plan that accomplishes inventories of all anadromous fish habitat for inclusion in the Catalog and identifies fish species present.

Objective 1.2: Comprehensive Surface & Groundwater Studies
By 2012, a comprehensive water quantity program will increase understanding of surface and groundwater, including quantities, flows, and variability in the Mat-Su Basin, and provide information for implementing and monitoring strategies for instream flow needs, stormwater management, fish passage, and climate change.

> **Strategic Action 1.2.1: Implement Study Plan and Water Data Clearinghouse**
> Develop a cooperative baseline & monitoring plan by winter 2008. Seek funding sources to implement and sustain plan. Develop clearinghouse to oversee funding efforts & identify lead entity to manage data by winter 2008.

> **Strategic Action 1.2.2: Support USGS Groundwater Program**
> Work with USGS groundwater modeling and monitoring program to ensure consistency with Partnership goals. Support and help secure funding for USGS program.

> **Strategic Action 1.2.3: Monitor Groundwater Use**
> Implement comprehensive well log database by 2009 and house information in a central location with public access. ADNR, Mat-Su Borough (MSB), or USGS may house this.

> **Strategic Action 1.2.4: Collect Hydrologic Data**
> Continuously gather hydrologic data with stream gages in three to five index watersheds. These index watersheds will be important to salmon and representative of Mat-Su Basin streams, and/or vulnerable to human activities and change in the Mat-Su Basin. USGS and other partners will collaborate on operating and securing funding for this stream gage network.

Objective 1.3: Water Quality Monitoring
By 2010 a comprehensive baseline and monitoring program for water quality exists to track and manage changes in Mat-Su Basin waterbodies.

Strategic Action 1.3.1: Develop Comprehensive Water Quality Monitoring Program
Work with Alaska Clean Water Actions program and other partners to develop a comprehensive water quality monitoring program for the Mat-Su Basin.

Strategic Action 1.3.2: Strengthen and Expand Water Quality Monitoring
Support and help secure funding for existing water quality programs. Seek long-term funding for a comprehensive program in the Mat-Su Basin.

Strategic Action 1.3.3: Support Baseline Data for Stream Temperatures
Support monitoring of temperatures in Mat-Su Basin waterbodies.

Additional Research Needs

Information on salmon and salmon habitats, as well as assessment of development, restoration, and mitigation measures, are essential components to effective salmon conservation. Development of accurate and predictive models is critical for effective conservation actions. Research priorities specific to watersheds will likely require a gap analysis for the watershed in question. During development of the Strategic Action Plan, the Science Working Group identified general and specific research needs. Many of those needs appear as objectives and strategic actions in the plan. This appendix (8 in the full plan) presents the full list for use by partners to development research programs.

General Research Needs:

- Assess the effects of passage barriers on fish populations.
- Assess the probable impacts of climate change for each focal conservation target.
- Assess impacts to salmon habitat from changes in hydrography.
- Develop and assess water quality and quantity baselines.
- Identify and classify critical salmon habitats, and monitor physical and biotic characteristics.
- Estimate salmon distribution and abundance; and assess stock status and limiting factors.
- Assess the likely effects of a coal-fired power plant on the focal conservation targets.
- Assess the cumulative impacts of development in riparian areas.
- Identify representative streams and stream reaches to conduct baseline and long-term monitoring.
- Conduct process studies to better understand systems.
- Document value of undeveloped riparian areas for acquisitions and conservation easements.
- Monitor dissolved oxygen in lakes classified as oligotrophic to confirm that the low dissolved oxygen status has a physical origin (e.g. long period of ice cover and subsequent quick stratification of the lakes does not allow adequate time for mixing and oxygenation), not a nutrient origin, and better understand the cause and implication of the low values.

To achieve objectives for focal issues identified in the Strategic Action Plan, the following research and monitoring needs were identified as action items:

Alteration of Riparian Areas:

1. Map and prioritize riparian habitats.
2. Prioritize subwatersheds based on a high importance for salmon, an expected high return on investment, and priorities already identified by partner programs.
3. Develop standards for riparian buffer protection on all lands sold by the state.

Filling of Wetlands:

1. Identify priority salmon watersheds within the Mat-Su Basin according to vulnerability and importance to salmon.
2. Map wetlands within priority watersheds.
3. Develop functional assessment methodology for all Mat-Su wetlands to aid in prioritization for protection.

Impervious Surfaces:

1. Develop Best Management Practices for new developments on municipal, state and private lands.
2. Assess current level and extent of imperviousness.
3. Institute a comprehensive baseline and monitoring program for water quality and quantity for surface and ground water in the Mat-Su Basin by 2010.
4. Develop baseline & monitoring plan by winter 2008.

Culverts that Block Fish Passage:

1. Inventory all anadromous fish habitat for inclusion in the Anadromous Waters Catalog.
2. Develop and implement culvert monitoring plan to ensure fish passage maintained or improved.
3. Assess fish passage status on all culverts on state and borough roads by Fall 2009; Inventory and assess all culverts on private roads and the railroad by 2012.
4. Prioritize culverts based on an analysis of benefit to fish versus cost of replacement.
5. Develop a fish passage educational and outreach program.
6. Identify index watersheds and start gathering hydrologic data.

Invasive Northern Pike:

1. Develop and implement a collaborative research plan on Northern pike invasion pathways.
2. Develop and implement a collaborative control program.
3. Develop a collaborative outreach program.

Stormwater & Urban Runoff:

1. Assess adequacy of National Pollutant Discharge Elimination System (NPDES) permitting and adequacy of Alaska Department of Environmental Conservation (ADEC) monitoring.
2. Map and identify stormwater drainage network that includes pipes and ditches.
3. Map accumulations of stormwater runoff in streams.
4. Determine current impact of runoff to water quality and hydrograph of streams and lakes.
5. Maintain adequate water volume in anadromous streams through instream water reservations.
6. Develop Best Management Practices for new developments on municipal, state and private lands.

Loss of Estuaries & Nearshore Habitats:

1. Identify and map habitat types in Cook Inlet.
2. Use sampling telemetry to map salmon distribution and movements through the inlet.
3. Use this information to determine use of and productivity of various habitat types.
4. Study processes in the inlet and interactions with salmon, similar to studies undertaken by Exxon Valdez Oil Spill (EVOS) Trustee Council in Prince William Sound.

Septic Systems:

1. Identify areas that are poorly-suited to onsite systems and/or that are subject to existing ADEC regulations.

Loss of Water Flow or Volume:

1. Prioritize anadromous streams and lakes for water reservations based on importance to salmon and vulnerability.
2. File for water reservations on the highest priority anadromous lakes and stream reaches.
3. Prioritize watersheds for gaging network based on importance to salmon and vulnerability.
4. USGS and other Partners will collaborate on operating a stream gage network.
5. Identify current and future water needs based on population trends and assess capacity of groundwater supply.

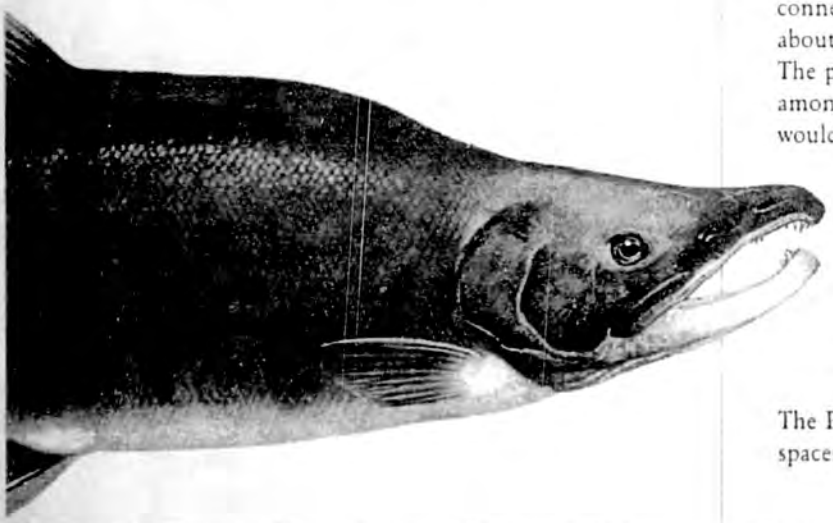
The Matanuska Susitna Basin Salmon Habitat Partnership

Clark James Mishler

Thriving fish, healthy habitats, and vital communities in the Mat-Su Basin

In Alaska, nature runs on salmon. Hundreds of thousands of wild salmon return to spawn in the Matanuska-Susitna Basin, where lakes and rivers serve as a nursery for salmon and other fish, including world-class rainbow trout, char and grayling. The five species of wild salmon that share these living waters help define life for people in the Mat-Su Basin.

Though the Mat-Su Basin's rivers, lakes, wetlands, tundra, boreal forest, glaciers and mountain ranges include some of the wildest terrain on earth, communities in the lower reaches of the basin comprise the fastest growing region in Alaska. To help ensure that wild salmon survive in a place where development pressures are growing, the Matanuska-Susitna Basin Salmon Habitat Partnership was formed.



A partnership

The Mat-Su Salmon Partnership believes that thriving fish, healthy habitats, and vital communities can co-exist in the Mat-Su Basin.

The Partnership is addressing the growing list of impacts to wild salmon habitat with an approach that is collaborative, cooperative, and non-regulatory. It brings together a diverse group of people from business and government and the non-profit community who are concerned with the health of wild salmon.

The Mat-Su Salmon Partnership developed a Strategic Action Plan to identify collaborative projects and other actions that will protect and restore important habitat for wild salmon in the Mat-Su Basin. The broad goals are to protect salmon and their habitats in the Mat-Su Basin and Upper Cook Inlet, mitigate potential threats to salmon and their habitats, restore connectivity between salmon habitats, and increase knowledge about salmon and their use of freshwater and marine habitats. The plan's conservation strategies encourage collaboration among multiple partners to achieve common objectives that would be difficult for any one partner to accomplish alone.

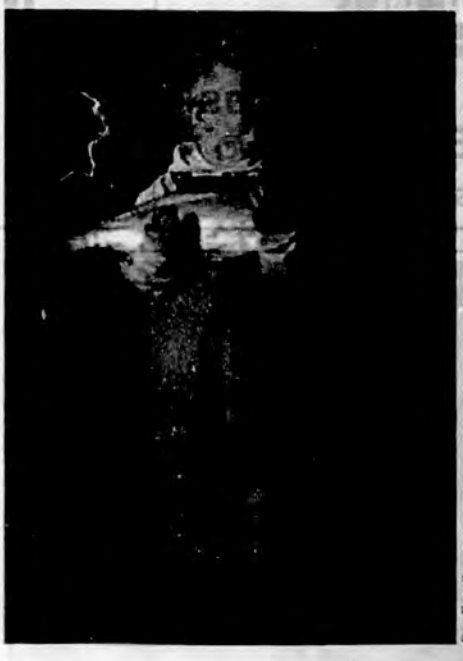
The history of salmon in other parts of the world indicates that wild salmon cannot persist in their full abundance unless stakeholders work together to protect salmon habitat. Only in working together, can all the key components for salmon habitat be protected to ensure healthy, abundant salmon runs in the Mat-Su Basin into the future.

The Plan is available at http://conserveonline.org/workspaces/MatSuSalmon

National Fish Habitat Action Plan

The Mat-Su Salmon Partnership's focus on a bottom-up, locally driven, voluntary and non-regulatory effort was inspired by the approach outlined in the National Fish Habitat Action Plan. Its mission is to protect, restore, and enhance the nation's fish and aquatic communities through partnerships that foster fish habitat conservation and improve the quality of life for the American people.

National Fish Habitat Action Plan is available at www.fishhabitat.org


Dan Parrell

Partners as of September, 2008

Alaska Dept. of Commerce, Community & Economic Development
Alaska Dept. of Environmental Conservation
Alaska Dept. of Fish & Game
Alaska Dept. of Natural Resources
Alaska Dept. of Transportation & Public Facilities
Alaska Center for the Environment
Alaska Outdoor Council
Alaska Railroad Corporation
Alaskans for Palmer Hay Flats
Aquatic Restoration & Research Institute
Bureau of Land Management
Butte Area Residents Civic Organization
Chickaloon Village Traditional Council
ConocoPhillips Alaska, Inc.
Cook Inlet Aquaculture Association
Cook Inletkeeper
Environmental Protection Agency
Friends of Mat-Su
Glacier Ridge Properties
Great Land Trust
Knik River Watershed Group
Matanuska River Watershed Coalition
Matanuska-Susitna Borough
National Marine Fisheries Service
National Park Service
Native Village of Eklutna
Natural Resources Conservation Service
Palmer Soil & Water Conservation District
Sierra Club
The Conservation Fund
The Nature Conservancy
Upper Susitna Soil & Water Conservation District
US Army Corps of Engineers
US Fish & Wildlife Service
US Geological Survey
USDA Forest Service
Wasilla Soil & Water Conservation District

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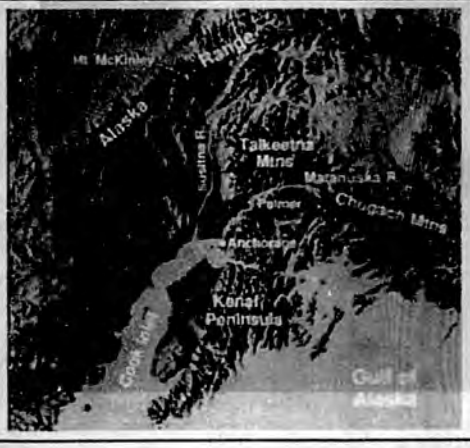
jessica@chickaloon.org

Mat-Su salmon
PARTNERSHIP

US Army Corps of Engineers ®
Alaska District

Matanuska-Susitna Rivers Watershed Study

Local Sponsor: Mat-Su Borough

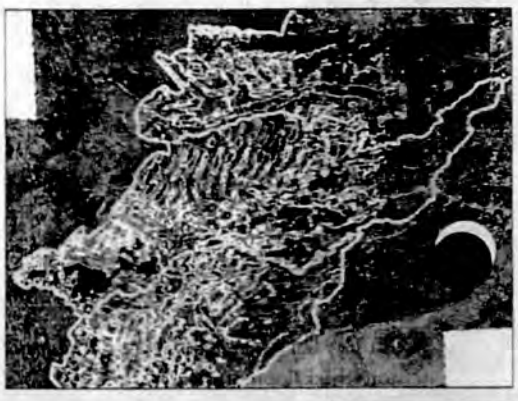


Location & Description: The project location includes the entire watershed area of the Matanuska and Susitna Rivers in addition to the Knik River with it's confluence to Upper Cook Inlet. The Matanuska-Susitna Valley area commonly known as the Mat-Su valley is approximately 24,000 square miles in size. The Matanuska River is a significant natural resource. It rises in the glacier fields of the Chugach Mountains and flows westerly for about 75 miles to empty into the Knik River and ultimately into Knik Arm at the head of Cook Inlet. The Susitna River, highly valued for its salmon fisheries, originates with the Susitna Glacier located on Mount Hayes in the Alaska Range. This 300 mile river flows in a winding course generally southwest to Curry, then south along the west side of the Talkeetna Mountains, past the villages of Talkeetna, Chulitna and Susitna and drains into Cook Inlet about 25 miles west of Anchorage.

Problem & Need: The overall purpose of this study is to produce a comprehensive watershed assessment for the Matanuska-Susitna watershed. The watershed assessment will provide several planning tools and products that will serve as a decision-making framework for local, state, and federal agencies, and other interested stakeholders including private property owners. An important component of this process will be a concentrated effort on the wetlands resources. In scoping this study effort, wetlands resources were brought up at almost every meeting with every stakeholder as a resource of concern. We will be working on a coordinated multi-agency effort to map, delineate jurisdictional wetlands, as well as perform a qualitative functional assessment of the wetland resources in currently developed, developing, and areas recognized for future development within the watershed.

These tasks will support the activities and research of on-going efforts in the Matanuska-Susitna Rivers watershed. The process will not duplicate existing or on-going research and data collection but will provide a vehicle for using the existing information in a watershed context. The intent of this study and the watershed assessment is to work as an umbrella to bring together in a collaborative manner all of the groups currently working in the watershed.

Activities for 2008/2009: In 2008, three sub-watershed areas were selected for wetland mapping: the Big Lake, Knik-Fairview and Little Susitna. In 2007 the area commonly known as the Core Area was mapped. A total of 271,764 acres have now been mapped in 2007 and 2008. Overall, 55,501 acres of wetlands cover the three watersheds mapped in 2008; making up about 29% of the land surface. In addition, a technical committee consisting of members from Federal, State, Local governments and private organizations are developing a wetlands functional assessment methodology to help better understand and predict how a wetlands functions on the landscape and what is the associated values of those functions. Both the mapping and the methodology work will continue in 2009 and 2010 fiscal years.



Contact Information

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Dave Martinson
Project Manager
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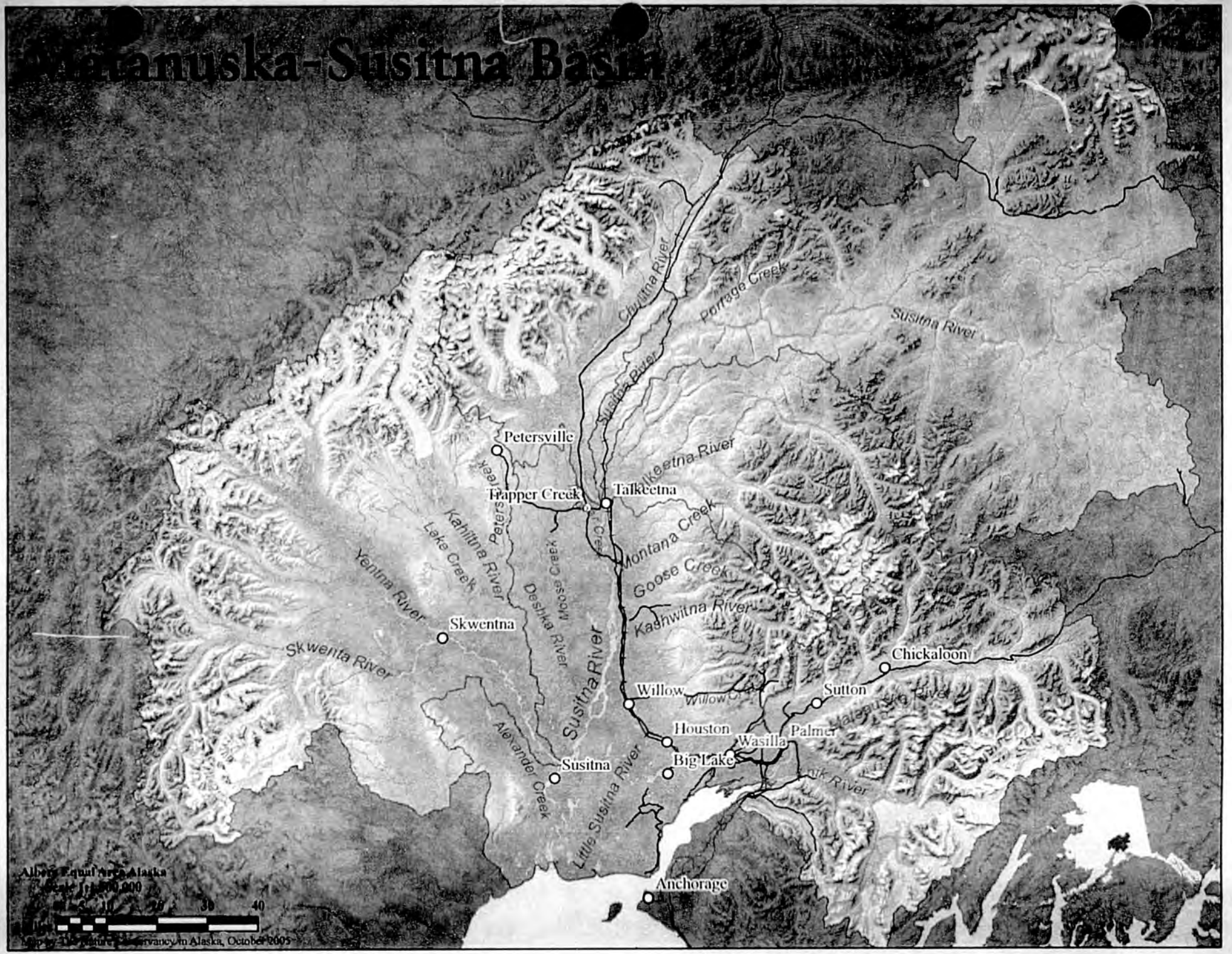
Matanuska-Susitna Basin
Chulitna River
Portage Creek
Susitna River
Susitna River
Petersville
Talkeetna River
Peters Creek
Happer Creek
Talkeetna
Kahiltna River
Lake Creek
Yentna River
Moose Creek
Deshka River
Montana Creek
Goose Creek
Kashwitna River
Skwentna
Skwenta River
Susitna River
Chickaloon
Willow
Willow Creek
Sutton
Houston
Wasilla
Palmer
Matanuska River
Alexander Creek
Susitna
Big Lake
Little Susitna River
Anchorage
Albers Equal Area Alaska
Scale 1:1,000,000
0 10 20 30 40
Copyright The Nature Conservancy in Alaska, October 2005

Title 5. Fish and Game.

Chapter 21. Cook Inlet Area.

Article 3. Salmon Fishery.

5 AAC 21.333(a) is amended to read:

(a) Except as specified in (e-**g**) of this section, two Cook Inlet drift gillnet CFEC permit holders may concurrently fish from the same vessel and jointly operate up to 200 fathoms of drift gillnet gear under this section.

5 AAC 21.333(c) is amended to read:

(c) When two Cook Inlet drift gillnet CFEC permit holders fish from the same vessel and jointly operate **additional** drift gillnet gear under this section, the vessel must display its ADF&G permanent license plate number followed by the letter "D" to identify the vessel as a dual permit vessel. The letter "D" must be removed or covered when the vessel is operating with only one **registered** drift gillnet CFEC permit holder on board the. The **permanent license plate** [IDENTIFICATION] number and letters must be displayed

...

5 AAC 21.333(e) is repealed and readopted to read:

(e) The joint operation of additional drift gillnet gear under this section is not allowed when drift gillnet gear is restricted to any of the following areas:

...

5 AAC 21.333 is amended by adding new subsections to read:

(f) A vessel with two registered CFEC permit holders on board, when transitting through any area where the legal limit of gillnet gear is less than 200 fathoms, may have on board up to 200 fathoms of gillnet gear as long as no portion of the gear is deployed into the water;

(g) When fishing on a vessel with two registered CFEC permit holders on board in areas where the operation of gear is restricted to less than 200 fathoms of gillnet as specified in subsection (e) of this section, the gillnet in excess of the legal limit must be removed from the reel and securely bagged or sacked. (Eff. 6/4/2008, Register 186; am _____/_____/2008, Register _____)

Authority: AS 16.05.251

Salmon | Herring | Groundfish | Shellfish

Division Overview

Division Awards

Employee Spotlight

Staff Listings

Office Locations

Site Index

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Commercial Fisheries Div.
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Juneau, AK 99811-5526

Phone: 907-465-4210
Fax: 907-465-2604
TTY: 800-478-3648 or 907-465-3646

Highlights

- Press Release: ADF&G Unveils New Publication Today at Board Of Fisheries: "Sustaining Alaska's Fisheries: Fifty Years of Statehood"
- 2009 Bristol Bay Sockeye Salmon Processing Capacity Survey - (PDF 46KB)
- 2008 Fish Expo Presentations on Bristol Bay Capacity
- 2009 Bristol Bay Sockeye Salmon Forecast - (PDF 92KB)

Click on a Fishery Area

Admin. Regions: 1 • 2 • 3 • 4

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- Personal Use Fisheries
- Workforce Info (Dept. of Labor)

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- Wildlife Notebook Series
- ADF&G Writer's Guide

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- System Codes

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- CF & Vessel Licenses (CFEC)
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- Transporter Listing

Laboratory Services

- Gene Conservation
- Mark, Tag & Age
- Pathology

Aquaculture

- Mariculture & Aquatic Farming
- PNP Hatcheries/Enhancement

ADF&G - Division of Commercial Fisheries

www.cf.adfg.state.ak.us

Upper Cook Inlet Fisheries

(Upper Cook Inlet Salmon and Herring)

Salmon Fisheries

Fisheries

- Cook Inlet
- Kenai River
- Kasilof River
- Northern Cook Inlet

Fishery Announcements

- Announcements & Updates
- New! Cook Inlet Salmon Enhancement Plan, Phase II, 2006-2025

Inseason Information

- Inseason Harvest Summary
- UCI Offshore Test Fish Summary
- UCI Sockeye Salmon Escapements
- Kenai R. Early Run Chinook Escapement
- Kenai R. Late Run Chinook Escapement
- Russian R. Early Run Sockeye Escapement
- Russian R. Late Run Sockeye Escapement

UCI Fisheries Management Plans and Strategies

(Jointly issued: Commercial Fisheries and Sport Fish)

- Kasilof River Sockeye Salmon - PDF file* (25K)
- Kenai River Early-Run Chinook Salmon - PDF file* (25K)
- Kenai River Late-Run Chinook Salmon - PDF file* (25K)
- Kenai River Late-Run Sockeye Salmon - PDF file* (36K)
- Kenai River Coho Salmon - PDF file* (25K)
- Russian River Sockeye Salmon - PDF file* (24K)
- Northern District Chinook Salmon - PDF file* (26K)
- Northern District Chinook Salmon - PDF file* (26K)
- Northern District Salmon - PDF file* (34K)
- Personal Use Salmon - PDF file* (26K)
- Subsistence Salmon - PDF file* (21K)
- Northern Cook Inlet Coho Salmon - PDF file* (22K)
- Central District Drift Gillnet - PDF file* (35K)

Preseason Forecast & Outlook

- Management Outlook - PDF file* (126K)
- Sockeye Salmon Forecast - PDF file* (35K)

Herring Fisheries

- Announcements
- UCI Smelt & Herring Fishing Seasons - PDF file* (42K)
- Overview of Alaska's Herring Fisheries

News & Information

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- Sport Fishing News Releases & EO's
- Statewide Features Page

Cook Inlet Personal Use Fisheries

- Cook Inlet Personal Use Fisheries

Regulations

- CF Regulations
- Sport Fish Regulations

Publications

- 2007 UCI Management Report - PDF file* (3.29M)
- 2006 UCI Management Report - PDF file* (995K)
- 2005 UCI Management Report - PDF file* (702K)
- 2004 UCI Management Report - PDF file* (532K)
- 2003 UCI Management Report - PDF file* (621K)
- 2002 UCI Management Report - PDF file* (509K)
- 2001 UCI Management Report - PDF file* (245K)

Season Summary

- 2008 Season Summary - PDF file* (168K)

Salmon Fishery maps

- Cook Inlet
- Northern & Central Districts

Historical Information

- UCI Historical Salmon Information

Salmon Permits, Licenses & Forms

- Northern District Registration - PDF file* (50K)
- Greater Cook Inlet Registration - PDF file* (49K)
- Salmon Disposal Logbook Form - PDF file* (14K)
- Salmon Disposal Logbook Instructions

Salmon Genetics

- Cook Inlet Sockeye Salmon
- Cook Inlet Chinook Salmon

Salmon Hatcheries

- Central Region Hatchery Locations
- Statewide Hatchery Information

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* Adobe Acrobat PDF files require a free viewer available directly from Adobe.

Need a hard copy of a publication? Contact Central Region Publications.

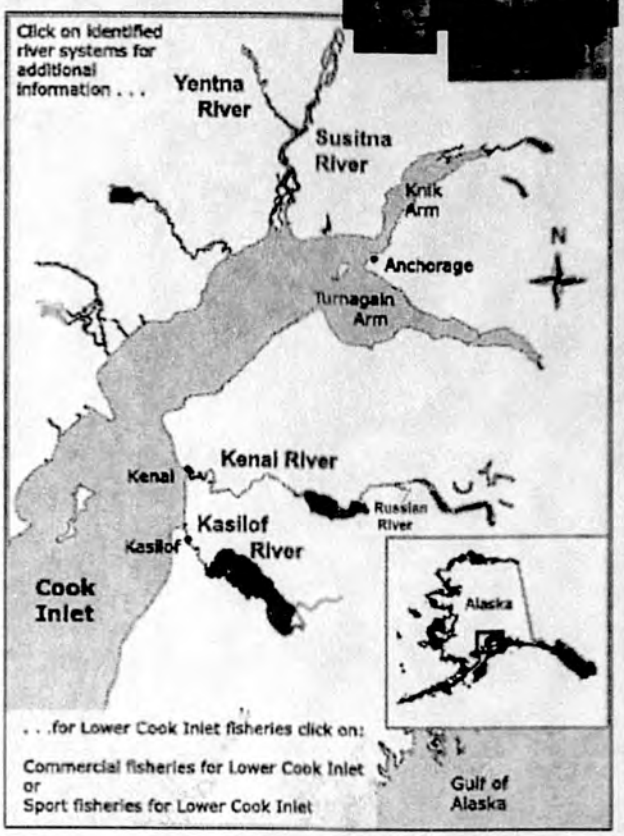
Alaska Department of Fish & Game

www.adfg.state.ak.us

Cook Inlet Fisheries

(Sport, Commercial, Personal Use, and Subsistence Fisheries)

Detailed river system information is available though clickable links in the map, through the tables below, or by using the following text links: Kenai River, Russian River, Kasilof River, Northern Cook Inlet (Yentna and Susitna Rivers). See also *Commercial Fisheries*: Upper Cook Inlet / Lower Cook Inlet, and *Sport Fisheries* Lower Cook Inlet.



Salmon Run Timing:

Kenai River	May	Jun	Jul	Aug	Sep
King Salmon					
Early Run					
Late Run					
Red Salmon					
Silver Salmon					
Pink Salmon					

Text Version

Russian River	May	Jun	Jul	Aug	Sep
Red Salmon					
Early Run					
Late Run					

Text Version

Kasilof River	May	Jun	Jul	Aug	Sep
King Salmon					
Red Salmon					
Silver Salmon					

Text Version

Susitna River	May	Jun	Jul	Aug	Sep
King Salmon					
Red Salmon					
Silver Salmon					
Pink Salmon					
Chum Salmon					

Text Version

Yentna River	May	Jun	Jul	Aug	Sep
King Salmon					
Red Salmon					
Silver Salmon					

Text Version

Upper Cook Inlet Commercial Fisheries Information

For Lower Cook Inlet Information please go to the following links: Commerical Fisheries for Lower Cook Inlet | Sport Fisheries for Lower Cook Inlet .

Contact Information:

Commercial Fishing

Commercial Fisheries Offices (Anchorage, Soldotna and Homer)
Recorded Messages

Sport Fishing

Sport Fish Offices (Anchorage, Palmer, Soldotna and Homer)
Recorded Messages

ADF&G
Sport Fish
Division

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- **Economic Significance of Sport Fishing**
- **Sport Fish Guide Services Board Discussion**
- **Report a Violation - Fish and Wildlife SAFEGUARD**
- **Sport Fish Stocking Policy**

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- Cook Inlet Personal Use
- Copper River Personal Use

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- Economic Significance of Sport Fishing
- Trophy Sport Fish
- Sport Fishing Survey Results
- Salmon Industry Restructuring Panel
- Endangered Species

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- Fish Passage
- Invasive Pike
- Stream Restoration
- Freshwater Species Inventory
- Instream Flow
- Forest Ecology
- New Zealand Mudsnails (PDF)
- "It Takes a Watershed to raise a Fish"

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- Fishing Brochures
- Strategic Plan
- Wildlife & Fish Conservation Strategy

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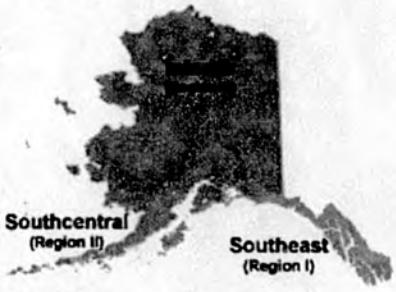

Programs

- Recreational Boating and Angler Access Program
- Kachemak Bay Research Reserve
- Refuges & Sanctuaries
- Legal Access
- SE Sustainable Salmon Fund
- Becoming an Outdoors-Woman
- Wild Trout Plan

Boards Support
ADF&G - Section of

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- Petition the Board

Board of Fisheries

2008/2009 Document Archive

Select File to Download

Meeting Date	Topics	Meeting Documents (*PDF)	Size of PDF
October 8-10, 2008 [3 days]	Worksession - Agenda Change Requests*, cycle organization, Stocks of Concern	Agenda/Roadmap & Notice	72 KB
		Board of Fisheries	51 KB
		09/10 Draft Schedule	708 KB
		Findings/Policies	12 KB
		Petitions	95 KB
		ACRs	1.34 MB
		Miscellaneous	3.37 MB
		Public Comments	230 KB
		RC Index & RC 2	193KB
		RC 3-15	3.19MB
		RC 16-30	5.12MB
December 1-7, 2008 [7 days]	Prince William Sound	Agenda/Roadmap	32KB
		Legal Notice	76KB
		Board of Fisheries	112KB
		Dept. of Law	1.41MB
		Findings/Policies	2.35MB
		Subsistence Materials	795KB
		Proposals	405KB
		Supplemental Proposals	35KB
		Index of Comments	160KB
		AC Comments	2.10MB
		Public Comments	12.8MB
		RC Index & Staff Comments	
		RCs 5-38	13.8MB
		RCs 38-123	11.1MB
January 21-27, 2009 [7 days]	Southeast and Yakutat Shellfish	Agenda/Roadmap	73KB
		Legal Notice	35KB
		Board of Fisheries	52KB
		Findings/Policies	496KB
		Dept. of Law	3.02MB
		Miscellaneous	1.61MB
		Proposals	329KB
		Subsistence Materials	795KB
		Index of Comments	75KB
		AC Comments	2.06 MB
		Public Comments	9.25 MB
		RC Index & Staff Reports	
		RCs	
February 17-26, 2009 [10 days]	Southeast and Yakutat Finfish	Agenda/Roadmap	
		Legal Notice	
		Board of Fisheries	
		Findings/Policies	
		Dept. of Law	
		Proposals	
		Index of Comments	214 KB
		AC Comments	6.48 MB

		Public Comments	19.9MB
		RC Index & Staff Reports	
		RC's	
March 16-20, 2009 [5 days]	Statewide Dungeness Crab, Shrimp, Misc. Shellfish	Agenda/Roadmap Legal Notice Board of Fisheries Findings/Policies Dept. of Law Proposals AC Comments1-7 Public Comments RC Index & Staff Reports RCs	

To view previous years document archives, click on the year below:

2007-2008

(*PDF) These documents are in PDF format. To open this document you must download the free software, Adobe Acrobat Reader.

Fishery Manuscript No. 07-06

Review of Salmon Escapement Goals in Upper Cook Inlet, Alaska, 2007

by

Lowell F. Fair,

Robert A. Clark,

and

James J. Hasbrouck

November 2007

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)	
centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)	
cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature	
day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry	
all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General	
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)	
fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics	
all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY MANUSCRIPT NO. 07-06

REVIEW OF SALMON ESCAPEMENT GOALS IN UPPER COOK INLET, ALASKA, 2007

by

Lowell F. Fair,
Division of Commercial Fisheries, Anchorage
and
Robert A. Clark, and James J. Hasbrouck
Division of Sport Fish, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

November 2007

The Division of Sport Fish Fishery Manuscript series was established in 1987 for the publication of technically-oriented results of several years' work undertaken on a project to address common objectives, provide an overview of work undertaken through multiple projects to address specific research or management goal(s), or new and/or highly technical methods. Since 2004, the Division of Commercial Fisheries has also used the Fishery Manuscripts series. Fishery Manuscripts are intended for fishery and other technical professionals. Fishery Manuscripts are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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and

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Alaska Department of Fish and Game, Division of Sport Fish,
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This document should be cited as:
L. F. Fair, R. A. Clark, and J. J. Hasbrouck. 2007. Review of salmon escapement goals in Upper Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-06, Anchorage.

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If you believe you have been discriminated against in any program, activity, or facility please write:

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ABSTRACT

In January 2007, a salmon escapement goal review committee, composed of Alaska Department of Fish and Game staff from the Division of Commercial Fisheries and Division of Sport Fish, was formed to review Pacific salmon *Oncorhynchus* spp. escapement goals for the major river systems in Upper Cook Inlet, Alaska. Escapement goals were evaluated for 22 Chinook salmon, 1 chum salmon, 3 coho salmon, and 8 sockeye salmon stocks. The committee did not recommend a change to any existing goals, however, the committee recommended re-instating the sustainable escapement goals (SEG) of 50–700 for Campbell Creek Chinook salmon and 15,000–30,000 for Packers Creek sockeye salmon. In addition, the committee recommended removing the SEG for South Fork Eagle River Chinook salmon and Campbell Creek coho salmon.

Key words: Upper Cook Inlet, escapement goal, biological escapement goal, BEG, sustainable escapement goal, SEG, sockeye salmon, *Oncorhynchus nerka*, Chinook salmon, *O. tshawytscha*, coho salmon, *O. kisutch*, chum salmon, *O. keta*, Alaska Board of Fisheries.

INTRODUCTION

Upper Cook Inlet (UCI), Alaska, supports all five species of Pacific salmon *Oncorhynchus*. The Alaska Department of Fish and Game (ADF&G; department) reviews the escapement goals for UCI salmon stocks on a schedule that corresponds to the Alaska Board of Fisheries (BOF) 3-year cycle for considering area regulatory proposals. This report describes the UCI salmon escapement goals that were reviewed in 2007 and presents information from the subsequent 3 years in the context of these goals. UCI escapement goals were thoroughly reviewed during the previous 2004–2005 BOF cycle (Clark et al. 2007; Hasbrouck and Edmundson 2007). Due to the thoroughness of the previous analyses, this review re-analyzed only those goals with recent (2004–2006) data that substantially changed findings from the 2004 review.

Escapement goals were reviewed based on the Policy for the Management of Sustainable Salmon Fisheries (SSFP; 5 AAC 39.222) and the Policy for Statewide Salmon Escapement Goals (EGP; 5 AAC 39.223). The Alaska Board of Fisheries adopted these policies into regulation during winter 2000–2001 to ensure that the state's salmon stocks are conserved, managed, and developed using the sustained yield principle. Two important terms defined in the SSFP were:

"Biological Escapement Goal" or "(BEG)" means the escapement that provides the greatest potential for maximum sustained yield; BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted; BEG will be developed from the best available biological information, and should be scientifically defensible on the basis of available biological information; BEG will be determined by the department and will be expressed as a range based on factors such as salmon stock productivity and data uncertainty; the department will seek to maintain evenly distributed salmon escapements within the bounds of a BEG;" and

"Sustainable Escapement Goal" or "(SEG)" means a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10 year period, used in situations where a BEG cannot be estimated due to the absence of a stock specific catch estimate; the SEG is the primary management objective for the escapement, unless an optimal escapement or inriver run goal has been adopted by the board, and will be developed from the best available biological information; the SEG will be determined by the department and will be stated as a range that takes into account data uncertainty; the department will seek to maintain escapements within the bounds of the SEG.

During the 2007 review process, escapement goals for the following stocks were evaluated:

- Sockeye salmon *O. nerka*: Fish and Packers creeks, and Crescent, Kasilof, Kenai, Russian (early and late run), and Yentna rivers;
- Chinook salmon *O. tshawytscha*: Alexander, Campbell, Clear, Crooked, Goose, Lake, Little Willow, Montana, Peters, Prairie, Sheep, and Willow creeks, and Chuitna, Chulitna, Deshka, Eagle River South Fork, Kenai (early and late run), Lewis, Little Susitna, Talachulitna, and Theodore rivers;
- Chum salmon *O. keta*: Clearwater Creek;
- Coho salmon *O. kisutch*: Campbell and Jim creeks, and Little Susitna River.

During the winter of 2006–2007, the department established an escapement goal review committee (hereafter referred to as the committee). The committee consisted of 4 Division of Commercial Fisheries and 7 Division of Sport Fish personnel (Table 1). The committee was formed to recommend the appropriate type of escapement goal (BEG or SEG) and provide an analysis for recommending an escapement goal for each stock.

The committee formally met 16 January, 2007 to review escapement goals and develop recommendations. The committee also communicated by email. All committee recommendations were reviewed by ADF&G regional and headquarters staff prior to being adopted by ADF&G as escapement goals per the SSFP and EGP.

METHODS

Available escapement, catch, and age data for each stock were compiled from research reports, management reports, and unpublished historical databases. Escapement refers to the annual estimated size of the spawning salmon stock. Escapement is affected by a variety of factors including exploitation, predation, diseases, and physical and biological changes in the environment. The committee evaluated the type, quality, and quantity of data for each stock. This evaluation was used to determine the appropriate type of escapement goal as defined in regulation. Generally speaking, an escapement goal for a stock should provide escapement that produces sustainable yields. Escapement goals for salmon have typically been based on spawner-recruit relations (e.g., Beverton and Holt 1957; Ricker 1954), which represent the productivity of the stock and estimated carrying capacity. However, specific methods to determine escapement goals vary in their technical complexity. Thus, escapement goals should be evaluated and revised over time as improved methods of assessment and goal setting are developed, and when new and better information become available. An escapement goal for a stock was defined as a BEG if a sufficiently long time series of escapement, catch, and age estimates were available; the estimates were sufficiently accurate and precise; and the data were considered sufficient to provide a scientifically defensible estimate of MSY (as per rules and methods in Hilborn and Walters 1992; CTC 1999; Quinn and Deriso 1999). A BEG is used when the reference points can be estimated and there is sufficient fishing power and inseason management capability to harvest annual runs to achieve the BEG. An escapement goal for a stock was defined as an SEG if a sufficiently long time series of escapement estimates were available, but there was concern about the spawner-return data (lack of age composition

estimates and/or concern with stock-specific catch allocation) or there was a lack of information on stock productivity.

Study Area

The UCI management unit consists of that portion of Cook Inlet north of Anchor Point and is divided into the Central and Northern districts (Figure 1). The Central District is approximately 120 km (75 miles) long, averages 50 km (32 miles) in width, and is further subdivided into 6 subdistricts. The Northern District is 80 km (50 miles) long, averages 32 km (20 miles) in width, and is divided into 2 subdistricts. Commercial salmon fisheries target mainly sockeye salmon with secondary catches of Chinook, coho, chum and pink salmon. Sport fish management is divided into the Northern Kenai Peninsula, Northern Cook Inlet, and the Anchorage management areas. These areas offer diverse personal use and recreational fishing opportunities for all 5 species of Pacific salmon.

Escapement and Harvest Data Collection

Estimates or indices of salmon escapement are obtained with a variety of methods such as foot and aerial surveys, capture-recapture experiments, weir counts, and hydroacoustics (sonar). Differences in methods among years can affect the comparability and reliability of data. In the practical arena of salmon management, fishery biologists try to determine the amount of harvestable surplus and the number of spawners necessary to perpetuate the stock or run, known as the escapement goal.

Escapements of most Chinook salmon stocks in UCI have been monitored by single foot and aerial surveys. Such surveys provide only an index of escapement because we lack supporting data (i.e., accurate estimates of stream life and observer variability) to estimate number of fish in the escapement. The indices are a measurement on a numeric scale that provides information only about the relative level of the escapement. These measurements provide a ranking of escapement magnitude across years, but alone these measurements provide no information on the total number of fish in the escapement or of their age composition.

Hydroacoustics (sonar) have been used to assess early- and late-run Chinook salmon inriver runs to the Kenai River (Miller et al. 2005). An associated gillnetting program has been used to sample Chinook salmon to estimate age, sex, and size composition (Reimer 2004). Since 1995, the Deshka River Chinook salmon escapement has been counted and sampled at a weir, but in prior years escapement was indexed annually by single aerial surveys (Yanusz *In prep*). Chinook salmon escapement into the Deshka River prior to 1995 was estimated by expanding the aerial surveys in those years using the relationship between weir counts and survey indices observed since 1995. A weir project has also been in place to count and sample Chinook salmon in Crooked Creek (Gamblin et al. 2004). Sonar and weir data provides a count or an estimate of the total number of fish in the escapement.

For coho salmon stocks, escapements have been monitored with a combination of single foot surveys and weir counts (Bue and Hasbrouck *Unpublished*). Peak aerial surveys have been used to index escapement of chum salmon in Clearwater Creek, the only chum salmon stock in UCI that is monitored by ADF&G (Tobias and Willette 2007).

Sonar has been deployed to count or estimate sockeye salmon passing specific locations in the Crescent, Kasilof, Kenai, and Yentna rivers. Fish wheel catches were used to apportion sonar counts to species in these systems and to sample fish for age, sex, and size information

(Westerman and Willette 2006). Weirs have been installed to count and sample adult sockeye salmon escapements in the Russian River (Gamblin et al. 2004), Fish Creek (Sweet et al. 2004), and Packers Creek (Fandrei 1996).

Commercial catch statistics were compiled from ADF&G fish ticket information. The majority of sockeye salmon returning to UCI are caught in mixed stock fisheries (Shields 2007). A weighted age-composition apportionment method has been used to estimate stock-specific harvests of sockeye salmon in commercial gillnet fisheries in UCI (Tobias and Willette 2007). This method is based upon the assumption that age-specific exploitation rates were equal among stocks in the gillnet fishery (Bernard 1983) and is dependent upon accurate and precise escapement measures for all contributing stocks to the fishery. The age-composition catch apportionment method utilizes four data sources: (1) commercial harvests, (2) escapements into major UCI drainages, (3) age composition of harvests, and (4) age composition of escapements. Harvest allocation for each stock was estimated by harvest location and age composition. Estimates of sport harvest were derived from the postal survey (Statewide Harvest Survey) conducted annually by the Division of Sport Fish (Jennings et al. 2007).

ESCAPEMENT GOAL RECOMMENDATION

Escapement goals were evaluated for UCI stocks using the following methods: (1) Spawner-Return data; (2) Yield Analysis; (3) Smolt/Fry Information; and (4) Percentile Approach. Spawner-Return data was used to estimate escapement goals when the committee determined it had "good" estimates of total return (escapement and stock-specific harvest) for a stock. When "good" spawner-return data was available, escapement goals were estimated based on: (1) escapements producing average yields that were 90–100% of MSY (S_{MSY}) from a stock-recruitment model, and (2) the Yield Analysis, explained below, which also estimates MSY with corresponding 90–100% yield range. Smolt and/or fry information, when available, was used to aid in the estimation of escapement goals for stocks by examining the stability of freshwater productivity (average weight through time) and to better understand the effects of process error in marine versus freshwater environments. If marine survival is assumed to be largely density independent, a smolt stock-recruit production model provides improved estimates of yield related to spawners by eliminating marine environmental influences on survival.

Spawner-Return Data

Salmon spawner-return data were analyzed for all available brood years. Annual runs, the sum of escapements and harvests, were estimated as described in Bernard (1983). Where quantifiable, sport and subsistence harvests were included in total return estimates.

Spawner-return data were analyzed using a Ricker (1954) stock-recruitment model to estimate MSY and the escapement goal range. Results were not used if the model fit the data poorly ($p \geq 0.20$) or model assumptions were violated. Hilborn and Walters (1992), Quinn and Deriso (1999), and the CTC (1999) provide good descriptions of the Ricker model and diagnostics to assess model fit. All stock-recruitment models were tested and corrected for serial correlation of residuals when necessary. Additionally, the Ricker alpha parameter was corrected for the logarithm transformation bias induced into the model as described in Hilborn and Walters (1992) from fitting a regression line to ln(recruits/spawners) versus spawners.

Additional spawner-return analyses were conducted to examine stock productivity and the escapement goal for Kenai River sockeye salmon. Details about the various methods are provided in Clark et al. (2007). These analyses included:

(1) examination of a hierarchy of mathematical models that related number of spawners and adult recruitment of sockeye salmon;

(2) simulations using brood-interaction model parameters (Carlson et al. 1999) using the 1969–1999 spawner-recruit data and for the recent brood years 1979–1999 because the latter data set was obtained using more consistent methods for stock composition; and

(3) simulations testing the effects of alternating spawner abundances on yields in the brood-interaction model.

Yield Analysis

For the Kenai River sockeye salmon stock, Clark et al. (2007) conducted a Markov yield analysis (Hilborn and Walters 1992) to further evaluate the escapement goal range using three data sets: (1) the original spawner-recruit data set used in 1999, (2) an updated data set, and (3) a reduced data set. As in the original 1999 analysis, the yield table was constructed by partitioning the data into overlapping intervals of 200,000 spawners. The mean number of spawners, mean return, mean return per spawner, mean yield, and the range of yields was calculated for each interval of spawner abundance.

Percentile Approach

Most salmon stocks in UCI with an escapement goal have an SEG. In 2001, the SEG of these stocks was developed using percentiles of observed escapements, whether estimates or indices, that incorporated contrast in the escapement data and exploitation of the stock (Bue and Hasbrouck *Unpublished*). Percentile ranking is the percent of all escapement values that fall below a particular value. To calculate percentiles, escapement data are ranked from smallest to the largest value, with the smallest value the 0^{th} percentile (i.e., none of the escapement values are less than the smallest). The percentile of all remaining escapement values is a cumulative, or summation, of 1/(n-1), where n is the number of escapement values. Contrast in the escapement data is simply the maximum value divided by the minimum value. As contrast increased, the percentiles used to estimate the SEG were narrowed, primarily from the upper range, to allow the SEG to include a wide range of escapements. For exploited stocks with high contrast, the lower end of the SEG range was increased to the 25^{th} percentile as a precautionary measure for stock protection. The percentiles used at different levels of contrast were as follows (Bue and Hasbrouck *Unpublished*):

Escapement Contrast and Exploitation	SEG Range
Low Contrast (<4)	15^{th} Percentile to maximum observation
Medium Contrast (4 to 8)	15^{th} to 85^{th} Percentile
High Contrast (>8); Low Exploitation	15^{th} to 75^{th} Percentile
High Contrast (>8); Exploited Population	25^{th} to 75^{th} Percentile

For this review, the SEG ranges of all stocks were reevaluated using the percentile approach with updated or revised escapement data. If the estimated SEG range was consistent with the current goal (i.e., a high degree of overlap), the committee recommended no change to the goal.

RESULTS

There were 34 escapement goals evaluated for 32 stocks in UCI (Table 2). There were 32 existing escapement goals and 2 new goals for stocks that previously had goals. The recommendation for each escapement goal follows by species and river. The detailed information for each escapement goal can be found in the previous review reports (Clark et al. 2007; Hasbrouck and Edmundson 2007).

CHINOOK SALMON

Eagle River South Fork

The committee recommended that the Eagle River South Fork escapement goal for Chinook salmon be dropped. The sport harvest on this stock is very small (averaging less than 100 fish per year) and 5 of the past 6 surveys were poor quality, providing little information about escapements.

Campbell Creek

The committee recommended that the Campbell Creek Chinook salmon goal be re-instated to its previous level of 50 to 700 fish. During the 2004 review the goal was dropped because no fishery on this stock existed. In January of 2005 however, the BOF created a small youth-only fishery, which now warrants an escapement goal for this stock. The annual harvest for this fishery is approximately 100 fish (D. Bosch, Fishery Biologist, ADF&G, Division of Sport Fish, Region II; personal communication).

CHUM SALMON

The committee did not recommend any changes to the Clearwater Creek goal, the only chum salmon goal in UCI.

COHO SALMON

Campbell Creek

The committee recommended that the Campbell Creek escapement goal for coho salmon be dropped. Coho salmon runs to Campbell Creek are predominantly hatchery-stocked fish, with brood stock from Ship Creek.

SOCKEYE SALMON

Packers Creek

The committee recommended that the Packers Creek sockeye salmon goal be re-instated to its previous level of 15,000 to 30,000 before the 2004 review when it was dropped. In 2004, the committee dropped this goal because the weir had not operated since 2001. In 2005 however, a video counting system was installed for an annual assessment of escapement.

Fish Creek

The SEG for Fish Creek sockeye salmon is 20,000 to 70,000 fish after broodstock needs have been met (Appendix C2; CIAA 2007). Escapements during 2004–2006 were below the goal once (2005) and within the goal twice (Appendix C2).

The committee recommended no change to the SEG for Fish Creek sockeye salmon. Since 2002 this goal has been based on the percentile approach (Bue and Hasbrouck *Unpublished*; Hasbrouck and Edmundson 2007) applied to observed escapements from a time period prior to hatchery supplementation (1938–1978) so that the effects of supplementation did not influence yields and subsequent escapement of this stock. It was thought that a range of escapements from 20,000 to 70,000 fish would utilize available spawning areas, produce adequate numbers of juvenile salmon that would not tax the productive capacity of the lake, and sustain yields into the future.

Currently, this goal is evaluated using escapements of hatchery and naturally-produced fish because we can't manage fisheries to target hatchery fish. Hatchery supplementation of this stock began in 1979 and continues to the present (Dodson 2007). Prior to 1999 the hatchery did not mark fry released into the lake so there was no method to differentiate hatchery-produced from naturally-produced adults at the weir. Returning adults of hatchery origin have been differentiated from naturally produced fish at the weir from 2002 to the present. Although insufficient to assess the current goal, this information will prove useful in future evaluations of the escapement goal.

Fish used as broodstock in the hatchery program have not been (Bue and Hasbrouck *Unpublished*; Hasbrouck and Edmundson 2007) and should not be included in the evaluation of the escapement goal. These fish are used as a source of eggs and milt to produce fry that are stocked into Big Lake in the Fish Creek drainage and are also used to support hatchery programs in other waters (Dodson 2007). Broodstock do not contribute to the spawning escapement of the Fish Creek stock at the time of the evaluation of the escapement goal. Moreover, broodstock fish are not involved in the competition for spawning sites that may be a significant factor in the productive capacity of Fish Creek. Conversely, if rearing capacity is limiting production in the Fish Creek drainage, juveniles produced from broodstock and stocked back into Fish Creek would compete with naturally produced juvenile sockeye salmon. Competition from these hatchery-produced juveniles would likely be disproportionately greater than the naturally produced juveniles from an equivalent number of adult salmon taken during brood collection and evaluation of the escapement goal.

DISCUSSION

The committee recommended that most escapement goals for UCI salmon stocks remain status quo (Table 2). However, the Campbell Creek Chinook salmon and Packers Creek sockeye salmon goals that were dropped in the last review from 2004 were re-instated. Also, the Eagle River South Fork Chinook salmon and Campbell Creek coho salmon goals were dropped.

Historical escapement through 2006 and, when possible, harvest or total return data, of each stock appear in Appendices A–D. Through their respective time frames, data in the appendices were used in the review of escapement goals and development of SEGs of UCI salmon stocks in 2001 (Bue and Hasbrouck *Unpublished*), 2004 (Clark et al. 2007; Hasbrouck and Edmundson

2007), and in this review. Escapement values of some Chinook and coho salmon stocks were corrected because errors were discovered in the data.

It was recommended that the majority of current escapement goals for sockeye salmon in UCI remain unchanged. In this review, the committee did not have evidence to warrant a change in sockeye salmon escapement goals. However, some of the stocks underlying spawner-recruit data may be changed in the relatively near future using new information to allocate harvests.

The department has recently developed new, less expensive genetic techniques that are being used to estimate the stock composition of commercial sockeye salmon harvests in UCI for 2005 to 2007. It is anticipated that the results from these analyses will provide somewhat different estimates of harvest by stock for the major sockeye salmon producing stocks in UCI, and will thereby change the estimates of total run for these stocks. ADF&G has received General Fund monies to allow for the analysis of genetics samples each year. As time and funding allow, it is anticipated that select historical harvests will be genetically tested for stock composition and in conjunction with run strength, age composition, and run timing, modeled to re-estimate historical harvest composition by stock.

REFERENCES CITED

Bernard, D. R. 1983. Variance and bias of catch allocations that use the age composition of escapements. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 227, Anchorage.

Beverton, R. J. H., and S. J. Holt. 1957. On the dynamics of exploited fish populations. Fisheries Investment Series 2, Vol. 19 U.K. Ministry of Agriculture and Fisheries, London.

Bue, B. G., and J. J. Hasbrouck. *Unpublished.* Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Carlson, S. R., K. E. Tarbox, and B. G. Bue. 1999. The Kenai sockeye salmon simulation model: a tool for evaluating escapement and harvest levels. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A99-08, Anchorage.

Clark, J. H., D. M. Eggers, and J. A. Edmundson. 2007. Escapement goal review for Kenai River late-run sockeye salmon: Report to the Alaska Board of Fisheries, January 2005. Alaska Department of Fish and Game, Special Publication No. 07-12, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp07-12.pdf

CTC (Chinook Technical Committee). 1999. Maximum sustained yield of biologically sustained escapement goals for selected Chinook stocks used by the Pacific Salmon Commission's Joint Technical Committee for escapement assessment, Volume 1. Pacific Salmon Commission Joint Technical Committee Report No. TCCHINOOK (99)-3, Vancouver, British Columbia, Canada.

CIAA (Cook Inlet Aquaculture Association). 2007. Trail Lakes hatchery annual management plan, calendar year 2007, Soldotna.

Dodson, T. T. 2007. Big Lake sockeye salmon enhancement progress report, 2006. Cook Inlet Aquaculture Association, Soldotna.

Fandrei, G. 1996. Packers Lake sockeye salmon enhancement progress report. 1995. Cook Inlet Aquaculture Association, Soldotna.

Gamblin, M., L. E. Marsh, P. Berkhahn, and S. Sonnichsen. 2004. Area management report for the recreational fisheries of the Northern Kenai Peninsula, 2000 and 2001. Alaska Department of Fish and Game, Fishery Management Report No. 04-04, Anchorage.

REFERENCES CITED (Continued)

Hasbrouck, J. J., and J. A. Edmundson. 2007. Escapement goals for salmon stocks in Upper Cook Inlet, Alaska: report to the Alaska Board of Fisheries, January 2005. Alaska Department of Fish and Game, Special Publication No. 07-10, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp07-10.pdf

Hilborn, R., and C. J. Walters. 1992. Quantitative fisheries stock assessment. Chapman and Hall, New York.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2007. Participation, catch, and harvest in Alaska sport fisheries during 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-40, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-40.pdf

Miller, J. D., D. L. Burwen, and S. J. Fleischman. 2005. Estimates of Chinook salmon abundance in the Kenai River using split-beam sonar, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 05-59, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds05-59.pdf

Quinn, T. J., II, and R. Deriso. 1999. Quantitative fish dynamics. Oxford University Press, New York.

Reimer, A. 2004. Chinook salmon creel survey and inriver gillnetting study, lower Kenai River, Alaska, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 04-32, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds04-32.pdf

Ricker, W. E. 1954. Stock and recruitment. Journal of Fisheries and Research Board of Canada 11:559-623.

Shields, P. 2007. Upper Cook Inlet commercial fisheries annual management report, 2006. Alaska Department of Fish and Game, Fishery Management Report No. 07-36, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/Fmr07-36.pdf

Sweet, D., S. Ivey, and D. Rutz. 2004. Area management report for the recreational fisheries of Northern Cook Inlet, 2003. Alaska Department of Fish and Game, Fishery Management Report No. 04-05, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr04-05.pdf

Tobias, T. M., and M. Willette. 2007. Abundance, age, sex and size of Chinook, sockeye, coho and chum salmon returning to Upper Cook Inlet, Alaska, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-33, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-33.pdf

Westerman, D. L., and T. M. Willette. 2006. Upper Cook Inlet salmon escapement studies, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 06-49, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds06-49.pdf

Yanusz, R. J. *In prep*. Productivity of the Deshka River Chinook salmon stock, 1974 to 2003. Alaska Department of Fish and Game, Fishery Manuscript, Anchorage.

TABLES AND FIGURES

Table 1.–List of members on the Alaska Department of Fish and Game (ADF&G) Upper Cook Inlet salmon escapement goal committee. Also provided is a list of other participants who assisted with the escapement goal review.

Name	Affiliation
Escapement Goal Committee:	
Lowell Fair	ADF&G, Division of Commercial Fisheries
Tracy Lingnau	ADF&G, Division of Commercial Fisheries
Scott Raborn	ADF&G, Division of Commercial Fisheries
Mark Willette	ADF&G, Division of Commercial Fisheries
Robert Begich	ADF&G, Division of Sport Fish
Bob Clark	ADF&G, Division of Sport Fish
James Hasbrouck	ADF&G, Division of Sport Fish
Tim McKinley	ADF&G, Division of Sport Fish
Dave Rutz	ADF&G, Division of Sport Fish
Tom Vania	ADF&G, Division of Sport Fish
Rich Yanusz	ADF&G, Division of Sport Fish
Other Participants:	
Doug Eggers	ADF&G, Division of Commercial Fisheries
Jeff Regnart	ADF&G, Division of Commercial Fisheries
Jim Seeb	ADF&G, Division of Commercial Fisheries
Matt Miller	ADF&G, Division of Sport Fish
George Pappas	ADF&G, Division of Sport Fish

Table 2.–Current escapement goals, escapements observed from 2004 through 2007, and escapement goal recommendations in 2007 for Chinook, chum, coho, and sockeye salmon stocks of Upper Cook Inlet, Alaska.

System	Escapement Data [a]	Escapement Goal Type (BEG, SEG)	Escapement Goal Range	Escapements [b] 2004	2005	2006	Recommendation [c]
Chinook Salmon							
Alexander Creek	SAS	SEG	2,100–6,000	2,215	2,140	885	NC
Campbell Creek	SFS	SEG	50–700	964	1,097	1,052	Re-instated previous SEG
Chuitna River	SAS	SEG	1,200–2,900	2,938	1,307	1,911	NC
Chulitna River	SAS	SEG	1,800–5,100	2,162	2,838	2,862	NC
Clear (Chunilna) Creek	SAS	SEG	950–3,400	3,417	1,924	1,520	NC
Crooked Creek [d]	Weir	SEG	650–1,700	2,196	1,903	1,516	NC
Deshka River	Weir	BEG	13,000–28,000	57,934 [e]	37,725	31,150	NC
Eagle River-S. Fork	SFS	SEG	50–350	47	32 [f]	13 [f]	Drop goal
Goose Creek	SAS	SEG	250–650	417	468	306	NC
Kenai River - Early Run	Sonar	BEG	4,000–9,000	11,855	16,387	18,560 [g]	NC
Kenai River - Late Run	Sonar	BEG	17,500–35,700	40,198	26,046	24,843 [g]	NC
Lake Creek	SAS	SEG	2,500–7,100	7,598	6,345	5,300	NC
Lewis River	SAS	SEG	250–800	1,000	441	341	NC
Little Susitna River	SAS	SEG	900–1,800	1,694	2,095	1,855	NC
Little Willow Creek	SAS	SEG	450–1,800	2,227	1,784	816	NC
Montana Creek	SAS	SEG	1,100–3,100	2,117	2,600	1,850	NC
Peters Creek	SAS	SEG	1,000–2,600	3,757	1,508	1,114	NC
Prairie Creek	SAS	SEG	3,100–9,200	5,570	3,862	3,570	NC
Sheep Creek	SAS	SEG	600–1,200	285	760	580	NC
Talachulitna River	SAS	SEG	2,200–5,000	8,352	4,406	6,152	NC
Theodore River	SAS	SEG	500–1,700	491	478	958	NC
Willow Creek [d]	SAS	SEG	1,600–2,800	2,840	2,411	2,193	NC
Chum Salmon							
Clearwater Creek	PAS	SEG	3,800–8,400	3,900	530	500	NC

-continued-

Table 2.–Page 2 of 2.

System	Escapement Data [a]	Escapement Goal Type (BEG, SEG)	Escapement Goal Range	Escapements [b] 2004	2005	2006	Recommendation [c]
Coho Salmon							
Campbell Creek	SFS	SEG	100–500	713	1,130	542	Drop goal
Jim Creek [h]	SFS	SEG	450–700	4,652	1,464	2,389	NC
Little Susitna River	Weir	SEG	10,100–17,700	40,199	16,839	8,786 [i]	NC
Pink Salmon							
No stocks with an escapement goal							
Sockeye Salmon							
Crescent River	Sonar	BEG	30,000–70,000	103,000	125,000	92,000	NC
Fish Creek (Knik) [j]	Weir	SEG	20,000–70,000	20,465	12,051	26,712	NC
Kasilof River	Sonar	BEG	150,000–250,000	575,000	346,000	366,000	NC
Kenai River	Sonar	SEG	500,000–800,000	1,120,000	1,113,000	1,270,000 [k]	NC
Packers Creek	Weir	SEG	15,000–30,000	NS	25,516	NS	Re-instated previous SEG
Russian River - Early Run	Weir	SEG	14,000–37,000	56,582	52,903	80,524	NC
Russian River - Late Run	Weir	SEG	30,000–110,000	110,244	54,808	84,432	NC
Yentna River	Sonar	SEG	90,000–160,000	71,281	36,921	92,045	NC

[a] SAS = Single Aerial Survey, PAS = Peak Aerial Survey, SFS = Single Foot Survey.

[b] NS = No Survey. Fish required to meet broodstock needs, in addition to meeting escapement goal, include 250 Chinook salmon at Crooked Creek and Deception Creek; 500 Chinook salmon at Ship Creek; 150 coho salmon at Jim Creek; 1,000 coho salmon at Ship Creek; 10,000 sockeye salmon at the Kasilof River; and 5,000 sockeye salmon at Fish Creek.

[c] NC = No Change.

[d] Escapement of naturally produced fish only.

[e] Weir count. Historic harvest upstream of weir = 1,005 Chinook salmon during 2000–2003.

[f] Poor survey count due to timing, weather, or poor visibility.

[g] Actual estimates of escapement not available until fall 2008 pending results from the Statewide Harvest Survey.

[h] Foot survey of McRoberts Creek only, upon which the SEG is based.

[i] Incomplete weir count due to flooding.

[j] The goal represents total spawner abundance minus sockeye salmon taken for broodstock.

[k] Used preliminary estimate of sport harvest upstream of sonar.

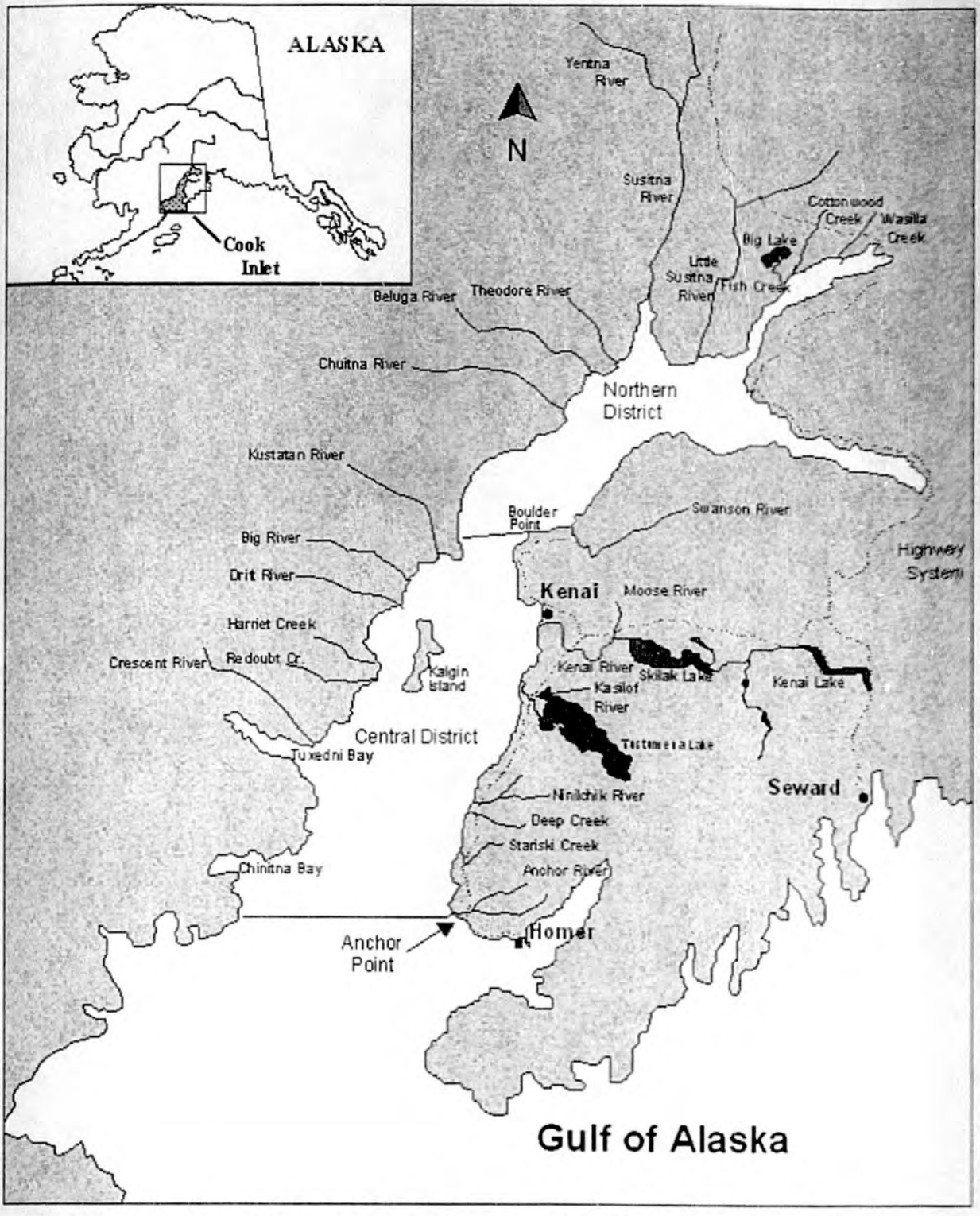

Figure 1.–Map of Upper Cook Inlet showing locations of the Northern and Central Districts and the primary salmon spawning drainages.

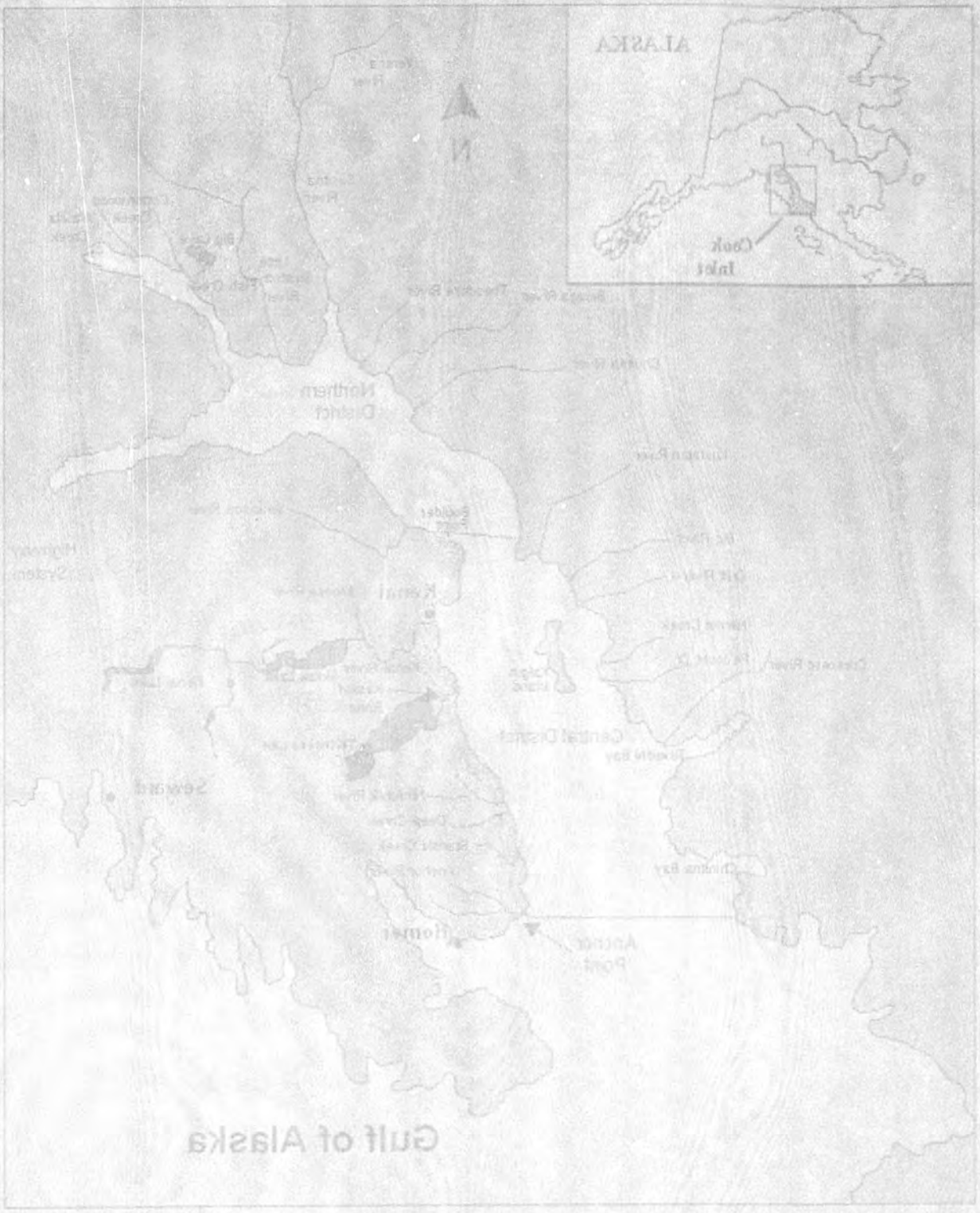

Figure 1.—Map of Upper Cook Inlet showing locations of the Northern and Central Districts and the primary salmon spawning drainage.

APPENDIX A.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR CHINOOK SALMON OF UPPER COOK INLET

Appendix A1.–Data available for analysis of escapement goals, Alexander Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1974	2,193	
1975	1,878	
1976	5,412	
1977	9,246	
1978	5,854	
1979	6,215	712
1980		1,438
1981		1,121
1982	2,546	2,506
1983	3,755	1,711
1984	4,620	2,107
1985	6,241	2,761
1986	5,225	2,937
1987	2,152	2,224
1988	6,273	4,687
1989	3,497	4,882
1990	2,596	5,119
1991	2,727	6,548
1992	3,710	4,124
1993	2,763	5,154
1994	1,514	3,070
1995	2,090	1,217
1996	2,319	1,005
1997	5,598	1,470
1998	2,807	1,275
1999	3,974	2,241
2000	2,331	2,721
2001	2,282	2,313
2002	1,936	1,992
2003	2,012	2,293
2004	2,215	1,294
2005	2,140	1,052
2006	885	1,396

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because the escapement time series precedes the survey (begun in 1977) or harvest could not be estimated from survey data.

Appendix A2.–Data available for analysis of escapement goals, Campbell Creek Chinook salmon.

Year	Escapement [a]
1961	70
1962	40
1963	187
1964	116
1965	119
1966	15
1967	300
1968	125
1969	
1970	63
1971	102
1972	37
1973	201
1974	79
1975	
1976	210
1977	349
1978	
1979	
1980	
1981	
1982	68
1983	
1984	423
1985	
1986	733
1987	571
1988	
1989	218
1990	458
1991	590
1992	931
1993	937
1994	1,076
1995	734
1996	369
1997	1,119
1998	761
1999	1,035
2000	591
2001	717
2002	744
2003	747
2004	964
2005	1,097
2006	1,052

[a] Escapement not surveyed or monitored during years with no escapement value.

Appendix A3.–Data available for analysis of escapement goals, Chuitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		227
1978		408
1979	1,246	78
1980		17
1981	1,362	115
1982	3,438	105
1983	4,043	1,185
1984	2,845	723
1985	1,600	734
1986	3,946	960
1987		146
1988	3,024	312
1989	990	581
1990	480	1,064
1991	537	377
1992	1,337	516
1993	2,085	893
1994	1,012	530
1995	1,162	201
1996	1,343	844
1997	2,232	728
1998	1,869	551
1999	3,721	561
2000	1,456	513
2001	1,501	457
2002	1,394	629
2003	2,339	592
2004	2,938	333
2005	1,307	294
2006	1,911	445

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A4.–Data available for analysis of escapement goals, Chulitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1982	863	
1983	4,058	
1984	4,191	
1985	783	
1986		
1987	5,252	
1988		
1989		
1990	2,681	
1991	4,410	
1992	2,527	
1993	2,070	
1994	1,806	
1995	3,460	
1996	4,172	43
1997	5,618	0
1998	2,586	41
1999	5,455	76
2000	4,218	10
2001	2,353	38
2002	9,002	0
2003		0
2004	2,162	0
2005	2,838	12
2006	2,862	0

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey for North Fork Chulitna River only (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A5.–Data available for analysis of escapement goals, Clear Creek Chinook salmon.

Year	Escapement [a]
1979	864
1980	
1981	
1982	982
1983	938
1984	1,520
1985	2,430
1986	
1987	
1988	4,850
1989	
1990	2,380
1991	1,974
1992	1,530
1993	886
1994	1,204
1995	1,928
1996	2,091
1997	5,100
1998	3,894
1999	2,216
2000	2,142
2001	2,096
2002	3,496
2003	
2004	3,417
2005	1,924
2006	1,520

[a] Escapement not surveyed or monitored during years with no escapement value.

Appendix A6.–Data available for analysis of escapement goals, Crooked Creek Chinook salmon.

Brood Year	Count at the Weir [a]			Actual Escapement [b]		Year	Sport Harvest [c]	
	Wild	Hatchery	Total	Total	Wild		Early Run (thru 6/30)	Total
1976	1,682 [d]		1,682	1,537	1,537			
1977	3,069 [d]		3,069	2,390	2,390			
1978	4,535	180	4,715	4,388	4,220	1978		251
1979	2,774	770	3,544	3,177	2,487	1979		283
1980	1,764	518	2,282	2,115	1,635	1980		310
1981	1,871	1,033	2,904	2,919	1,881	1981		1,242
1982	1,449	2,054	3,503	4,107	1,699	1982		2,316
1983	1,543	2,762	4,305	3,842	1,377	1983		2,853
1984	1,372	2,278	3,650	3,409	1,281	1984		3,964
1985	1,175	1,637	2,812	2,491	1,041	1985		2,986
1986	1,539	2,335	3,874	4,055	1,611	1986		7,071
1987	1,444	2,280	3,724	3,344	1,297	1987		4,461
1988	1,174	2,622	3,796	700	216	1988		4,953
1989	1,081	1,930	3,011	750	269	1989		3,767
1990	1,066	1,581	2,647	1,663	670	1990		2,852
1991			2,281	893		1991		5,055
1992			3,533	843		1992		6,049
1993			2,291	657		1993		8,695
1994			1,790	640		1994		7,217
1995			2,206	750		1995		6,681
1996			2,224	764		1996	5,295	6,128
1997						1997	5,627	6,728
1998						1998	4,201	4,839
1999	602	1,189	1,791	1,503	505	1999	7,597	8,255
2000	662	752	1,414	1,100	515	2000	8,815	9,901
2001	2,122	462	2,584	3,023	1,381	2001	7,488	8,866
2002	2,506	797	3,303	3,254	958	2002	4,791	5,242
2003	2,923	1,204	4,127	4,780	2,554	2003	3,078	4,222
2004	2,641	2,232	4,873	4,674	2,196	2004	3,295	4,333
2005	2,107	1,055	3,162	2,923	1,903	2005	3,468	4,520
2006	1,589	1,056	2,645	2,568	1,516	2006	2,421	3,304

[a] Excludes age 0.1 fish. No weir count in 1997 and 1998.

[b] Number of fish estimated to have actually spawned. Includes fish counted during foot surveys below the weir. During all years fish were removed at the weir for brood stock and from 1988–1996 fish were also sacrificed for disease concerns.

[c] From Statewide Harvest Survey (Jennings et al. 2007) (large fish >20" only) for the Kasilof River sport fishery. Includes both wild and hatchery fish and an unknown number of late-run fish prior to 1996.

[d] Assumed wild.

Appendix A7.–Data available for analysis of escapement goals, Deshka River Chinook salmon.

Brood Year	Aerial Survey [a]	Spawning Escapement [b]	Weir Escapement	Total Return [a]	Yield	Return/ Spawner	Year	Sport Harvest [c]
1974	5,279	15,915		61,420	45,505	3.86	1974	
1975	4,737	14,840		33,603	18,764	2.26	1975	
1976	21,693	48,481		38,000	-10,480	0.78	1976	
1977	39,642	84,091		38,513	-45,579	0.46	1977	
1978	24,639	54,325		44,748	-9,577	0.82	1978	
1979	27,385	59,773		52,325	-7,448	0.88	1979	2,811
1980		35,132 [d]		44,840	9,708	1.28	1980	3,685
1981		23,605 [d]		44,783	21,178	1.90	1981	2,769
1982	16,000	37,186		75,172	37,986	2.02	1982	4,307
1983	19,237	43,608		36,457	-7,151	0.84	1983	4,889
1984	16,892	38,955		35,455	-3,501	0.91	1984	5,699
1985	18,151	41,453		47,362	5,909	1.14	1985	6,407
1986	21,080	47,264		31,066	-16,198	0.66	1986	6,490
1987	15,028	35,257		22,244	-13,013	0.63	1987	5,632
1988	19,200	43,534		21,472	-22,062	0.49	1988	5,474
1989		23,686 [d]		16,208	-7,478	0.68	1989	8,062
1990	18,166	41,483		6,988	-34,494	0.17	1990	6,161
1991	8,112	21,536		15,921	-5,614	0.74	1991	9,306
1992	7,736	20,790		43,081	22,291	2.07	1992	7,256
1993	5,769	16,887		31,748	14,860	1.88	1993	5,682
1994	2,665	10,729		30,309	19,580	2.83	1994	624
1995	5,150		10,048	52,974	42,926	5.27	1995	0
1996	6,343		14,349	25,488	11,139	1.78	1996	11
1997	19,047		35,587	33,599	-1,988	0.94	1997	42
1998	15,556	36,305		42,087	42,087	1.16	1998	3,384
1999	12,904		29,088	66,785	37,697	2.30	1999	3,496
2000 [e]			33,965				2000	7,075
2001 [e]			27,966				2001	5,007
2002 [e]	8,749		28,535				2002	4,508
2003 [e]			39,257				2003	6,605
2004 [e]	28,778		56,659				2004	9,050
2005 [e]	11,495		36,433				2005	7,332
2006 [e]	6,499		29,922				2006	7,753

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] Data used for spawner-recruit analysis. Aerial surveys were expanded, based on the relationship of aerial surveys to weir counts observed for 1995–2004, to obtain estimates of spawning escapement (Yanusz *In prep*).

[c] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because the escapement time series precedes the survey (begun in 1977) or harvest could not be estimated from survey data.

[d] Based on average survey indices from nearby years for 1980 and an expectation-maximization (E-M) algorithm for 1981 and 1989 (Yanusz *In prep*), and regression expansion noted in footnote b.

[e] Complete return data not yet available.

Appendix A8.–Data available for analysis of escapement goals, Goose Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1981	262	
1982	140	
1983	477	
1984	258	
1985	401	
1986	630	145
1987	416	334
1988	1,076	218
1989	835	385
1990	552	504
1991	968	288
1992	369	1,033
1993	347	633
1994	375	361
1995	374	226
1996	305	437
1997	308	298
1998	415	348
1999	268	371
2000	348	258
2001		160
2002	565	403
2003	175	350
2004	417	335
2005	468	150
2006	306	27

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A9.–Data available for analysis of escapement goals, Kenai River early-run Chinook salmon.

Year	Escapement	Total Return	Yield [a]	Return/ Spawner
1986	18,682	9,863	-8,819	0.53
1987	11,780	17,438	5,659	1.48
1988	5,331	20,736	15,404	3.89
1989	9,449	20,326	10,876	2.15
1990	8,494	19,716	11,222	2.32
1991	8,834	17,162	8,328	1.94
1992	7,610	11,008	3,398	1.45
1993	10,293	13,926	3,633	1.35
1994	9,947	21,814	11,867	2.19
1995	11,310	16,782	5,472	1.48
1996	16,595	8,857	-7,738	0.53
1997	8,185	12,516	4,331	1.53
1998	7,760	11,783	4,023	1.52
1999	17,276	21,101	3,825	1.22
2000	10,476 [b]			
2001	14,982 [b]			
2002	6,185 [b]			
2003	10,097 [b]			
2004	11,855 [b]			
2005	16,387 [b]			
2006	18,560 [b]			

[a] Yield is total return minus escapement.

[b] Complete return data not yet available.

Appendix A10.–Data available for analysis of escapement goals, Kenai River late-run Chinook salmon.

Year		Escapement	Total Return	Yield [a]	Return/ Spawner
1986		47,375	47,475	99	1.00
1987		34,900	65,177	30,278	1.87
1988		32,137	71,743	39,605	2.23
1989		19,256	44,111	24,855	2.29
1990		26,508	49,078	22,570	1.85
1991		26,695	69,694	42,998	2.61
1992		22,524	48,784	26,260	2.17
1993		33,738	47,132	13,394	1.40
1994		35,065	53,482	18,417	1.53
1995		31,255	53,697	22,442	1.72
1996		30,907	39,270	8,363	1.27
1997		26,297	43,586	17,289	1.66
1998		26,768	67,840	41,072	2.53
1999		34,962	99,135	64,173	2.84
2000	[b]	29,627			
2001	[b]	17,947			
2002	[b]	30,464			
2003	[b]	23,736			
2004	[b]	40,198			
2005	[b]	26,046			
2006	[b]	24,843			

[a] Yield is total return minus escapement.

[b] Complete return data not yet available.

Appendix A11.–Data available for analysis of escapement goals, Lake Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	4,196	1,796
1980		775
1981		795
1982	3,577	1,645
1983	7,075	2,423
1984		2,881
1985	5,803	2,575
1986		2,134
1987	4,898	3,282
1988	6,633	2,784
1989		3,554
1990	2,075	3,423
1991	3,011	2,712
1992	2,322	3,668
1993	2,869	6,425
1994	1,898	3,548
1995	3,017	2,838
1996	3,514	2,587
1997	3,841	3,777
1998	5,056	2,511
1999	2,877	3,037
2000	4,035	4,611
2001	4,661	4,067
2002	4,852	2,878
2003	8,153	4,467
2004	7,598	3,657
2005	6,345	4,508
2006	5,300	4,070

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A12.–Data available for analysis of escapement goals, Lewis River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		9
1978		12
1979	546	
1980		
1981	560	
1982	606	
1983		
1984	947	
1985	861	100
1986	722	
1987	875	185
1988	616	246
1989	452	190
1990	207	285
1991	303	16
1992	445	
1993	531	27
1994	164	
1995	146	
1996	257	
1997	777	
1998	626	
1999	675	
2000	480	
2001	502	
2002	439	0
2003	878	0
2004	1,000	0
2005	441	0
2006	341	0

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A13.–Data available for analysis of escapement goals, Little Susitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		191
1978		93
1979		800
1980		646
1981		1,418
1982		1,467
1983	929	1,187
1984	558	1,883
1985	1,005	1,845
1986		1,457
1987	1,386	2,282
1988	3,197	2,822
1989	2,184	4,204
1990	922	1,965
1991	892	2,102
1992	1,441	3,920
1993		3,441
1994	1,221	4,204
1995	1,714	1,698
1996	1,079	1,484
1997		2,938
1998	1,091	2,031
1999		2,713
2000	1,094	2,803
2001	1,238	2,243
2002	1,660	3,144
2003	1,114	2,138
2004	1,694	2,362
2005	2,095	2,724
2006	1,855	3,303

[a] Escapement not surveyed or monitored during years with no escapement value. No aerial survey conducted in 1989; however, in 1988, 1989, 1994, and 1995 a weir was operated on the Little Susitna River. Based on the relationship of weir counts to aerial surveys in 1988, 1994, and 1995, 50% of the 1989 weir count of 4,367 Chinook salmon was used for an index of escapement.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A14.–Data available for analysis of escapement goals, Little Willow Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	327	0
1980		32
1981	459	0
1982	316	0
1983	1,042	0
1984		37
1985	1,305	25
1986	2,133	872
1987	1,320	711
1988	1,515	937
1989	1,325	507
1990	1,115	387
1991	498	684
1992	673	1,023
1993	705	1,200
1994	712	745
1995	1,210	436
1996	1,077	896
1997	2,390	699
1998	1,782	546
1999	1,837	1,344
2000	1,121	577
2001	2,084	941
2002	1,680	580
2003	879	510
2004	2,227	445
2005	1,784	621
2006	816	449

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A15.–Data available for analysis of escapement goals, Montana Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1981	814	661
1982		241
1983		504
1984		1,522
1985		979
1986		2,796
1987	1,320	1,726
1988	2,016	1,070
1989		1,708
1990	1,269	478
1991	1,215	575
1992	1,560	3,078
1993	1,281	4,054
1994	1,143	3,111
1995	2,110	1,004
1996	1,841	1,612
1997	3,073	2,181
1998	2,936	1,471
1999	2,088	3,279
2000	1,271	1,728
2001	1,930	2,646
2002	2,357	2,026
2003	2,576	1,242
2004	2,117	1,071
2005	2,600	1,328
2006	1,850	1,672

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A16.–Data available for analysis of escapement goals, Peters Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1983	2,272	
1984	324	112
1985	2,901	
1986	1,915	
1987	1,302	
1988	3,927	549
1989	959	339
1990	2,027	385
1991	2,458	495
1992	996	655
1993	1,668	283
1994	573	202
1995	1,041	252
1996	749	74
1997	2,637	34
1998	4,367	74
1999	3,298	197
2000	1,648	236
2001	4,226	88
2002	2,959	52
2003	3,998	122
2004	3,757	85
2005	1,508	0
2006	1,114	33

[a] In 1983 only a tributary was surveyed, not the mainstem of Peters Creek.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A17.–Data available for analysis of escapement goals, Prairie Creek Chinook salmon.

Year	Escapement
1981	1,875
1982	3,844
1983	3,200
1984	9,000
1985	6,500
1986	8,500
1987	9,138
1988	9,280
1989	9,463
1990	9,113
1991	6,770
1992	4,453
1993	3,023
1994	2,254
1995	3,884
1996	5,037
1997	7,710
1998	4,465
1999	5,871
2000	3,790
2001	5,191
2002	7,914
2003	4,095
2004	5,570
2005	3,862
2006	3,570

Appendix A18.–Data available for analysis of escapement goals, Sheep Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	778	10
1980		45
1981	1,013	0
1982	527	0
1983	975	0
1984	1,028	0
1985	1,634	0
1986	1,285	1,778
1987	895	1,610
1988	1,215	1,847
1989	610	1,116
1990	634	1,537
1991	154	1,519
1992		2,663
1993		2,300
1994	542	1,349
1995	1,049	746
1996	1,028	1,397
1997		550
1998	1,160	700
1999		2,558
2000	1,162	852
2001		1,420
2002	854	928
2003		1,284
2004	285	914
2005	760	878
2006	580	707

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A19.–Data available for analysis of escapement goals, Talachulitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	1,648	293
1980		121
1981	2,025	57
1982	3,101	0
1983	10,014	336
1984	6,138	424
1985	5,145	224
1986	3,686	201
1987		116
1988	4,112	909
1989		403
1990	2,694	709
1991	2,457	848
1992	3,648	445
1993	3,269	875
1994	1,575	927
1995	2,521	509
1996	2,748	697
1997	4,494	778
1998	2,759	563
1999	4,890	977
2000	2,414	694
2001	3,309	409
2002	7,824	508
2003	9,573	587
2004	8,352	344
2005	4,406	800
2006	6,152	452

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A20.–Data available for analysis of escapement goals, Theodore River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		237
1978		58
1979	512	20
1980		17
1981	535	77
1982	1,368	42
1983	1,519	0
1984	1,251	1,110
1985	1,458	1,195
1986	1,281	1,418
1987	1,548	1,146
1988	1,906	1,137
1989	1,026	1,317
1990	642	748
1991	508	369
1992	1,053	522
1993	1,110	527
1994	577	581
1995	694	360
1996	368	183
1997	1,607	0
1998	1,807	0
1999	2,221	0
2000	1,271	0
2001	1,237	21
2002	934	0
2003	1,059	13
2004	491	0
2005	478	0
2006	958	0

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A21.–Data available for analysis of escapement goals, Willow Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	848	459
1980		289
1981	991	585
1982	592	629
1983	777	534
1984	2,789	774
1985	1,856	1,063
1986	2,059	1,017
1987	2,768	1,987
1988	2,496	2,349
1989	5,060	2,846
1990	2,365	3,237
1991	2,006	3,208
1992	1,660	8,884
1993	2,227	8,626
1994	1,479	5,980
1995	3,792	2,742
1996	1,776	2,690
1997	4,841	3,135
1998	3,500	2,793
1999	2,081	4,988
2000	2,601	3,782
2001	3,132	4,573
2002	2,553	3,591
2003	3,855	3,922
2004	2,840	2,818
2005	2,411	2,466
2006	2,193	2,141

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007) which includes harvest for the entire drainage, including wild and hatchery produced fish of Deception Creek origin.

APPENDIX B.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR COHO SALMON OF UPPER COOK INLET

Appendix B1.–Data available for analysis of escapement goals, Jim Creek coho salmon.

Year	Escapement [a]	Sport Harvest [b]
1981		1,801
1982		2,306
1983		774
1984		3,429
1985	662	2,523
1986	439	2,948
1987	667	3,676
1988	1,911	11,078
1989	597	4,220
1990	599	6,184
1991	484	2,920
1992	11	3,409
1993	503	2,878
1994	506	3,946
1995	702	3,549
1996	72	3,911
1997	701	1,786
1998	922	4,197
1999	12	2,612
2000	657	5,653
2001	1,019	8,374
2002	2,473	14,707
2003	1,421	6,415
2004	4,652	11,766
2005	1,464	10,114
2006	2,389	19,256

[a] Escapement for McRoberts Creek only, a tributary to Jim Creek. Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007) for Knik River and tributaries including Jim Creek.

Appendix B2.–Data available for analysis of escapement goals, Little Susitna River coho salmon.

Year	Total Escapement [a]	% Hatchery Contribution to Escapement [b]	Escapement		Sport Harvest [c]
			Hatchery	Wild	
1977					3,415
1978					4,865
1979					3,382
1980					6,302
1981					5,940
1982					7,116
1983					2,835
1984					14,253
1985					7,764
1986	6,999			6,999	6,039
1987					13,003
1988	20,491	22	4,428	16,063	19,009
1989	15,232	45	6,862	8,370	14,129
1990	14,310	24	3,370	10,940	7,497
1991	37,601	22	8,322	29,279	16,450
1992	20,393	11	2,324	18,069	20,033
1993	33,378	29	9,615	23,763	27,610
1994	27,820	18	5,124	22,696	17,665
1995	11,817	9	1,069	10,748	14,451
1996	16,699	3	444	16,255	16,753
1997	9,894			9,894	7,756
1998	15,159			15,159	14,469
1999	3,017			3,017	8,864
2000	15,436			15,436	20,357
2001	30,587			30,587	17,071
2002	47,938			47,938	19,278
2003	10,877			10,877	13,672
2004	40,199			40,199	15,307
2005	16,839			16,839	10,203
2006	8,786			8,786	12,399

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] Based on sampling and coded wire tag data collected at the weir in 1988–1996. Hatchery stocking program ended in 1995, thus no hatchery produced fish in the coho salmon run since 1997.

[c] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix B2.–Data available for analysis of escapement goals, Little Susitna River coho salmon.

Year	Escapement[a]	Contribution to Escapement[b]	% Hatchery Hatchery	Escapement Wild	Sport Harvest[c]
1977					3,415
1978					4,865
1979					3,382
1980					6,302
1981					5,940
1982					7,116
1983					2,835
1984					14,253
1985					7,704
1986	6,999			6,999	6,039
1987					13,003
1988	20,491	22	4,428	16,063	19,009
1989	15,212	45	6,842	8,370	14,129
1990	14,310	24	3,370	10,940	7,497
1991	37,601	22	8,322	29,279	16,450
1992	20,397	11	2,334	18,069	20,013
1993	33,378	29	9,615	23,763	27,610
1994	27,820	18	5,124	22,696	17,965
1995	11,817	9	1,069	10,748	14,451
1996	16,699	3	444	16,255	16,253
1997	9,804			9,804	7,756
1998	15,159			15,159	14,469
1999	3,017			3,017	8,864
2000	15,436			15,436	20,357
2001	30,587			30,587	17,071
2002	47,038			47,038	19,278
2003	10,877			10,877	13,672
2004	40,199			40,199	15,307
2005	16,839			16,839	10,203
2006	8,786			8,786	12,399

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] Based on sampling and coded wire tag data collected at the weir in 1988–1996. Hatchery stocking program ended in 1995; thus no hatchery produced fish in the coho salmon run since 1997.

[c] From Statewide Harvest Survey (Jennings et al. 2007).

APPENDIX C.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR SOCKEYE SALMON OF UPPER COOK INLET

Appendix C1.–Data available for analysis of escapement goals, Crescent River sockeye salmon.

Year	Escapement [a]	Total Return	Yield [a]	Return/ Spawner
1975	41,000	216,000	175,000	5.27
1976	51,000	52,000	1,000	1.02
1977	87,000	99,000	12,000	1.14
1978	74,000	245,000	171,000	3.31
1979	86,654	245,000	158,346	2.83
1980	90,863	275,000	184,137	3.03
1981	41,213	163,000	121,787	3.96
1982	58,957	168,000	109,043	2.85
1983	92,122	182,000	89,878	1.98
1984	118,345	114,000	-4,345	0.96
1985	128,628	54,000	-74,628	0.42
1986 [b]	95,000	90,000	-5,000	0.95
1987	120,219	64,000	-56,219	0.53
1988	57,716	51,000	-6,716	0.88
1989	71,064	80,000	8,936	1.13
1990	52,238	42,000	-10,238	0.80
1991	44,578	55,000	10,422	1.23
1992	58,229	85,000	26,771	1.46
1993	37,556	91,000	53,444	2.42
1994	30,355	88,000	57,645	2.90
1995	52,311	138,000	85,689	2.64
1996	28,729	76,000	47,271	2.65
1997	70,768	100,000	29,232	1.41
1998	62,257	180,000	117,743	2.89
1999	66,519	159,000	92,481	2.39
2000	56,599	178,000	121,401	3.14
2001 [c]	78,081			
2002 [c]	62,833			
2003 [c]	122,457			
2004 [c]	103,201			
2005 [c]	125,623			
2006 [c]	92,533			

[a] Escapement was estimated by sonar beginning in 1975.

[b] In 1986, the sonar operation was terminated earlier than usual on July 16. A total of 20,385 sockeye salmon had been counted through that date. To account for the missing period, total sockeye salmon escapement in 1986 was estimated using the exploitation rate through July 13 and total Western Subdistrict catch.

[c] Complete return data not yet available.

Appendix C2.–Data available for analysis of escapement goals, Fish Creek sockeye salmon.

Year	Escapement [a]	Year	Escapement [a]
1938	182,463	1973	2,705 [e]
1939	116,588	1974	16,225 [f]
1940	306,982	1975	29,882
1941	55,077	1976	14,032
1942		1977	5,183
1943		1978	3,555
1944		1979	68,739 [g]
1945		1980	62,828 [g]
1946	57,000 [b]	1981	50,479 [g]
1947	150,000 [b]	1982	28,164 [g]
1948	150,000 [b]	1983	118,797 [g]
1949	68,240	1984	192,352 [g]
1950	29,659	1985	68,577 [g]
1951	34,704	1986	29,800 [g]
1952	92,724	1987	91,215 [g]
1953	54,343	1988	71,603 [g]
1954	20,904	1989	67,224 [g]
1955	32,724	1990	50,000 [g]
1956	32,663 [c]	1991	50,500 [g]
1957	15,630	1992	71,385 [g]
1958	17,573	1993	117,619 [g]
1959	77,416 [c,d]	1994	95,107 [g]
1960	80,000 [c,d]	1995	115,000 [g]
1961	40,000 [c,d]	1996	63,160 [g]
1962	60,000 [c,d]	1997	54,656 [g]
1963	119,024 [c,d]	1998	22,853 [g]
1964	65,000 [c,d]	1999	26,746 [g]
1965	16,544 [c,d]	2000	19,533 [g]
1966	41,312 [c,d]	2001	43,469 [g]
1967	22,624 [c,d]	2002	90,483 [g]
1968	19,616 [c,d]	2003	92,298 [g]
1969	12,456	2004	22,157 [g]
1970	25,000	2005	14,215 [g]
1971	31,900	2006	32,562 [g]
1972	6,981		

[a] Data for 1979–2000 were excluded from analyses because hatchery stocks were present.

[b] Escapement enumerated by ground surveys.

[c] Escapement enumerated using a counting screen.

[d] Includes 3,500 sockeye salmon behind weir when it washed out on 8/8/70.

[e] Includes 500 sockeye salmon behind weir when it was removed on 8/7/71.

[f] Counting occurred downstream of Knik Road prior to 1983, at South Big Lake Road. From 1983–1991, and at Lewis Road from 1992–present.

[g] Partial counts due to termination of counting before the end of the run.

Appendix C3.–Data available for analysis of escapement goals, Kasilof River sockeye salmon.

Year	Escapement [a]	Total Return	Yield [a]	Return/ Spawner	Hatchery Release (millions) [b]
1975	44,000	365,000	321,000	8.30	1.14
1976	133,000	757,000	624,000	5.69	0.00
1977	153,000	696,000	543,000	4.55	0.40
1978	109,000	811,000	702,000	7.44	7.76
1979	149,000	869,000	720,000	5.83	5.21
1980	178,000	1,207,000	1,029,000	6.78	8.78
1981	246,000	2,059,000	1,813,000	8.37	15.95
1982	168,000	1,457,000	1,289,000	8.67	16.94
1983	199,000	1,040,000	841,000	5.23	17.05
1984	219,000	830,000	611,000	3.79	16.39
1985	493,000	421,000	-72,000	0.85	13.56
1986	263,000	789,000	526,000	3.00	15.53
1987	235,000	1,076,000	841,000	4.58	6.27
1988	141,000	755,000	614,000	5.35	6.01
1989	149,000	581,000	432,000	3.90	6.01
1990	137,000	564,000	427,000	4.12	6.00
1991	228,000	1,062,000	834,000	4.66	6.06
1992	176,000	925,000	749,000	5.26	6.00
1993	140,000	585,000	445,000	4.18	0.00
1994	190,000	858,000	668,000	4.52	6.00
1995	191,000	580,000	389,000	3.04	6.14
1996	237,000	803,000	566,000	3.39	5.98
1997	256,000	746,000	490,000	2.91	4.56
1998	262,000	889,000	627,000	3.39	5.95
1999	301,000	1,321,000	1,020,000	4.39	5.43
2000	245,000	1,495,000	1,250,000	6.10	0.00
2001 [c]	297,000				6.07
2002 [c]	216,000				6.02
2003 [c]	347,000				6.01
2004 [c]	575,000				6.00
2005 [c]	346,000				0.00
2006 [c]	366,000				0.00

[a] The hatchery component of the escapement was removed.

[b] Hatchery release arranged by brood year.

[c] Complete return data not yet available.

Appendix C4.–Data available for analysis of escapement goals, Kenai River sockeye salmon (excludes late-run Russian River escapement through the weir and Hidden Lake enhanced).

Year	Escapement	Total Return	Yield	Return/ Spawner
1968	82,180	916,445	834,265	11.15
1969	51,850	409,481	357,631	7.90
1970	72,400	519,828	447,428	7.18
1971	289,270	862,669	573,399	2.98
1972	301,950	2,185,543	1,883,593	7.24
1973	358,070	1,995,399	1,637,329	5.57
1974	144,470	665,130	520,660	4.60
1975	128,500	895,207	766,707	6.97
1976	353,161	1,186,922	833,761	3.36
1977	663,627	2,810,690	2,147,063	4.24
1978	349,828	3,450,735	3,100,907	9.86
1979	245,850	1,110,592	864,742	4.52
1980	397,557	2,345,553	1,947,996	5.90
1981	359,344	2,267,624	1,908,280	6.31
1982	56[illegible]034	8,929,594	8,363,560	15.78
1983	566,652	8,697,304	8,130,652	15.35
1984	309,514	3,251,505	2,941,991	10.51
1985	396,032	2,245,906	1,849,874	5.67
1986	400,302	1,740,938	1,340,636	4.35
1987	1,333,136	9,530,501	8,197,365	7.15
1988	838,851	2,119,694	1,280,843	2.53
1989	1,333,687	3,898,327	2,564,640	2.92
1990	439,052	1,333,864	894,812	3.04
1991	376,149	3,926,048	3,549,899	10.44
1992	752,239	3,468,728	2,716,489	4.61
1993	669,758	1,287,000	617,242	1.92
1994	894,646	2,549,000	1,654,354	2.85
1995	520,778	1,490,000	969,222	2.86
1996	578,927	1,887,000	1,308,073	3.26
1997	872,041	3,136,000	2,263,959	3.60
1998	551,891	3,654,000	3,102,109	6.62
1999	582,907	5,159,000	4,576,093	8.85
2000	393,154	6,291,000	5,897,846	16.00
2001 [a]	457,760			
2002 [a]	700,549			
2003 [a]	938,398			
2004 [a]	1,120,000			
2005 [a]	1,113,000			
2006 [a]	1,270,000			

[a] Complete return data not yet available.

Appendix C5.–Data available for analysis of escapement goals, Packers Lake sockeye salmon.

Year	Escapement [a]
1974	2,123
1975	4,522
1976	13,292
1977	16,934
1978	23,651
1979	37,755
1980	28,520
1981	12,934
1982	15,687
1983	18,403
1984	30,403
1985	36,864
1986	29,604
1987	35,401
1988	18,607
1989	22,304
1990	31,868
1991	41,275
1992	30,143
1993	40,869
1994	30,776
1995	29,473
1996	16,971
1997	31,439
1998	17,728
1999	25,648
2000	20,151
2001	
2002	
2003	
2004	
2005	22,000
2006	

[a] Only weir data from 1974–1989 were used in calculating the goal.

Appendix C6.–Table of data available for analysis of escapement goals, early-run Russian River sockeye salmon.

Brood Year	Escapement [a]	Total Return	Yield	Return/ Spawner	Year	Harvest [b]
1965	21,510	5,970	-15,540	0.28	1965	10,030
1966	16,660	7,822	-8,838	0.47	1966	14,950
1967	13,710	18,662	4,952	1.36	1967	7,240
1968	9,120	19,800	10,680	2.17	1968	6,920
1969	5,000	13,169	8,169	2.63	1969	5,870
1970	5,450	12,642	7,192	2.32	1970	5,750
1971	2,650	8,728	6,078	3.29	1971	2,810
1972	9,270	98,980	89,710	10.68	1972	5,040
1973	13,120	26,788	13,668	2.04	1973	6,740
1974	13,160	52,849	39,689	4.02	1974	6,440
1975	5,650	14,130	8,480	2.50	1975	1,400
1976	14,735	115,408	100,673	7.83	1976	3,380
1977	16,060	17,515	1,455	1.09	1977	20,400
1978	34,240	17,001	-17,239	0.50	1978	37,720
1979	19,750	94,836	75,086	4.80	1979	8,400
1980	28,620	42,401	13,781	1.48	1980	27,220
1981	21,140	76,040	54,900	3.60	1981	10,720
1982	56,110	278,179	222,069	4.96	1982	34,500
1983	21,270	23,549	2,279	1.11	1983	8,360
1984	28,900	42,857	13,957	1.48	1984	35,880
1985	30,610	43,776	13,166	1.43	1985	12,300
1986	36,340	90,637	54,297	2.49	1986	35,100
1987	61,510	109,215	47,705	1.78	1987	154,200
1988	50,410	87,848	37,438	1.74	1988	54,780
1989	15,340	57,055	41,715	3.72	1989	11,290
1990	26,720	94,893	68,173	3.55	1990	30,215
1991	32,389	126,044	93,655	3.89	1991	65,390
1992	37,117	64,978	27,861	1.75	1992	30,512
1993	39,857	41,584	1,727	1.04	1993	37,261
1994	44,872	114,649	69,777	2.56	1994	48,923
1995	28,603	26,462	-2,141	0.93	1995	23,572
1996	52,905	192,657	139,752	3.64	1996	39,075
1997	36,280	63,876	27,596	1.76	1997	36,788
1998	34,143	57,692	23,549	1.69	1998	42,711
1999	36,607	106,219	69,612	2.90	1999	34,283
2000	32,736	94,932	62,196	2.90	2000	40,732
2001 [c]	78,255	20,468			2001	35,400
2002 [c]	85,943				2002	52,139
2003 [c]	23,650				2003	22,986
2004 [c]	56,582				2004	32,727
2005 [c]	52,903				2005	37,139
2006 [c]	80,524				2006	51,167

[a] Escapements of brood years 1965–1968 from tower counts and of 1969–2000 from weir counts.

[b] Harvest during 1965–1996 from an onsite creel survey and during 1997–2000 from Statewide Harvest Survey (Jennings et al. 2007). Estimates are only of fish harvested near the Russian River itself.

[c] Complete return data not yet available.

Appendix C7.–Data available for analysis of escapement goals, late-run Russian River sockeye salmon.

Year	Harvest [a]	Escapement [b]		Local Return
		Above Weir	Below Weir	
1963	1,390	51,120	Unknown	52,510
1964	2,450	46,930	Unknown	49,380
1965	2,160	21,820	Unknown	23,980
1966	7,290	34,430	Unknown	41,720
1967	5,720	49,480	Unknown	55,200
1968	5,820	48,880	4,200	58,900
1969	1,150	28,870	1,100	31,120
1970	600	26,200	220	27,020
1971	10,730	54,420	10,000	75,150
1972	16,050	79,115	6,000	101,165
1973	8,930	25,070	6,680	40,680
1974	8,500	24,900	2,210	35,610
1975	8,390	31,960	690	41,040
1976	13,700	31,940	3,470	49,110
1977	27,440	21,360	17,090	65,890
1978	24,530	34,340	18,330	77,200
1979	26,840	87,850	3,920	118,610
1980	33,500	83,980	3,220	120,700
1981	23,720	44,520	4,160	72,400
1982	10,320	30,800	45,000	86,120
1983	16,000	33,730	44,000	93,730
1984	21,970	92,660	3,000	117,630
1985	58,410	136,970	8,650	204,030
1986	30,810	40,280	15,230	86,320
1987	40,580	53,930	76,530	171,040
1988	19,540	42,480	30,360	92,380
1989	55,210	138,380	28,480	222,070
1990	56,180	83,430	11,760	151,370
1991	31,450	78,180	22,270	131,900
1992	26,101	63,478	4,980	94,559
1993	26,772	99,259	12,258	138,289
1994	26,375	122,277	15,211	163,863
1995	11,805	61,982	12,479	86,266
1996	19,136	34,691	31,601	85,428
1997	12,910	65,905	11,337	90,152
1998	25,110	113,477	19,593	158,180
1999	32,335	139,863	19,514	191,712
2000	30,229	56,580	13,930	100,739
2001	18,550	74,964	17,044	110,558
2002	31,999	62,115	6,858	100,972
2003	28,085	157,469	27,474	213,028
2004	22,417	110,244	30,458	163,119
2005	18,503	54,808	29,048	102,359
2006	29,694	84,432	18,452	132,578

[a] Harvest during 1963–1996 from an onsite creel survey and during 1997–2000 from Statewide Harvest Survey (Jennings et al. 2007). Estimates are only of fish harvested near the Russian River itself.

[b] Escapements of brood years 1963–1968 from tower counts and of 1969–2000 from weir counts.

Appendix C8.–Data available for analysis of escapement goals, Yentna River sockeye salmon.

Year	Escapement
1981	139,401
1982	113,847
1983	104,414
1984	149,375
1985	107,124
1986	92,076
1987	66,054
1988	52,330
1989	96,269
1990	140,290
1991	109,632
1992	66,074
1993	141,694
1994	128,032
1995	121,220
1996	90,660
1997	157,822
1998	119,623
1999	99,029
2000	133,094
2001	83,532
2002	78,591
2003	180,813
2004	71,281
2005	36,921
2006	92,045

APPENDIX D.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR CHUM SALMON OF UPPER COOK INLET

Appendix D1.–Data available for analysis of escapement goals, Clearwater Creek chum salmon.

Year	Escapement [a]
1971	5,000
1972	
1973	8,450
1974	1,800
1975	4,400
1976	12,500
1977	12,700
1978	6,500
1979	1,350
1980	5,000
1981	6,150
1982	15,400
1983	10,900
1984	8,350
1985	3,500
1986	9,100
1987	6,350
1988	
1989	2,000
1990	5,500
1991	7,430
1992	8,000
1993	1,130
1994	3,500
1995	3,950
1996	5,665
1997	8,230
1998	2,710
1999	6,400
2000	31,800
2001	14,570
2002	8,864
2003	7,200
2004	3,900
2005	530
2006	500

[a] Escapement not surveyed or monitored during years with no escapement value.

Fishery Manuscript No. 07-07

Post-season Stock Composition Analysis of Upper Cook Inlet Sockeye Salmon Harvest, 2005-2007

REVISED 2/20/2008

This document includes the original report released December 2007 with corrections included in the addendum released 1/25/2008.

by

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December 2007

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)	
centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm
Weights and measures (English)	
cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd
Time and temperature	
day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s
Physics and chemistry	
all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General	
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)	
fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL
Mathematics, statistics	
all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	′
not significant	NS
null hypothesis	H_0
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	″
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY MANUSCRIPT NO. 07-07

POST-SEASON STOCK COMPOSITION ANALYSIS OF UPPER COOK INLET SOCKEYE SALMON HARVEST, 2005-2007

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December 2007

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This document should be cited as:
Habicht, C., W. D. Templin, T. M. Willette, L. F. Fair, S. W. Raborn, L. W. Seeb. 2007. Post-season stock composition analysis of Upper Cook Inlet sockeye salmon harvest, 2005-2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-07, Anchorage.

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ABSTRACT

Genetic data were collected from sockeye salmon *Oncorhynchus nerka* originating from all major systems in Upper Cook Inlet, Alaska, that produce sockeye salmon. All individuals in the baseline were assayed for genotypes at 45 SNP markers. These DNA-based markers revealed population structure similar to that observed in the previous analyses with allozymes. Simulations indicated that seven regional groups (Kenai River, Susitna River, Yentna River, West Cook Inlet, Kasilof River, Northeast Cook Inlet, and Knik Arm) could be identified in mixtures at high levels of precision and accuracy. Samples taken from within the rivers at fish wheels were analyzed to evaluate the precision and accuracy possible using the baseline of new markers and statistical methods. Sockeye salmon from these drainages are commercially harvested in mixed-stock aggregations in Upper Cook Inlet. Genetic Stock Identification using Bayesian methods with data from 40 to 42 loci were performed to estimate the proportion of source populations in the harvest from set and drift gillnet fisheries during selected periods in the Central District of Upper Cook Inlet from 2005 to 2007. Samples from fisheries were analyzed postseason. Samples from the offshore test fishery were also analyzed. Patterns of stock proportions through time in the fishery were similar to results from allozyme data, indicating that Kenai River fish are present in the harvest later in the season relative to Kasilof River fish. High inter-annual variation in stock composition through space and time was detected, but this high level of variation might have been due, in part, to the unusual nature of the fishery during the 3 years investigated.

Key words: Cook Inlet, sockeye salmon, *Oncorhynchus nerka*, genetic stock identification, GSI, commercial fishery, SNP.

INTRODUCTION

BACKGROUND

Since the early 1990s the Alaska Department of Fish and Game (ADF&G) has actively developed and refined genetic stock identification (GSI; see Box 1 for definition of terms) applications to provide improved stock composition information for management of commercial fisheries. These efforts have encompassed nearly the entire State of Alaska with projects focusing on chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and sockeye *O. nerka* salmon (e.g. Seeb et al. 2004; Templin et al. 2005; Habicht et al. 2007). ADF&G now conducts GSI projects throughout the state and maintains extensive tissue archives from spawning populations for all three species.

One of the earliest GSI projects was initiated by ADF&G in 1992 for Cook Inlet sockeye salmon following the *Exxon Valdez* oil spill (Seeb et al. 1997). Building on the earlier genetic studies of Grant et al. (1980) and Wilmot and Burger (1985), the project was designed to detect the contribution of Kenai River sockeye salmon to the commercial harvest. Over the course of the project ADF&G sampled approximately 8,300 sockeye salmon from 54 spawning populations between 1992 and 1997 and provided a detailed analysis of the population structure of sockeye salmon in Cook Inlet using allozyme (protein) analyses (Seeb et al. 2000). The data revealed a substantial amount of genetic diversity among populations of Cook Inlet with the diversity distributed both within and among major drainages. The data supported a model of population structure generally organized around the lakes in which juvenile sockeye salmon rear (nursery lakes).

These allozyme data, paired with the GSI statistical methods available at that time, were able to differentiate among populations spawning in the major sockeye salmon-producing regions: Yentna/Susitna, Kenai, and Kasilof rivers, and groups of minor river drainages including those in West Cook Inlet, Northeast Cook Inlet, and Knik Arm. Single-region mixtures of simulated fish (fish were simulated based on population-specific allele frequencies) subjected to GSI, allocated on average 91% to the correct region. However, when samples were taken from fish captured at fish wheels within the Kenai, Kasilof, Susitna, and Yentna rivers, allocations to the local reporting group averaged 85%. In addition, stock composition estimates from fish sampled in drift and set gillnet fisheries showed higher day to day variability than was expected by the

fishery managers. This combination of results did not provide the managers with the confidence necessary to use these data for management decisions regarding Cook Inlet sockeye salmon.

Concurrent with these fishery monitoring activities, ADF&G actively focused on research to improve the techniques of GSI, including: 1) development and evaluation of genetic markers for improved resolution of stock identification, 2) development of statistical techniques for more accurate and precise estimation of stock composition, and 3) development of the infrastructure to support high-throughput and low-error genotyping.

Here we report on an initiative begun in July of 2005 to apply improved GSI techniques to estimate the stock composition of sockeye salmon in Upper Cook Inlet (UCI) commercial harvests for selected periods from 2005 through 2007.

Box 1.–Definition of terms commonly used in genetic stock identification of Pacific salmon.

Allele	Alternative form of a given gene or DNA sequence.
Allozyme	Allelic form of a protein enzyme encoded at a given locus. Allozymes are usually distinguished by protein electrophoresis and histochemical staining techniques.
Locus (loci, plural)	A fixed position or region on a chromosome that may contain more than one genetic marker.
Genetic marker	A known DNA sequence that can be identified by a simple assay.
GSI	Genetic Stock Identification: Method using allele frequencies from populations and genotypes from mixture samples to estimates stock compositions of mixtures
Microsatellites	DNA sequences containing short (2–5 base pairs) tandem repeats of nucleotides (e.g. GTGTGTGT)
PCR	The polymerase chain reaction or PCR amplifies a single or few copies of a locus across several orders of magnitude, generating millions of copies of the DNA.
SNP	Single nucleotide polymorphism; DNA sequence variation occurring when a single nucleotide (A, T, C, or G) differs among individuals or within an individual between paired chromosomes.

Note: adapted from Seeb et al. (2007).

IMPROVEMENTS TO GSI TECHNIQUES

Development of Genetic Markers

DNA sequence polymorphisms among individuals provide the basis for GSI. The portion of a DNA sequence that is polymorphic among individuals of a species is called a "genetic marker" (see Box 1). Assays for genetic markers have been developed to allow the inference of the DNA sequence. For example, allozyme markers reflect changes in DNA that code for the formation of protein products. Forms of the marker (alleles) are detected as a result of differences in size or charge of a protein product. Over the last 15 years, allozyme markers have been replaced by markers that directly reflect differences in DNA sequence (Schlotterer 2004). The alleles at these markers reflect either the sequence of nucleic acids in the DNA or varying lengths of particular DNA fragments. These markers have an advantage over allozymes in that they typically do not require lethal sampling, can be chosen to reflect a variety of evolutionary rates and forces, and can be readily automated for high-throughput genotyping.

In the 1990s ADF&G recognized the limitations associated with the Cook Inlet allozyme data and began to evaluate other genetic markers based on DNA as part of the *Exxon Valdez* study (Seeb et al. 1997). A wide range of DNA marker types were evaluated for sockeye salmon. Allendorf

and Seeb et al. (2000) compared allozymes, microsatellites (see Box 1), randomly amplified polymorphic DNA markers (RAPDs), and mitochondrial DNA (mtDNA) for Cook Inlet sockeye salmon and found concordance in population structure identified by the different marker types.

At the same time, studies utilizing microsatellites were being conducted on Bristol Bay sockeye salmon by ADF&G (Olsen et al. 2004; Habicht et al. 2004; Habicht et al. 2007). Partially driven by the early results (Habicht et al. 2007) indicating that ADF&G's microsatellite markers might be insufficient to differentiate among some Bristol Bay sockeye salmon stocks, ADF&G began to evaluate single nucleotide polymorphisms (SNPs; Box 1), which are single-base differences at a nucleotide position in a DNA sequence. The human genome project and similar projects on other species have shown that SNPs are ubiquitous throughout the genome. Since SNPs occur throughout the genome in many species, they are likely subject to a wider range of evolutionary rates than microsatellites and are thus useful for addressing a broader range of questions (Brumfield et al. 2003; Morin et al. 2004). Because some SNPs are influenced by natural selection they are particularly valuable for GSI applications where other markers show no differences between geographically close populations. For example, Miller et al. (2001) found that apparent differences in selection for SNPs in the MHC locus resulted in strong genetic distinction between nearby populations of sockeye salmon, in contrast to observations at neutral loci. Similarly, Beacham et al. (2001) demonstrated that SNPs involved in the immune system of salmon could provide as good or better resolution for genetic stock analyses than microsatellites.

SNP applications in GSI studies of Pacific salmon have become increasingly common (Smith et al. 2005b; Smith et al. *In press*; Narum et al. *In review*). ADF&G developed assays for SNP markers for sockeye salmon (Smith et al. 2005a; Elfstrom et al. 2006), and these markers are now used by U.S. laboratories for projects on sockeye salmon by the Pacific Salmon Commission in the Northern Boundary region. This same method has been used by ADF&G in Bristol Bay with sockeye salmon both in-season to estimate relative stock contributions passing through the Port Moller test fishing area, and post-season to estimate the commercial-catch stock contributions in fisheries for brood-tables used to establish escapement goals. This same set of SNPs was used in this study.

Statistical Developments

The 1990s Cook Inlet study (Seeb et al. 2000) used conditional maximum likelihood methods as reviewed in Pella and Milner (1987) and implemented in the software program SPAM (Debevec et al. 2000) to estimate the composition of stocks in mixtures. This method assumes that the baseline populations were accurately and completely represented by the baseline samples.

Research by scientists at the National Marine Fisheries Service Auke Bay Laboratories focused on the uncertainties and error associated with sampling baseline (spawning) populations used in mixture analyses (Pella and Masuda 2001). Conditional maximum likelihood methods do not use the information in the stock-mixture sample to improve the estimates of the baseline allele frequencies. Pella and Masuda (2001) and Koljonen et al. (2005) implemented Bayesian methods that incorporate the information available in the mixture to augment the information in the baseline samples to better estimate the genetic composition of the various stocks in the mixture.

Along with improvements in stock composition estimation techniques, ADF&G investigated methods to detect specific populations in mixtures (Reynolds and Templin 2004a) and to compare mixture estimates (Reynolds and Templin 2004b) using Cook Inlet sockeye salmon.

Infrastructure Improvements

Genotyping technologies for SNPs have been developing at a rapid rate and are now faster than those for any other marker class (Ranade et al. 2001; Melton 2003). SNP genotypes can be assayed by a variety of methods, typically with exceedingly low error rates, and these assays are readily transferred and repeatable across instruments and laboratories. Recently, ADF&G installed highly automated technology to further reduce costs and increase throughput.

The movement to high-throughput analyses has also required ADF&G to develop a laboratory database and implement quality control measures to ensure data integrity and to measure genotyping error rates. Both of these components were used and are reviewed in this study.

MANAGEMENT OF UCI SOCKEYE

Management strategy

Sockeye salmon are commercially harvested in UCI using drift and set gillnets. Drift gillnet fisheries occur in the Central District only; whereas set gillnet fisheries occur in both the Central and Northern Districts on both eastern and western shores (Figure 1). During the season, regularly scheduled fishery openings occur for 12 hours on Mondays and Thursdays beginning at 7:00 AM. Additional fishing time may be allowed via emergency orders depending on the abundance and projected run size of sockeye salmon. The season generally begins in late June and runs through early August for a total of 14 regularly scheduled fishery openings.

In recent years the drift gillnet fleet has been restricted to a smaller portion of the district to reduce the exploitation of specific sockeye salmon stocks. These restrictions to the drift fleet can vary throughout the season and across years. During the most restrictive periods, only the Kasilof River terminal area remains open. Less restrictive periods may open areas south of the northern tip of Kalgin Island or the southern tip of Kalgin Island or the Kenai or Kasilof corridors. East Side Subdistrict (Central District) set gillnet fisheries in the Kasilof Section are also sometimes restricted to within ½ mile from the beach to reduce harvests of Kenai River stocks (Figure 1). Descriptions of the management plans governing these fisheries and details of these restrictions for specific years can be found in the UCI annual management reports (Shields 2007) and in reports to the Alaska Board of Fisheries.

ADF&G uses the catch (number of fish harvested) and escapement (number of fish allowed to spawn) estimates of sockeye salmon in UCI to manage the fisheries. Escapement is estimated with hydroacoustics (sonar) and weirs. Commercial fishery participants in each fishery are required to report their catch. This occurs at various processors or tenders for the drift gillnet fishery and at the buying stations, processors, or tenders for the set gillnet fishery. Although these reports provide overall enumeration of the commercial harvest, an estimate of stock composition (the proportion of fish in the harvest originating from each drainage or area; often the synonym 'stock mixture' is used) of the catch is still required to develop brood tables and estimate escapement goals for specific stocks within the area.

Since 1968, a weighted age-composition allocation method has been used to estimate the stock composition of commercial gillnet sockeye salmon harvests in UCI (Tobias and Tarbox 1999). This method is based on two primary assumptions (1) that age-specific exploitation rates are equal among stocks in the gillnet fisheries (Bernard 1983), and (2) that harvests in specific fisheries are composed of nearby stocks, e.g. harvests in the East Side set gillnet fishery are assumed to be composed of stocks from the Kenai and Kasilof rivers. The age-composition

catch allocation method utilizes four data sources: (1) commercial harvests, (2) escapements into major UCI river systems, (3) age composition of harvests, and (4) age composition of escapements. Beginning in 1979, side-looking sonars were used to enumerate sockeye salmon, and fish wheels were used to collect scale samples on all major river systems in UCI (Westerman and Willette 2003). Prior to 1979, uplooking sonar arrays were used on the Kasilof River, and peak ground survey counts on 23 streams were used to index escapements in the Susitna drainage. The age-composition of sockeye salmon harvests has been estimated annually using a stratified systematic sampling design (Tobias and Willette 2004a). A minimum sample (n=403) of readable scales has been used to estimate the age composition of sockeye salmon in each stratum within 5% of the true proportion 90% of the time (Thompson 1987). These various data sources have been used to construct brood tables for the major UCI sockeye salmon stocks beginning with brood year 1968 (Tarbox et al. 1983), but the most consistent methods have been applied since brood year 1979 (Tobias and Willette 2004b).

Description of Fishery 2005 to 2007

From 2005 to 2007, the years depicted in this report, sockeye salmon runs were very different from each other. Salmon run migration patterns and strengths typically vary from year to year. However, in 2005, 2006, and 2007, sockeye salmon runs were substantially atypical. The oddity of these years is described below.

In 2005, the estimated UCI commercial harvest of 5.1 million sockeye salmon was 25% above the preseason forecast, and the total run of sockeye salmon to UCI was 44% more than the preseason forecast (Tobias and Willette *In prep*). Returns to all systems in UCI, with the exception of the Susitna River and Fish Creek, were stronger than expected in 2005. The Kenai River sockeye salmon run was approximately 66% greater than the preseason forecast. The Kasilof River sockeye salmon run was approximately 27% greater than the preseason forecast. The total run to the Susitna River, however, was 66% lower than the forecast. With roughly half of the Susitna River run bound for the Yentna River, the escapement to the Yentna River was significantly short of the escapement goal.

In 2006 preseason forecasts of sockeye salmon runs to the Kenai and Susitna rivers were below average, and inseason projections in early July also indicated a weak run (Shields 2007). As a result, the Central District drift gillnet fishery and the Kenai Section of the East Side Subdistrict set gillnet fishery were closed during late July, and the Northern District set gillnet fishery was closed after July 6. Based on the preseason forecast, ADF&G first managed for an inriver sonar goal range of 650,000 to 850,000 sockeye salmon in the Kenai River, but by August 7 the actual return to the Kenai River was projected to be between 2.2 and 2.5 million, so the inriver goal range was changed to 750,000 to 950,000 fish. The midpoint of the run in 2006 was more than 9 days late, by far the latest run timing observed in UCI. Nearly 530,000 fish passed the Kenai River sonar site after the commercial season ended on August 10, and a total of 860,000 sockeye salmon (or 57%) passed in August, the largest August component of sonar passage on record (Tobias and Willette *In prep*). The final inriver sonar estimate in the Kenai River was 1.5 million sockeye salmon, 550,000 fish over the upper end of the inriver goal range. With the Kasilof River exceeding escapement objectives early in the run, the Kasilof River Special Harvest Area was used aggressively in an attempt to harvest surplus sockeye salmon above escapement needs. In 2006 approximately one-third of the entire inlet harvest was taken within approximately 3 square miles in the Kasilof River terminus. The Kasilof River run was 77% over the forecast, and the Kenai River run was nearly 40% over the forecast. Because these two

runs were larger than other systems within the inlet, the inlet-wide run in 2006 was 38% larger than forecasted. Returns to systems other than the Kenai and Kasilof rivers were reasonably close to the forecasted returns.

The run timing in 2007 was fairly typical and for the first time in many years, the Kenai River run projection remained within the same tier throughout the season. This meant the inriver goal for the Kenai River remained the same (750,000 to 950,000). Although the run timing seemed normal, the migration of the fish once in the district was abnormal. For the first time since 1992 the drift fleet had back-to-back periods with a sockeye salmon catch-per-unit-effort (fish per boat per period; CPUE) greater than 1,000. Since 1974, only 6 years experienced drift periods with a CPUE over 1,000. The CPUE for the July 16 and July 19 periods were the 2nd and 5th highest in the fishery. Even more unusual, was that in both of these periods, the drift fleet was restricted to south of the southern tip of Kalgin Island, plus the Kenai and Kasilof Sections (corridor). The offshore test fishery had observed a large number of sockeye salmon entering the district for a few days prior to these openings. After these strong drift gillnet catches, it was anticipated that subsequent set gillnet catches would also increase as this large body of fish made its way to the Kenai and Kasilof rivers. But this did not happen; a "strong push" of sockeye salmon to the beaches was never experienced.

CURRENT STUDY

Although the weighted age-composition catch allocation method has provided the best information available, the associated assumptions may not always be valid, especially the assumption of equal exploitation among stocks. More scientifically defensible estimates of stock compositions are now available using GSI methods. The primary goal of the UCI sockeye salmon genetics project is to estimate the stock composition of the sockeye salmon harvests. Coupled with escapement estimation projects, the results will ultimately provide reliable sockeye salmon estimates of total run (catch + escapement) for brood table development and escapement goal analyses.

We report on an initiative begun in July 2005 to apply the improved GSI techniques to estimate the stock composition of harvests of UCI sockeye salmon. One of the objectives of the project was to sample fisheries across at least 3 years to provide a representation of the interannual natural variability. The current study drew heavily on collection efforts from the 1990s for tissue samples from spawning populations and inriver collections, as well as a large number of individuals collected from mixed stock fisheries and fish wheels during the period from 2005 through 2007. The application differentiates among seven major reporting groups with a high degree of accuracy and precision and elucidates patterns in the stock composition of the harvest for selected openings for the different fisheries over this 3-year period.

METHODS

TISSUE SAMPLING

Baseline

Baseline samples for SNP analysis were collected from spawning populations of sockeye salmon by ADF&G using gill nets and beach seines (Table 1; Figure 2). Most collections were made in the 1990s and reported in Seeb et al. (2000). Collections selected for inclusion in the current study represent all the populations previously identified in Seeb et al. (2000). These populations represent the known genetic diversity both geographic (location) and temporal (early- and late-

spawning). Additional collections were made in 2006 from underrepresented areas. Target sample size for baseline collections was 95 individuals across all years to achieve acceptable precision for the allele frequency estimates (Allendorf and Phelps 1981; Waples 1990a).

Mixtures

Fish Wheels

Genetic samples were collected from fish captured in fish wheels operating on the Yentna, Susitna, Kenai, and Kasilof rivers in the 1990s and again in 2005. These fish wheels are all located below the spawning sites in each river (Figure 2) and are thought to capture only fish destined to spawn within the rivers where the fish wheels operate.

Offshore Test Fishery

Genetic samples were collected from the offshore test fish harvests of sockeye salmon taken at six fixed stations from Anchor Point to Red River delta from July 1–August 1, 2006 and July 1-August 2, 2007 (Figure 3). Genetic samples were taken from fish harvested at each station. If less than 30 individuals were harvested at a station, all were sampled. If more than 30 sockeye salmon were harvested at a station, a maximum of 30 were randomly sampled. Samples from multiple stations and dates were combined to form mixtures of 400 individuals.

Commercial Drift and Set Gillnet Fisheries

Commercial fishery harvests were sampled using a stratified systematic sampling design. Area strata were determined *a priori* using established fishery districts and subdistricts (Figures 1 and 4–8). Temporal stratification was determined post season based on catch patterns in each fishery and the number of samples collected. In 2005, harvests were sampled in proportion to the historical average fishery harvest on each date. In 2006–2007, drift gillnet harvests were sampled in proportion to expected harvest, and set gillnet harvests were over sampled to allow for composite samples to be constructed in proportion to actual harvest post season. In 2005, sampling was conducted over 4 weeks, and in 2006–2007 sampling was conducted over 7 weeks (Table 2).

Target sample size within strata was set at 400 fish to estimate stock composition with 90% confidence of being within 5% of true stock proportions (Thompson 1987). Thompson's (1987) sample size estimator only considers uncertainty from sampling error and not uncertainty from genetic assignment error. Therefore, this expected level of precision is conservative because it assumes perfect GSI. Composite samples were constructed by combining samples from all time and area substrata to achieve this sample size goal. In 2006–2007, composite samples were constructed in proportion to actual harvests within substrata. Funding for GSI analysis of UCI sockeye salmon commercial harvests allowed for laboratory analyses of 8,000 samples per year which limited the number of stratum estimates each year. Generally, samples selected for analyses were from the earlier fishing periods (mostly from late June and July) within years.

Drift Gillnet Sampling

In 2005, most of the drift gillnet fishery sampling was conducted at Inlet Salmon's two docks located on the Kenai and Kasilof rivers. From 50 to 200 samples were taken during eight regular drift gillnet fishery openings from July 4 through July 28 (Table 2). During each sample period, 10 to 20 boats were sampled and 5 to 10 samples were collected from each boat. Overall, 63

different boats were sampled from one to four times each. We analyzed samples representing harvest from July 7 to 21 (Table 2).

In 2006–2007, drift gillnet fishery sampling was conducted at three processors (Ocean Beauty, Inlet Salmon, and Icicle Seafoods), which historically accounted for about 60% of the total drift gillnet fishery harvest. At each processor, sampling was conducted in proportion to the harvest expected to be delivered. At Ocean Beauty and Inlet Salmon, as many boats as possible were systematically sampled (i.e., every other boat or every other pair of boats) throughout the delivery period for each fishery opening. The proportion of the catch to sample from each boat was estimated based on the number of boats expected to deliver at each processor and their expected average catch estimated by the processor. The target sample proportion for all processors for each period was set based on a target sample goal of 130 fish from the processor expected to receive the least catch. For example, if the smallest processor was expected to receive 26,000 fish from all boats and we sampled from one half of the catch (i.e., 13,000 fish from sampling every other boat), then the sampling rate needed to be 1% to obtain 130 tissue samples. The same proportion of the catch was then sampled at all processors. During an unloading event, fish were removed from the boats, sorted, weighed and placed in plastic totes. Samples were randomly taken from the totes throughout the unloading of each boat. Because we were sampling in proportion to catch on each boat and sampling throughout the entire delivery period, any pattern in the delivery sequence of boats was correctly weighted. The sampling of the fish from Icicle Seafoods occurred on the day following the period. Icicle Seafoods had at least two tenders which collected sockeye salmon from commercial drift gillnet boats in Cook Inlet during and after the fishery. The tender unloaded in Homer the day after the fishery, and the fish were trucked to its Seward Plant. Crews met the drift gillnet tenders at the dock and sampled at least 130 fish from whichever tenders were available. Since the tenders carried a mix of fish from various boats, samples were taken from as many totes as possible. Temporal strata were identified post season, and composite random samples were constructed in proportion to the actual substratum (fishery/processor) harvests. We analyzed samples representing harvest from June 26 to July 27 in 2006 and from June 25 to July 19 in 2007 (Table 2). The July 24 to 27 openings in 2006 were restricted to the Kasilof Terminal Area (Table 2).

Set Gillnet Sampling

In 2005, set gillnet harvests were sampled in proportion to the historical average fishery harvests on each date. The East Side Subdistict (Central District) set gillnet harvests were sampled from July 4 to August 4. The West Side Subdistrict (Central District) was sampled once, and the Eastern (Northern District) and Kalgin Island (Central District) Subdistricts were sampled twice. Samples collected from General Subdistrict (Northern District) harvests were not sufficient to estimate stock composition because catches from this district were mixed with catches from other districts at the processors. We analyzed samples representing harvest from July 2 to 28 in the Kasilof Section and from July 11 to 26 in the Kenai Section (Table 2).

In 2006–2007, East Side Subdistict (Central District) set gillnet harvests were over sampled to allow for composite samples to be constructed in proportion to actual harvest post season because harvests delivered to buying stations were not known at the time of sampling. Two sections were established for sampling of East Side Subdistrict set gillnet harvests, one north of the Blanchard line (Kenai Section) and one south of the line (Kasilof Section; Figure 1). These two sections were further divided into two substrata each. Each substratum was composed of one or two subsections. Kenai Section was divided into the North/South Salamatof and the

North Kalifornsky (K.) Beach substrata while the Kasilof Section was divided into the South K. Beach and the Cohoe/Ninilchik substrata (Figure 1). We determined substratum sample sizes based on the highest proportion of catch observed in each substratum over the last 5 years. For example, if the harvest in the North/South Salamatof substratum was historically three times that in the North K. Beach substratum during a specific fishery period, then the sample sizes collected from the Salamatof and North K. Beach substrata would be 300 and 100, respectively. In some years, >90% of the harvest in the Kenai Section came from the North/South Salamatof substratum, so 400 samples were collected from this substratum to provide for postseason construction of composite samples in proportion to substratum harvests. Genetic samples were randomly collected at buying stations on the beaches and at processors. Fish were trucked to buying stations about an hour after being picked from the set gillnets at every high and low tide during a period. There were 4 to 6 buying stations near each beach (substratum), and each buying station received fish from different sites within the beach that were then mixed in totes. Crews attempted to sample from all the buying stations twice during a period, obtaining half their sample after the high tide and half after the low tide. Mixtures from the Kasilof and Kenai Sections set gillnet fisheries were pooled within years and then divided into substrata to produce new mixtures for which stock composition estimates were produced. For 2006, we analyzed samples representing harvest from June 26 to July 27 in the Kasilof Section and from July 10 to 17 in the Kenai Section (Table 2). The July 24 to 27 openings were restricted to the Kasilof Terminal Area (Table 2). For 2007, we analyzed samples representing harvest from June 25 to July 21 in the Kasilof Section and from July 9 to 28 in the Kenai Section (Table 2).

Harvests from the West Side and Kalgin Island subdistricts (Central District) were sampled at Pacific Star and Inlet Salmon processors where tenders that purchase fish from these areas were unloaded the morning after each fishery period. ADF&G randomly collected 130 samples from the harvest from each fishing period in 2006 and 100 per period in 2007. None of these samples have been analyzed in the laboratory at this time.

The Kasilof Terminal Area (Central District, East Side Subdistrict) was established at the mouth of the Kasilof River to target the harvest of Kasilof River sockeye salmon (Figure 4). Genetic samples were collected from the Kasilof Terminal Area harvest in 2006 and 2007. In 2006, the combined set and drift gillnet harvest was sampled from July 17 to July 23. From July 24 to July 27, set and drift gillnet harvests were sampled separately. Only the two later collections from 2006 have been analyzed in the laboratory at this time.

Tissue Handling

Tissue samples for genetic analysis were collected from sockeye salmon without regard to size, sex, or condition. An axillary process was excised from individual fish and placed in ethanol in either individually labeled 2 ml plastic vials or deep-well plates. For data continuity, tissue samples were paired with age, sex, and length information collected from each fish. These data were collated and archived by Commercial Fisheries Division staff at the ADF&G office in Soldotna.

Laboratory Analysis

Genomic DNA was extracted using a DNeasy® 96 Tissue Kit by QIAGEN® (Valencia, CA). Forty-five sockeye SNP markers were assayed, 3 mitochondrial and 42 nuclear DNA (Table 3).

For all samples except the samples collected in 2007, SNP genotyping was performed in 384-well reaction plates. Each reaction was conducted in a 5-μL volume consisting of 0.10-μL template DNA in 0.7x TaqMan Universal Buffer (Applied Biosystems), 900 nM of each polymerase chain reaction (PCR) primer, and 200 nM of each probe. Thermal cycling was performed on a Dual 384-Well GeneAmp PCR System 9700 as follows: an initial denaturation of 10 min at 95°C followed by 50 cycles of 92° for 15 s and annealing/extension temperature for 1.0 or 1.5 min. Cycling was conducted at a ramp speed of 1°C per s. The plates were read on an Applied Biosystems (AB) Prism 7900HT Sequence Detection System after amplification and scored using AB Sequence Detection software 2.2.

For the samples collected in 2007, SNP genotyping for *One_MHC2_251* and *One_STC-410* was accomplished as described above, while genotyping of the additional 43 markers was performed using the BioMark 48.48 Dynamic Array (Fluidigm http://www.fluidigm.com/biomark_genotyping.htm). The BioMark 48.48 Dynamic Array contains a matrix of integrated channels and valves housed in an input frame. On one side of the frame are 48 inlets to accept the sample DNA from 48 individual fish, and on the other are 48 inlets to accept the assays for up to 48 SNP markers. Once in the wells, the components are pressurized into the chip using the NanoFlex 4-IFC Controller. The 48 samples and 48 assays are then systematically combined into 2,304 parallel reactions. In this study, 43 assays were loaded. Each reaction was conducted in a 6.75 nL volume consisting of 1xTaqMan Universal Buffer (Applied Biosystems), 1.5 U AmpliTaq Gold DNA Polymerase (Applied Biosystems), 9 mM of each polymerase chain reaction (PCR) primer, 2 mM of each probe, 1xDA Assay Loading Buffer (Fluidigm), 12.5xROX (Invitrogen), and 0.01% Tween-20. Thermal cycling was performed on a BioMark IFC Cycler as follows: an initial denaturation of 10 min at 95°C followed by 50 cycles of 92° for 15 s and 60° for 1 min. The Dynamic Arrays were read on a BioMark Real-Time PCR System after amplification and scored using BioMark Genotyping Analysis software (Fluidigm).

Genotypes collected from both instruments were entered into the Gene Conservation Laboratory Oracle database, *LOKI*. Quality control measures included reanalysis of 8% of each collection for all markers to insure that genotypes were reproducible and to identify laboratory errors and measure rates of inconsistencies during repeated analyses. Assuming that the inconsistencies are due equally to errors in original genotyping and errors during the quality control, error rates in the original genotyping can be estimated as ½ the rate of inconsistencies.

STATISTICAL ANALYSIS

Baseline Development

Genotype distributions were tested for deviation from Hardy-Weinberg expectation (H-W), and all pairs of markers were tested for linkage disequilibrium within each collection using GENEPOP (version 3.3; updated version of Raymond and Rousset 1995). Critical values (α=0.01) were adjusted for multiple tests within collections and multiple tests across markers within collection (Rice 1989). If linkage disequilibrium was significant in more than half of the collections, we produced composite haplotypes for each fish by combining the genotypes from these markers and treated them as a single locus in further analyses. Composite haplotypes were used rather than eliminating one of the loci because, for some loci, linkage associations between alleles are not consistent across populations. Eliminating a locus would result in the loss of additional information found in the differences in association between alleles. For each fish, if

the genotype for either marker was missing, then the composite-haplotype locus was excluded from further analysis. All mtDNA markers were combined into a single locus.

Collections taken at the same or adjacent sites in different years were pooled following the recommendations of Waples (1990b). Collections made at nearby locations whose fish demonstrate phenotypic similarity were tested for homogeneity using pair-wise exact tests for genetic differentiation (Goudet 1995) calculated in GENEPOP with the following Markov chain parameters: 5000 as the dememorisation number, 1,000 batches, and 1,000 iterations per batch. Collections were pooled if the exact tests indicated homogeneity (collections grouped within sites or pooled collections taken at different sites are referred to as "populations.")

Nei (1978) genetic distances between all pairs of populations were computed, and 1,000 bootstrapped neighbor-joining (N-J) trees were produced by bootstrap resampling loci using PHYLIP version 3.63 (http://evolution.gs.washington.edu/phylip.html) to visualize relationships among populations and test node concordance.

Baseline Evaluation

Simulations

Populations were assigned into seven reporting groups based on geographic structure (e.g. watersheds) and management needs; four that represented the larger drainages (Kenai, Kasilof, Yentna, and Susitna rivers) and three that represented regions with many, smaller drainages (West Cook Inlet, Knik Arm, and Northeast Cook Inlet). Populations were maintained separately within these reporting groups as recommended by Wood et al. (1987). We then assessed the potential of these reporting groups for GSI applications with 100% simulations. To do these simulations, we generated 400 fish based on the population-specific allele frequencies from all the populations within each reporting group. An equal number of fish were generated from each population within each reporting group such that the total for each mixture equaled 400 fish. This process was repeated 1,000 times, and the mean and central 90% of the distribution of estimates were reported as the estimate and the 90% confidence interval. Simulated mixtures were analyzed using SPAM version 3.7b (Debevec et al. 2000; ADF&G 2001). A critical level of 90% correct allocation was used to determine if the reporting group was acceptably identifiable.

Proof Tests

Individuals from known origins, but not included in the baseline, were used as another test of baseline performance. These tests, termed "proof tests", were performed to further examine the baseline using both maximum likelihood and Bayesian analyses. Two hundred fish were randomly sampled without replacement and removed from the baseline from each reporting group. These 200 fish were used to create mixtures that were analyzed to evaluate accuracy and precision of the reporting groups. This analysis does not assume populations are in H-W equilibrium as does the simulation analysis. The proof tests are conservative because the baseline is reduced by the removal of individuals that contribute to the mixtures and, thus, the overall number of individuals in the baseline is reduced. Proof tests allow evaluation of the baseline using both the SPAM and BAYES (Pella and Masuda 2001) methods. For BAYES, the estimation was run using a single chain without thinning with a Markov Chain Monte Carlo sample size of 10,000. Three chains were run beginning with different starting conditions. Inference was based on the posterior distribution based on a combined set of the last 5,000 steps

of each chain. The mean of the posterior distribution is reported as the best estimate, and the central 90% of the distribution was reported as the 90% credibility interval. Both a SPAM prior distribution and a flat prior distribution were evaluated for accuracy and precision in the BAYES analyses. For the flat prior, the Dirichlet prior distribution parameters for stock proportions were equal (1/N). For the SPAM prior, the Dirichlet prior distribution parameters for each stock were proportional to the SPAM estimation results.

Fish Wheel Samples

Finally, we analyzed fish captured in the fish wheels operating in the Kenai, Kasilof, Yentna, and Susitna rivers as a further test of the performance of the baseline (Table 4). We used BAYES with a SPAM prior to estimate the composition of the fish wheel samples. Based on the geographic locations of the fish wheels within the rivers, we expected that all fish captured in the fish wheel were spawned within the particular drainage and that no fish from the fish wheels were strays or were "nosing in." This was the most challenging test of the method because fish may have originated from populations not represented in the baseline and the proportion of fish from each population was likely to be in proportion to the relative run strength of each population within the river drainage.

Mixed Stock Analysis

We estimated stock composition proportions from approximately weekly samples from the offshore test fishery and all mixtures outlined in Table 2. In addition, samples from the Kenai and Kasilof sections of the set gillnet fisheries were combined within years and then split out by subsection to estimate stock composition by subsection for each year. Stock compositions for all mixture samples were estimated using BAYES with the SPAM prior, the best performing GSI method identified in the proof test analyses. Once stock compositions and their 90% credibility intervals were estimated for each time/fishery stratum, the estimates were multiplied by the harvest represented by the analyzed sample to determine the best estimate and the 90% credibility interval around the estimate. Estimates and their 90% credibility intervals were tabulated and estimates were graphically represented using stacked bar graphs for ease of interpretation.

Differences in the Baseline Among Analyses

The statistical analyses on different mixtures were performed at different times during the assembly of the baseline and, as a result, the analyses deviated in the number of collections represented by the baseline and in the number of markers screened. A reduced set of baseline collections was used in the proof tests and the fish wheel analyses, whereas all other analyses used the full baseline (Table 1). This reduced set of baseline collections resulted in a two-population reduction in the baseline, both from the Susitna reporting group. In addition, the reduced set of baseline collections reduced the sample sizes for four populations; three in the Yentna reporting group and one in the Susitna reporting group. The smallest set of loci (35 loci), was also used for the fish wheel analyses, followed by the proof tests and the 2005 and 2006 fishery mixtures (40 loci), while the 2007 fishery mixtures contained the full set of loci (42 loci; Table 3).

RESULTS

BASELINE DEVELOPMENT

Within Population Diversity

Spawning populations of sockeye salmon were collected from throughout Cook Inlet (Table 1; Figure 2). The majority of collections were made during the 1990s. Collection efforts resumed in 2006, and eight collections were made in that year. Most locations were sampled in a single year; only four were collected in multiple years. A total of 5,841 fish collected over spawning areas were analyzed for the baseline. These fish represented 68 collections taken at 62 locations throughout Cook Inlet drainages.

During quality control procedures a total of 500 fish were reanalyzed for all markers for a total of 22,500 comparisons. An inconsistency rate of 0.044% was found in the baseline data. Conformance to Hardy-Weinberg (H-W) equilibrium was tested for all collections. Over all markers and locations, 2,898 H-W tests were performed of which 23 were significant ($p < 0.01$) without the multiple test adjustment. These were spread over 17 markers with no markers out of H-W equilibrium in more than three collections. No collection was out of H-W equilibrium at more than two markers. After adjusting for multiple tests, only one collection (Six Mile Creek) was significant for only one marker (*One_MHC2_190*).

Linkage disequilibrium within each collection yielded significant results within some collections at four marker pairs (# collections before adjustment for multiple tests/# of collections after adjustment for multiple tests): *One_GPDH-201* and *One_GPDH2-187* (17/11); *One_IL8r_362* and *One_KPNA_422* (4/2); *One_MHC2_190* and *One_MHC2_251* (46/45); and *One_TF_ex11-750* and *One_TF_in3-182*(13/5). Of these, only *One_MHC2_190* and *One_MHC2_251* were significantly out of linkage equilibrium in more than half of the collections after adjustment for multiple tests (45 out of 68 collections tested). These two markers were pooled and treated as a composite-haplotype locus.

Patterns of Population Structure

A total of 59 populations were identified after pooling collections taken from similar locations over multiple years and after pooling collections made at nearby sites that exhibited both similar phenotypes and genetic homogeneity (pooled collections and collections taken at different sites are referred to as "populations"; Table 1). In two areas (between Skilak and Kenai lakes and Tustumena Lake), all collections were not pooled despite the high levels of genetic similarity observed in the N-J tree (Figure 9). The decision to keep these separate was based on field observations of discontinuous spawning between Skilak and Kenai lakes and phenotypic differentiation among spawners in Tustumena Lake (Woody et al. 2000). Between Skilak and Kenai lakes, collections from sites 1 and 2 were pooled and sites 4 and 5 were pooled, but not all sites were pooled. In collections from Tustumena Lake (Glacier Flats, Moose, Bear, Nikolai, and Seepage creeks, and sites A and B from shoals), only the sites A and B from shoals were pooled. A more complete analysis of the patterns of population structure revealed by SNPs is underway.

Genetic relationships among baseline populations are shown in the N-J tree (Figure 9). The patterns of genetic similarity between populations are consistent with those revealed by earlier studies and support a model of population structure based on the nursery lake (e.g. Seeb et al. 2000). Straying among spawning areas is usually higher within drainages than among drainages

(Wood et al. 1994) which can result in similarity among salmon spawning within a drainage and higher differentiation among salmon spawning in different drainages.

Kasilof River populations clustered as a single group with little variation among populations, including tributary and lake-shore spawners. Juveniles from these populations all rear in Tustumena Lake.

Kenai River populations rear in numerous lakes within the drainage, and the genetic structure mirrors this complexity. Populations spawning above the falls on the Russian River clustered together, a relationship previously described with allozymes. Populations spawning in the mainstem between Kenai and Skilak lakes (including the Russian River below the falls) use both lakes for their early life history and clustered together in 47% of the trees. Populations rearing in Trail Lake (Johnson, Railroad, and Moose creeks) also form a separate group. Other populations spawning in the Kenai River appear to be more similar to populations within the drainage than to other populations outside the Kenai River. All the Northeastern Cook Inlet populations clustered together with good support.

The rest of the reporting groups contained some populations that clustered and others that did not, however there were no well-supported nodes that included populations from multiple reporting groups. Some of the Northeast populations clustered below well-supported nodes: the Eska, Bodenburg and Jim creek populations in one cluster and the Big Lake, Fish and Six Mile creeks in another cluster. Nancy Lake and Cottonwood Creek populations did not cluster with any other populations.

Several well-supported nodes clustered populations spawning within the Yentna and Susitna rivers. Most of these nodes clustered geographically proximate collections including Hewitt and Whiskey lakes in the Yentna River and Mama and Papa Bear lakes, Talkeetna sloughs, and Larson Creek in the Susitna River. The one exception to this relationship between geographic proximity and clustering is the well-supported cluster that includes Trinity/Movie lakes and the Hewitt/Whiskey lakes within the Yentna River which are geographically farther apart than some of the other populations.

The West Cook Inlet reporting group had only one well-supported cluster and this cluster contained the two Crescent Lake populations. The rest of the populations in this reporting group were below nodes with little support or were highly distinct (West Fork Coal Creek and Chilligan River).

BASELINE EVALUATION

Simulations

Sets of populations were combined into seven reporting groups based on geographic structure (e.g. watersheds) and management needs. Four reporting groups represented the primary drainages (Kenai, Kasilof, Yentna, and Susitna rivers), and three groups contained populations from regions with many smaller tributaries separated by saltwater (West Cook Inlet, Knik Arm and Northeast Cook Inlet). These reporting groups are similar to those used in the allozyme analyses in Seeb et al. (2000).

Evaluating the utility of the baseline for estimating stock composition began with a series of 100% simulations to ascertain the precision and accuracy of the reporting groups. These

simulations indicated that these reporting groups can be identified with an average of better than 97% accuracy (Table 5). For these simulations, even the lower bound of the confidence interval was above the 90% threshold.

Proof Tests

Analyses of fish of known origin taken out of the baseline and used as mixtures (proof tests) also demonstrated high correct allocations for every reporting group (Table 6; Figure 10). In these tests, mixtures created from 200 genotypes from a single region showed correct allocations of 90% (Susitna River) or better using SPAM. When the Bayesian methods were applied accuracy and precision improved to almost complete identifiability (99% or better correct allocation).

Fish Wheel Samples

A total of 1,330 individuals from seven collections sampled from fish captured in fish wheels were assayed for genotypes at the SNPs in the baseline. During quality control procedures a total of 112 fish were reanalyzed for all markers for a total of 5,040 comparisons. No inconsistencies were found in the mixture data. Stock composition estimates for these samples showed low (generally < 2%) contribution of populations outside the drainage where the fish wheels operated (Table 7; Figure 11). The Kenai River and Kasilof River fish wheel collections allocated above 98% to those rivers for both the samples collected in 1992–1994 and samples taken in 2005. The 1992 Yentna River fish wheel sample allocated above 99% to the Yentna River, while the 2005 sample allocated 94% to the Yentna River with most of remaining identified as coming from the Susitna River. The Susitna River fish wheel allocated 98% to Susitna River, with the remaining portion identified as coming from the Yentna River.

Mixed Stock Analysis

During quality control procedures a total of 1,378 fish were reanalyzed for all markers for a total of 62,010 comparisons. An inconsistency rate of 0.098% was found in the mixture data.

Offshore Test Fishery

A total of 3,474 fish captured in the offshore test fishery in 2006 and 2007 were successfully genotyped (Table 8; Figure 12). The sets of individuals sampled each year were divided into four periods in 2006 (1,385 individuals) and five periods in 2007 (2,089 individuals). In each of the 2 years, a consistent pattern was seen in the distribution of stocks over time; the proportion of Kasilof River sockeye salmon decreased, and the proportion of Kenai River sockeye salmon increased. The percentage of West Cook Inlet populations fluctuated between 5% and 11% with an exception of the early period in 2007 when it was 17% of the sample. The Yentna River was estimated to make up a larger portion (range: 6–15%) of the samples than the Susitna River (range: 0–7%). Northeast Cook Inlet populations were not detected in any of the test fishery samples.

Commercial Fishery Sampling

A total of 39,242 fish were sampled for tissue suitable for genetic analysis from commercial catches from throughout the Cook Inlet Central District in 2005, 2006 and 2007. These fish represented 230 individual collections. Of these fish, 12,306 fish from 102 of the collections were subsampled to create 35 mixtures for which the stock composition and stock-specific harvest were estimated (Table 9; Figures 13–22). These mixtures had sample sizes ranging between 266 and 444 fish.

Drift Gillnet

We observed a general pattern of increasing proportions of Kenai River and decreasing proportions of Kasilof River sockeye salmon in drift gillnet fishery harvests within season for each of the 3 years (Table 9). However, the estimated percentage of Kenai River sockeye salmon in drift gillnet harvests varied tremendously among years from 22–72% during the first period in July to 41–90% during the last period sampled (Table 9). For each of the 3 years of the study, estimated harvests of Kenai River sockeye salmon peaked during July 11–19. The estimated percentage of Yentna River sockeye salmon varied from 2–15%, with the peak occurring during the first period in July for all years. In 2005 and 2006 the percentage of West Cook Inlet sockeye salmon in the harvest fluctuated from 0–5%, but in 2007 this reporting group accounted for 23% of the harvest at the beginning of the season (June 25–28) before falling back to near 6% two periods later (July 9–12). During all periods, the combined contribution of the Susitna, Knik, and Northeast Cook Inlet reporting groups did not exceed 6%.

Set Gillnet

Tables 9, 11 and 12 and corresponding Figures 13–20 were based on sampling fish in proportion to catch within periods. As such, these estimates are the best estimates of stock-specific catches in the selected periods of the Central District drift, Kasilof Section set, and Kenai Section set gillnet fisheries. The analyses presented in Table 13 were designed to examine differences in the stock composition of catches in the substrata within the Kasilof and Kenai Sections and were not weighed by harvest. Because these estimates are not weighted by harvest, low-harvest periods are treated as equal with periods in which the harvest was much larger. Table 13 does provide insights on spatial patterns of stock-specific harvest within the Kenai and Kasilof Section set gillnet fishery.

Kasilof River fish dominated the harvest in the Kasilof Terminal Area (93–96%) with Kenai River sockeye salmon comprising the remainder (3–7%; Table 10; Figures 15 and 16).

Within the East Side set gillnet fishery, we did not observe a consistent pattern of decreasing abundance of Kasilof River and increasing abundance of Kenai River sockeye salmon (Tables 11 and 12; Figures 17–20). The percent of harvest for Yentna River sockeye salmon in the East Side set gillnet harvests were as follows: 1) Kenai Section on July 16–19, 2005 (3%) and July 21–28, 2007 (13%), and 2) Kasilof Section on June 25–July 5, 2007 (7%) and July 16–21, 2007 (4%). The 90% credibility intervals for these estimates did not include zero.

Further examination of stock compositions in four statistical substrata within the East Side set net fishery were performed on mixtures ranging in size from 189 to 1,335 fish. These mixtures revealed that Yentna River sockeye salmon were primarily harvested in the Cohoe/Ninilchik and North/South Salamatof substrata (Table 13; Figures 21 and 22).

DISCUSSION

This report reviews an initiative to expand and improve on earlier ADF&G studies to estimate the stock composition of sockeye salmon in Upper Cook Inlet. ADF&G focused on research to improve the techniques of GSI as applied to Cook Inlet sockeye salmon. These efforts addressed three areas: 1) development and evaluation of genetic markers for improved resolution, 2) development of statistical techniques for more accurate and precise estimation of stock composition, and 3) development of the infrastructure to support high-throughput and low-error genotyping.

Here we report on the development and evaluation of the baseline and the results from harvest sampling for the period from 2005 through 2007. ADF&G anticipates that this report will be the first of a series on GSI studies in Cook Inlet.

BASELINE DEVELOPMENT

The pattern of similarity between populations revealed by these SNPs is similar to the pattern revealed by other marker types (Seeb et al. 2000; Allendorf and Seeb 2000). The populations from the Kenai and Kasilof rivers form a large cluster with internal structure. All markers surveyed have shown little genetic heterogeneity among populations spawning in the Kasilof River drainage (Burger et al. 1997), although phenotypic diversity was observed by Woody et al. (2000). While Burger et al. (1995) detected a distinct late run of river spawners at the outlet of Tustumena Lake, no outlet spawners were included in either the allozyme or SNP baselines. Within the Kenai River drainage three main groups were found: 1) Skilak and Kenai lakes, 2) Hidden, Tern, and Trail lakes, and 3) Russian Lake.

Variation is also found among the populations within the remaining regions: Susitna and Yentna rivers, Knik Arm, Northeast Cook Inlet, and West Cook Inlet. Unlike the Kenai and Kasilof drainages, there are no large nursery lakes that support multiple tributary-spawning populations. These systems tend to have a number of isolated smaller lakes. The close affinity of the Yentna and Susitna slough spawners may indicate common ancestry and a high level of historical gene flow similar to the "river-type" sockeye salmon described by Gustafson and Winans (1999).

Temporal stability of allele frequencies, which allows the use of baseline samples collected over many years, is typical for selectively neutral genetic markers when population sizes are large (e.g. Beacham et al. 2006; Habicht et al. 2007). In this study, the majority of baseline collections were made in the early 1990's, or three sockeye salmon generations ago. Baseline populations sampled for this study represented the primary spawning areas from throughout the Cook Inlet drainage and represented large populations (>1,000 fish/population). General temporal stability of allele frequencies was indicated by the lack of differences among years within the few populations where samples were collected over multiple years. In addition, samples taken from fish wheels over 10 years apart allocated to rivers in which the fish wheels operated. The only allocations outside of the river in which the fish wheel operated were observed from the Yentna River to the Susitna River for the 2005 collection and vice-versa for the single Susitna collection. Four hypotheses may explain this outside-river allocation: 1) "nosing-in" of fish from the other drainage, 2) similarities between the slough spawners in the two rivers as seen in the N-J tree (Figure 9), 3) incomplete baseline coverage of slough-spawning sockeye salmon, and 4) temporal changes in allele frequencies within one or both of these rivers. These data do not resolve among these alternatives.

Currently, SNPs have been screened on 59 populations in this region with an average of 99 individuals per population. This represents an initial baseline and contains more populations but fewer fish per population than the allozyme baseline which had 54 populations with an average of 188 individuals analyzed per population. This new baseline has additional representation in the Kenai, Susitna and Yentna rivers, and Knik Arm. It is the intent of ADF&G to continue to expand the baseline to achieve greater coverage. In addition, although previously reported with allozyme markers that allele frequencies within these populations were temporally stable, we will continue to monitor for changes in SNP allele frequencies as the opportunities arise. In

particular, we will monitor for changes at loci such as *MHC* that are likely influenced by selection (Aguilar and Garza 2007).

IMPROVEMENT OF THE GSI MODEL

The new SNP data and statistical methods demonstrated a significant improvement in the performance of the GSI model from the 1990s, which was based on allozymes and maximum likelihood methods (SPAM). These DNA-based markers (SNPs) and the Bayesian estimation methods (BAYES) provided unprecedentedly high levels of accuracy and precision of the stock composition estimates (Tables 5 and 6). In the 1990s GSI was unable to clearly distinguish between contributions from the Yentna and Susitna rivers and even when these reporting groups were combined 100% simulations showed average correct allocations of 91%. The updated baseline and methods can now distinguish between the Yentna and Susitna rivers with average correct allocations above 99%.

Improvement due to marker type and statistical analysis can be measured using the fish wheel samples. In the 1990s, samples were collected from sockeye salmon captured in fish wheels as a test of the method (Seeb et al. 2000). Using the information available at that time, estimated stock compositions averaged 85% to the river in which the fish wheel operated. When some of these same samples from fish wheels were reanalyzed using the new SNP baseline and the old statistical method (SPAM), the allocations improved: 1) Kenai from 82% to 99%; 2) Yentna from 82% to 86%; 3) Susitna from 77% to 95%; and 4) Kasilof from 85% to 98% (this study; data not shown). When the Bayesian estimation method was used with the SNP data, estimates further improved to 98%, 100%, 98%, 100%, respectively (Table 7). Improvement in estimation using Bayesian statistical methods have also been observed in stock composition estimates of Atlantic salmon (Koljonen et al. 2005).

DIFFERENCES IN THE BASELINE AMONG ANALYSES

Over the course of the project there were small changes in the baseline used to complete analyses (Tables 1 and 3). The fish wheel analyses used the smallest set of loci (35 loci), followed by the proof tests and the 2005 and 2006 fishery mixtures (40 loci), while the 2007 fishery mixtures contained the full set of loci (42 loci; Table 3). In addition, the baseline contained seven fewer collections (only two fewer populations) for both the proof tests and the fish wheel analyses.

The differences in the baseline information used for the different analyses are unlikely to significantly affect the results because the differences were minor. This is supported by the results of the fish wheel analyses. If anything, the effect of using fewer SNPs and fewer populations would likely lead to conservative estimates in the performance of the fish wheels, because the fish wheels used the smallest baseline with the smallest number of loci. Even with the smaller dataset, the fish wheel analyses produced very high allocations to the river in which they operated.

DIFFERENCES IN SAMPLING DESIGNS AMONG YEARS

Four sampling design changes were implemented after the 2005 season to improve the accuracy and precision of estimates of stock composition of the commercial catch. First, in the drift gillnet fishery, we sampled at three of the major processors and sampled every other boat throughout the period when fish were delivered to each processor to provide a representative sample of the entire drift fishery harvest. Second, we sampled the drift fishery harvest in proportion to the catch on each boat and throughout the unloading of each boat. This design

should have correctly weighted any pattern in the delivery sequence among and within boats. Third, we attempted to sample all of the buying stations along the East Side beaches after the high and low tides to obtain samples throughout each statistical area and over time during each fishery opening. Fourth, we over-sampled the East Side set gillnet fishery and constructed random samples in proportion to harvest after the season when catches were known. This approach coupled with sampling throughout the fishery by time and area should have provided a more representative sample of the East Side set gillnet harvest. Finally, since we over-sampled the set gillnet fisheries, we have additional archived samples that can be analyzed to investigate the effect of sampling error on our stock composition estimates in specific cases.

Application of Data to Brood Table Refinement

The primary goal of this project was to accurately estimate the stock composition of commercial harvests in Upper Cook Inlet for each year. Knowledge of the composition of the mixed-stock catch is critical to determine the total run of each stock, especially when sockeye salmon stocks in Upper Cook Inlet can be exploited at rates up to 70%. The current age-composition method for estimating stock composition probably underestimates the productivity of some stocks and overestimates the productivity of other stocks. This directly affects fisheries management in a postseason fashion through the assessment and development of escapement goals. The primary management directive is to meet those escapement goals.

With the accuracy demonstrated for GSI, the stock composition estimates available from this project will allow an improved understanding of stock productivity as more years of data become available. To date, estimates from GSI provide the highest quality information ever available for stock compositions of the commercial harvest. But, genetic analyses of currently unanalyzed commercial fishery samples will be required before these stock composition estimates can be incorporated into brood tables. These laboratory analyses are scheduled for the near future. When GSI estimates of stock composition are available for the entire catch taken during the 3 years of this study, estimates will be compared to those obtained using the weighted age-composition catch allocation method.

Patterns in Fishery Stock Compositions

Interannual variability in run strength and timing among stocks and environmental conditions contributed to the variability in these stock composition estimates. For example, the estimated Kenai River sockeye salmon run was 5.5 million in 2005, 2.5 million in 2006, and 3.1 million in 2007 (Tobias and Willette *In prep*); whereas, the UCI sockeye salmon run past the offshore test fishery transect was 2 to 9 days late (Shields and Willette 2007 *In prep*) during each of the 3 years of this study (mean dates past the transect: July 21, 2005, July 24, 2006, July 17, 2007). These run strength and run timing differences produced some of the patterns observed in the stock compositions. For example, 2006 showed lower proportions of Kenai River fish in all fisheries compared with 2005 and 2007.

Within the offshore test fishery, the most prominent temporal pattern is the decreasing trend in the proportion of Kasilof River fish and an increasing trend in the proportion of Kenai River fish. This pattern might be expected based on the early run timing of the Kasilof River fish relative to Kenai River fish. This is the first analysis of the stock composition of fish captured in the offshore test fishery.

Stock composition estimates from the offshore test fishery compiled in this study can not be used to estimate total run by stocks because of how the samples were selected for tissue collection. First, genetic samples were not collected in proportion to abundance. In the test fishery, genetic samples were collected from all sockeye salmon harvested when the catch was <30 sockeye salmon, but when the catch was >30 sockeye salmon, only 30 samples were collected for genetic analysis. Since catches tended to be higher near the center of the inlet (Shields and Willette 2007), this sampling protocol resulted in stock composition estimates giving insufficient weight to harvests within the primary migratory pathway. Stock composition estimates will be weighted by CPUE in the test fishery in the future to correct for this bias. Secondly, collections were only made in July, and stock compositions before (June) and after (August) the test fishery are unknown. Projections of stock compositions into June and August may introduce significant bias into any estimates of total run by stock, because no stock composition estimates are available from these time periods and a significant percentage of the total UCI run comes during August in some years (2005–20%; 2006–35%; 2007–17%). Test fishery and genetic data could be used to estimate total run by stock in the future, but sampling would need to begin in mid June and end in mid to late August and may need to be collected at additional stations closer to shore.

Within the Central District drift gillnet fishery, many of the patterns observed in this study were also observed by Seeb et al. (2000). For example, the general pattern of increasing proportions of Kenai and decreasing proportions of Kasilof sockeye salmon in drift gillnet fishery harvests during the season is similar to that observed by Seeb et al. (2000). The estimated peak harvest dates of Kenai sockeye salmon were also in concordance to those observed by Seeb et al. (2000) who observed peak harvests of Kenai sockeye salmon between July 15–20, 1995–1996. Finally, both Seeb et al. (2000) and this study showed high variation in the estimated proportion of Kenai sockeye salmon in drift gillnet harvests among years.

Estimated peak harvests of Susitna/Yentna sockeye salmon in the drift gillnet fishery have generally occurred between July 10–16, but the estimated numbers of this stock taken were highly variable among years. In our study, the estimated peak harvests of Susitna/Yentna sockeye salmon in drift gillnet harvests occurred on July 11–14, 2005, July 3–6, 2006, and July 2–5, 2007 (Table 9; Figure 14). However, the drift gillnet fishery was restricted to the corridor after July 6, 2006, so the early peak date that year is not representative of harvests in the broader Central District fisheries (Figures 5–8). Seeb et al. (2000) estimated that peak proportions and harvests of Susitna/Yentna sockeye salmon in the drift gillnet fishery occurred on July 10, 1995, July 15, 1996, and July 14, 1997. However, Seeb et al. (2000) estimated that Susitna/Yentna sockeye salmon comprised an average of 16% (range 3–35%) of drift gillnet harvests. Whereas in our study, Susitna/Yentna sockeye salmon comprised an average of 7% (range 0–15%) of drift gillnet harvests. Higher estimated contributions for this stock in the 1990's may have been due to misclassification of Kenai River fish as Susitna/Yentna River fish as observed in the Kenai fish wheel samples using allozymes (Seeb et al. 2000), or higher relative abundance of this stock at that time (Tobias and Willette *In prep*). In the drift gillnet fisheries we sampled, the estimated total harvests of Susitna/Yentna sockeye salmon were 20,154 in 2005, 10,418, 2006, and 175,827 in 2007. Variation in the numbers of Susitna/Yentna River fish captured each year was likely due to several factors. A weak run in 2005 (Tobias and Willette *In prep*) and a severely restricted fishery in 2006 (Shields 2007) were consistent with the relatively low harvests of this stock in those years. The cause for the higher proportion of Susitna/Yentna stocks in 2007 is unclear, but may be related to the abnormal run entry patterns discussed in the "Distribution of Fishery – 2005 to 2007" section of the Introduction. In addition, in 2005 and 2006, analyzed

samples represented only 65% and 43% of the catch, respectively, while in 2007, the samples represented 79% of the catch (Table 2; Figure 14). Due to this restricted representation of the catches, the estimated Susitna/Yentna River fish catches represent minimum estimates of the total harvests. Further analyses of samples representing all drift gillnet fishery openings each year will be required to estimate the full harvest.

Within the Kasilof Terminal Area (Central District, East Side Subdistrict) drift and set gillnet fisheries the estimated stock composition of sockeye salmon harvested was dominated by Kasilof River fish. The high proportions of Kasilof River fish in this fishery were expected based on the proximity of the fishery to the mouth of the Kasilof River. Kenai sockeye salmon comprised a higher percentage of the drift (7%) than set (3%) gillnet harvests in this area (Table 10). A model based upon size and age data estimated a slightly lower percentage of Kenai sockeye salmon in the drift (3%) and set (1%) gillnet harvests in this area during this same time period.

Within the East Side Subdistrict (Central District) set gillnet fishery, we did not observe a consistent pattern of decreasing abundance of Kasilof River and increasing abundance of Kenai River sockeye salmon in July as described by Bethe et al. (1980) using scale pattern analysis (SPA). Such a pattern is somewhat evident in the Kenai Section in 2006 and in the Kasilof Section in 2005 and 2007, but it is not evident in the Kasilof Section in 2006 and the Kenai Section in 2005 and 2007. There are three potential explanations for this lack of a consistent pattern in the Kasilof Section in 2006: 1) the relatively strong Kasilof River (1.6 million) and weak Kenai River (2.5 million) sockeye salmon runs that year (Tobias and Willette *In prep*); 2) the inefficacy of the SPA for estimating stock compositions of UCI sockeye salmon due to the highly variable freshwater rearing environments occupied by sockeye salmon in this area (Waltemyer 1995; Waltemyer et al. 1996); and 3) changes in fishing patterns between the 1970s and 2006.

Yentna River sockeye salmon contributed to the East Side set gillnet harvests and most of these sockeye salmon were harvested in the substrata farthest from the Kenai and Kasilof river mouths (Table 13). Since these estimated harvests of Yentna River sockeye salmon in the East Side Subdistrict set gillnet fishery were highly variable over time, it is difficult to project when or under what conditions this stock may be harvested in this fishery in the future. These results are in concordance with previous allozyme-based GSI estimates that Susitna/Yentna sockeye salmon comprised 1–6% of East Side Section set gillnet harvests (Seeb et al. 2000). The SNP GSI results support the conclusions from the SPA that Susitna/Yentna sockeye salmon have contributed 0–28% of the East Side Subdistrict set gillnet harvests (Bethe et al. 1980; Cross et al. 1986).

Incorporating Patterns of Fishery Stock Compositions into Future Management

Stock composition by time and area may be affected by multiple variables that are under management control including the flood stage fished, geographic boundaries or restrictions within districts, and timing of fishing within the season. Understanding the relationship between stock compositions and these variables may provide information for managers to modify how the fisheries are prosecuted to achieve their goal of harvesting surplus production while meeting escapement goals for all stocks.

Both inter- and intra-annual variation in stock composition of fisheries will need to be examined before clear relationships between management actions and stock composition of the harvest are

realized. The interannual variation of stock compositions in the harvest over the 3 years analyzed in this project provide guidance on the range of inter-annual variability in stock compositions among the fishing strata as they are prosecuted. Specific experimental designs will be necessary to investigate each potential management action separately while controlling the other variables under management control. For example, to investigate how drift gillnet fishing restricted to the corridor affects stock composition of the harvest, the experimental design would require the analysis of fish caught in the corridor and in the full district during the same time periods within years and over multiple years. These specific experimental designs will likely require a combination of commercial and test fishing coupled with GSI. If commercial catches are used in this experimental design, steps will be required to ensure the catch is coming from consistent locations within strata because fishing is often prosecuted differently within strata over time depending on where fishers expect to gain the highest profit. Evaluation of multiple years will be required because of the inter-annual variability of stock-specific run strengths, run timings, and residence times of sockeye salmon in the district (Mundy et al. 1993). Here we have demonstrated that the new GSI methods have the potential to resolve these issues. To date, the funding for this project was targeted toward estimating the stock composition of the commercial harvest, as it was prosecuted, as a first step toward brood table refinement and evaluation of management strategies.

ACKNOWLEDGEMENTS

This study from concept to completion required the efforts of a large number of dedicated people. Most importantly, the authors would like to acknowledge the work of the people in the ADF&G Gene Conservation Laboratory including Carita Elfstrom, Heather Hoyt, Andy Barclay, Eric Lardizabal, Judy Berger, Beth McLain, and Gina Johnston. In addition, we would like to thank Anton Antonovich and Yingte Zhang for expert biostatistical analysis of the data.

Samples for this study were collected by a large number of dedicated staff who performed this task in addition to their many other duties. Specifically, we would like to thank Terri Tobias from the ADF&G Soldotna office for the wonderful work she has done with her group of enthusiastic samplers. Their tireless work enabled us to sample approximately 40,000 fish for this study.

In addition, we would like to acknowledge our intra-agency reviewers including Tracy Lingnau, Jack Erickson, John Hilsinger, Robert Clark, and Jeff Guyon. This report has also been thoroughly reviewed by outside independent reviewers, and we would specifically like to thank Robin Waples from the Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, and Kenneth Warheit from the Washington Department of Fish and Wildlife, Olympia, for their critical reviews and helpful suggestions. Finally, we would like to recognize John H. Clark, Jeff Regnart, and Jim Seeb for assistance with project implementation, oversight, and coordination.

Laboratory and statistical analyses were funded by the State of Alaska. The project relied heavily on the tissue samples and knowledge gained from Restoration Study 255 funded by *Exxon Valdez* Oil Spill Trustee Council and the SNP marker development work funded by North Pacific Research Board Grant #0303 and Northern Boundary Restoration and Enhancement Fund Project NF-2005-I-13.

Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 2001. SPAM Version 3.5: Statistics Program for Analyzing Mixtures. Alaska Department of Fish and Game, Commercial Fisheries Division, Gene Conservation Lab. Available for download from http://www.cf.adfg.state.ak.us/geninfo/research/genetics/software/spampage.php.

Aguilar, A., and J. C. Garza. 2007. Patterns of historical balancing selection on the salmonid Major Histocompatibility Complex class II b gene. Molecular Evolution. 65: 34-43.

Allendorf, F. W. and S. R. Phelps. 1981. Use of allelic frequencies to describe population structure. Canadian Journal of Fisheries and Aquatic Sciences 38: 1507-1514.

Allendorf, F. W. and L. W. Seeb. 2000. Concordance of genetic divergence among sockeye salmon populations at allozyme, nuclear DNA, and mitochondrial DNA markers. Evolution 54: 640-651.

Beacham, T. D., B. McIntosh, C. MacConnachie, K. M. Miller, and R. E. Withler. 2006. Pacific rim population structure of sockeye salmon as determined from microsatellite analysis. Transactions of the American Fisheries Society 135:174-187.

Beacham, T. D., J. R. Candy, K. J. Supernault, T. Ming, B. Deagle, A. Schulze, D. Tuck, K. H. Kaukinen, J. R. Irvine, K. M. Miller, and R. E. Withler. 2001. Evaluation and application of microsatellite and major histocompatibility complex variation for stock identification of coho salmon in British Columbia. Transactions of the American Fisheries Society 130: 1116-1149.

Bernard, D. R. 1983. Variance and bias of catch allocations that use the age composition of escapements. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 227, Anchorage.

Bethe, M. L., P. V. Krasnowski, and S. Marshall. 1980. Origins of sockeye salmon in the upper Cook Inlet fishery of 1978 based on scale pattern analysis. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet no. 186, Juneau.

Brumfield, R. T., P. Beerli, D. A. Nickerson, and S. V. Edwards. 2003. The utility of single nucleotide polymorphisms in inferences of population history. Trends in Ecology & Evolution 18: 249-256.

Burger, C. V., J. E. Finn, and L. Holland-Bartels. 1995. Pattern of shoreline spawning by sockeye salmon in a glacially turbid lake: evidence for subpopulation differentiation. Transactions of the American Fisheries Society 124: 1-15.

Burger, C. V., W. J. Spearman, and M. A. Cronin. 1997. Genetic differentiation of sockeye salmon subpopulations from a geologically young Alaskan lake system. Transactions of the American Fisheries Society 126: 926-938.

Cross, B. A., W. E. Goshert, and D. L. Hicks. 1986. Origins of sockeye salmon in the fisheries of upper Cook Inlet, 1983. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 181, Juneau.

Debevec, E. M., R. B. Gates, M. Masuda, J. Pella, J. Reynolds, and L. W. Seeb. 2000. SPAM (version 3.2): Statistics Program for Analyzing Mixtures. Journal of Heredity 91: 509–510.

Elfstrom, C. M., C. T. Smith, and J. E. Seeb. 2006. Thirty-two single nucleotide polymorphism markers for high-throughput genotyping of sockeye salmon. Molecular Ecology Notes 6: 1255-1259.

Goudet, J. 1995. FSTAT (Version 1.2): A computer program to calculate F-statistics. Journal of Heredity 86: 485-486.

Grant, W. S., G. B. Milner, P. Krasnowski, and F. M. Utter. 1980. Use of biochemical genetic variants for identification of sockeye salmon (*Oncorhynchus nerka*) stocks in Cook Inlet, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 37: 1236-1247.

Gustafson, R. G. and G. A. Winans. 1999. Distribution and population genetic structure of river- and sea-type sockeye salmon in western North America. Ecology of Freshwater Fish 8: 181-193.

Habicht, C., L. W. Seeb, and J. E. Seeb. 2007. Genetic and ecological divergence defines population structure of sockeye salmon populations returning to Bristol Bay, Alaska, and provides a tool for admixture analysis. Transactions of the American Fisheries Society 136: 82–94.

REFERENCES CITED (Continued)

Habicht, C., J. B. Olsen, L. Fair, and J. E. Seeb. 2004. Smaller effective population sizes evidenced by loss of microsatellite alleles in tributary-spawning populations of sockeye salmon from the Kvichak River, Alaska drainage. Environmental Biology of Fishes 69: 51-62.

Koljonen, M. L., J. J. Pella, and M. Masuda. 2005. Classical individual assignments versus mixture modeling to estimate stock proportions in Atlantic Salmon (*Salmo salar*) catches from DNA microsatellite data. Canadian Journal of Fisheries and Aquatic Sciences 62: 2143-2158.

Melton, L. 2003. On the trail of SNPs. Nature 422: 917-923.

Miller, K. M., K. H. Kaukinen, T. D. Beacham, and R. E. Withler. 2001. Geographic heterogeneity in natural selection on an MHC locus in sockeye salmon. Genetica 111: 237-257.

Morin, P. A., G. Luikart, and R. K. Wayne. 2004. SNPs in ecology, evolution and conservation. Trends in Ecology and Evolution 19: 208-216.

Mundy, P. R., K. K. English, W. J. Gazey, and K. E. Tarbox. 1993. Evaluation of the harvest management strategies applied to sockeye salmon populations of upper Cook Inlet, Alaska, using run reconstruction analysis. Pages. 107-139 in G. Kruse, D. M. Eggers, R. J. Marasco, C. Pautzke, T. J. Quinn (eds.) Proceedings of the International Symposium on Management Strategies for Exploited Fish Populations. Alaska Sea Grant College Program, University of Alaska, Fairbanks.

Narum, S. R., M. Banks, T. Beacham, R. Belllinger, M. Campbell, J. DeKoning, A. Elz, C. Guthrie, C. Kozfkay, K. Miller, P. Moran, R. Phillips, L. Seeb, C. Smith, K. Warheit, S. Young, and J. C. Garza. *In review*. Differentiating populations at broad and fine geographic scales with microsatellites and SNPs. Molecular Ecology.

Nei, M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. Genetics 89: 583-590.

Olsen, J. B., C. Habicht, J. Reynolds, and J. E. Seeb. 2004. Moderately and highly polymorphic microsatellites provide discordant estimates of population divergence in sockeye salmon, *Oncorhynchus nerka*. Environmental Biology of Fishes 69: 261-273.

Pella, J., and M. Masuda. 2001. Bayesian methods for analysis of stock mixtures from genetic characters. Fishery Bulletin 99: 151-167.

Pella, J. J., and G. B. Milner. 1987. Use of genetic marks in stock composition analysis. Pages 247-276 in N. Ryman and F. Utter, editors. Population Genetics and Fishery Management. Washington Sea Grant, University of Washington Press, Seattle.

Ranade, K., M.-S. Chang, C.-T. Ting, D. Pei, C.-F. Hsiao, M. Olivier, R. Pesich, J. Hebert, Y.-D. I. Chen, V. Dzau, D. Curb, R. Olshen, N. Risch, D. R. Cox, and D. Botstein. 2001. High-throughput genotyping with single nucleotide polymorphisms. Genome Research 11: 1262-1268.

Raymond, M. and F. Rousset. 1995. An exact test for population differentiation. Evolution 49: 1280-1283.

Reynolds, J. H. and W. D. Templin. 2004a. Detecting specific populations in mixtures. Environmental Biology of Fishes 69: 233-243.

Reynolds, J. H. and W. D. Templin. 2004b. Comparing mixture estimates by parametric bootstrapping likelihood ratios. Journal of Agricultural, Biological, and Environmental Statistics 9: 57-74

Rice, W. R. 1989. Analyzing tables of statistical tests. Evolution 43: 223-225.

Schlotterer, C. 2004. The evolution of molecular markers - just a matter of fashion? Nature Reviews Genetics 5: 63-69.

Seeb, L. W., A. Antonovich, M. A. Banks, T. D. Beacham, M. R. Bellinger, S. M. Blankenship, M. R. Campbell, N. A. Decovich, J. C. Garza, C. M. Guthrie III, T. A. Lundrigan, P. Moran, S. R. Narum, J. J. Stephenson, K. J. Supernault, D. J. Teel, W. D. Templin, J. K. Wenburg, S. F. Young, and C. T. Smith. 2007. Development of a standardized DNA database for Chinook salmon. Fisheries 32 (11): 540-552.

REFERENCES CITED (Continued)

Seeb, L. W., P. A. Crane, C. M. Kondzela, R. L. Wilmot, S. Urawa, N. V. Varnavskaya, and J. E. Seeb. 2004. Migration of Pacific Rim chum salmon on the high seas: Insights from genetic data. Environmental Biology of Fishes 69: 21-36.

Seeb, L. W., C. Habicht, W. D. Templin, K. E. Tarbox, R Z. Davis, L. K. Brannian, and J. E. Seeb. 2000. Genetic diversity of sockeye salmon of Cook Inlet, Alaska, and its application to management of populations affected by the Exxon Valdez oil spill. Transactions of the American Fisheries Society 129: 1223–1249.

Seeb, L. W., W. D. Templin, K. E. Tarbox, R. Z. Davis, and J. E. Seeb. 1997. Kenai River sockeye salmon restoration, Restoration Project 96255-2 Final Report, *Exxon Valdez* Oil Spill Trustee Council, Anchorage.

Shields, P. 2007. Upper Cook Inlet commercial fisheries annual management report, 2006. Alaska Department of Fish and Game, Fishery Management Report No. 07-36, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/Fmr07-36.pdf

Shields, P. and M. Willette. 2007. Migratory timing and abundance estimates of sockeye salmon into Upper Cook Inlet, Alaska, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 07-39, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-39.pdf

Shields, P. and M. Willette. *In prep.* Migratory timing and abundance estimates of sockeye salmon into Upper Cook Inlet, Alaska, 2006. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Smith C. T., A. Antonovich, W. D. Templin, C. D. Elfstrom, S. R. Narum, and L. W. Seeb. *In press.* Impacts of marker class bias relative to locus-specific variability on population inferences in Chinook salmon; a comparison of SNPs to STRs and allozymes. Transactions of the American Fisheries Society.

Smith, C. T., C. M. Elfstrom, J. E. Seeb, and L. W Seeb. 2005a. Use of sequence data from rainbow trout and Atlantic salmon for SNP detection in Pacific salmon. Molecular Ecology 14: 4193-4203.

Smith, C. T., W. D. Templin, J. E. Seeb, and L. W. Seeb. 2005b. Single nucleotide polymorphisms provide rapid and accurate estimates of the proportions of us and Canadian Chinook salmon caught in Yukon River fisheries. North American Journal of Fisheries Management 25: 944-953.

Tarbox, K. E., B. E. King, and D. L. Waltemyer. 1983. Cook Inlet sockeye salmon studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anadromous Fish Conservation Act Project Report No AFC-62, Anchorage.

Templin, W. D., R. L. Wilmot, C. M. Guthrie III, and L. W. Seeb. 2005. United States and Canadian Chinook salmon populations in the Yukon River can be segregated based on genetic characteristics. Alaska Fisheries Research Bulletin 11: 44-60.

Thompson, S. K. 1987. Sample size for estimating multinomial proportions. The American Statistician 41: 42-46.

Tobias, T. and K. E. Tarbox. 1999. An estimate of total return of sockeye salmon to upper Cook Inlet, Alaska 1976-1998. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A99-11, Anchorage.

Tobias, T. M. and T. M. Willette. 2004a. Abundance, age, sex and size of Chinook, sockeye, coho and chum salmon returning to Upper Cook Inlet, Alaska, in 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A04-10, Anchorage.

Tobias, T. M. and M. Willette. 2004b. An estimate of total return of sockeye salmon to Upper Cook Inlet, Alaska 1976-2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A04-11, Anchorage.

Tobias, T. M. and M. Willette. *In prep.* An estimate of total return of sockeye salmon to Upper Cook Inlet, Alaska 1976-2007. Alaska Department of Fish and Game, Fishery Data Report.

Waltemyer, D. L., B. G. Bue, and K. E. Tarbox. 1996. Evaluation of scale pattern analysis for upper Cook Inlet sockeye salmon stocks. Alaska Fisheries Research Bulletin 3(2): 69-80.

REFERENCES CITED (Continued)

Waltemyer, D. L. 1995. Component analysis of Kenai River sockeye salmon in the commercial fisheries of Upper Cook Inlet in 1990 and 1991 based on scale patterns. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report 95-03.

Waples, R. S. 1990a. Conservation genetics of Pacific salmon. III. Estimating effective population size. Journal of Heredity 81(4):277-289.

Waples, R. S. 1990b. Temporal changes of allele frequency in Pacific salmon: implications of mixed-stock fishery analysis. Canadian Journal of Fisheries and Aquatic Sciences 47:968-976.

Westerman, D. L. and T. M. Willette. 2003. Upper Cook Inlet Salmon Escapement Studies 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A04-03.

Wilmot, R. L., and C. V. Burger. 1985. Genetic differences among populations of Alaskan sockeye salmon. Transactions of the American Fisheries Society 114: 236–243.

Wood, C. C., S. McKinnell, T. J. Mulligan, and D. A. Fournier. 1987. Stock identification with the maximum-likelihood mixture model: sensitivity analysis and application to complex problems. Canadian Journal of Fisheries and Aquatic Sciences 44: 866-881.

Wood, C. C., B. E. Riddell, D. T. Rutherford, and R. E. Withler. 1994. Biochemical genetic survey of sockeye salmon (*Oncorhynchus nerka*) in Canada. Canadian Journal of Fisheries and Aquatic Sciences 51:114–131.

Woody, C. A., J. Olsen, J. Reynolds, and P. Bentzen. 2000. Temporal variation in phenotypic and genotypic traits in two sockeye salmon populations, Tustumena Lake, Alaska. Transactions of the American Fisheries Society 129:1031-1043.

TABLES AND FIGURES

Table 1.–Tissue collections of sockeye salmon in the Upper Cook Inlet genetic baseline including the year sampled and the number of individuals analyzed from each collection and their assigned reporting group for genetic stock identification.

Map No.	Pop. No.	Reporting Group	Location	Sub-location	Analysis set	Sample Year	N
1	1	West	Crescent Lake	Site 1	a,b	1994	48
1	2			Site 2	a,b	1994	47
2	3		Little Jack Creek		a,b	2006	95
3	4		Wolverine Creek		a,b	1993	95
4	5		McArthur River		a,b	1993	95
5	6		Chilligan River		a,b	1992	95
6	7		West Fork Coal Creek		a,b	1993	95
7	8		Packers Lake		a,b	1992	95
8	9	Yentna	Puntilla Lake		a,b	2006	95
9	10		Red Salmon Lake		a,b	2006	95
10	11		Shell Lake		a,b	1993	94
11	12		Judd Lake		a,b	1993	95
12	13		Trinity and Movie Lakes		a,b	1992	95
12	13				a	1993	95
13	14		Hewitt Lake		a,b	1992	49
13	14				a	2006	65
14	15		Whiskey Lake Outlet		a,b	2006	58
15	16		West Fork Yentna River slough		a,b	1992	96
15	16				a	1993	100
16	17		Chelatna Lake		a,b	1993	95
17	18	Susitna	Susitna River sloughs		a,b	1995	50
17	18				a	1996	6
17	18				a	1997	95
18	19		Byers Lake		a,b	1993	95
19	20		Swan Lake		a,b	2006	95
20	21		Stephan Lake		a,b	1993	95
21	22		Larson Creek		a,b	1993	95
22	23		Mama and Papa Bear Lakes		a	1997	50
23	24		Talkeetna River sloughs		a,b	1997	79
24	25		Birch Creek		a	1993	67
25	26	Knik	Nancy Lake		a,b	1993	95
26	27		Big Lake		a,b	1992	95
27	28		Fish Creek		a,b	1993	95
28	29		Cottonwood Creek		a,b	1993	95
29	30		Eska Creek		a,b	2006	95

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Table 1.–Page 2 of 2.

Map No.	Pop. No.	Reporting Group	Location	Sub-location	Analysis set	Sample Year	N
30	31		Bodenburg Creek		a,b	2006	95
31	32		Jim Creek		a,b	1997	95
32	33		Six Mile Creek		a,b	1997	95
33	34	Northeast	Daniels Lake		a,b	1993	95
34	35		Bishop Creek		a,b	1993	95
35	36		Swanson River		a,b	1997	95
36	37	Kenai	Johnson Creek		a,b	1997	88
37	38		Railroad Creek		a,b	1997	95
38	39		Moose Creek		a,b	1994	95
39	40		Ptarmigan Creek		a,b	1993	95
40	41		Tern Lake		a,b	1993	95
41	42		Quartz Creek		a,b	1993	95
42	43		Upper Russian River Early	Lower Lake Outlet	a,b	1992	96
43	43			Goat Creek	a,b	1997	95
42	44		Upper Russian River Late	Lower Lake Outlet	a,b	1993	95
44	45			Upper Lake Bear Creek	a,b	1997	95
45	46			Upper Lake South Shore	a,b	1999	95
46	47			Upper Lake North Shore	a,b	1999	95
48	48		Lower Russian River		a,b	1993	94
49	49		Kenai River, between Skilak	site 1	a,b	1994	47
50	49		and Kenai lakes	site 2	a,b	1994	48
51	50			site 3	a,b	1994	143
52	51			site 4	a,b	1994	48
53	51			site 5	a,b	1994	95
54	52		Hidden Creek		a,b	1993	95
55	53		Skilak Lake outlet		a,b	1992	96
56	54	Kasilof	Glacier Flats Creek		a,b	1994	95
57	55		Moose Creek		a,b	1992	96
58	56		Bear Creek		a,b	1993	95
59	57		Nikolai Creek		a,b	1992	95
60	58		Seepage Creek		a,b	1994	95
61	59		Tustumena Lake	site A	a,b	1994	48
62	59			site B	a,b	1994	48

Note: Map numbers correspond to sampling sites on Figure 2, unique population numbers represent all the collections that contribute to single population, and the analysis set denotes what collections were included and are as follows: (a) simulation and mixture analyses, and (b) proof test and fish wheel analyses.

Table 2.–Tissue collections for genetic analysis from fish captured in the Upper Cook Inlet fisheries in 2005, 2006, and 2007.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Sample Size Analyzed	Sample Size Collected
Central District Drift Gillnet							
	1	7/4/05	63,795	7/4			100
	1	7/7/05	112,174	7/7	7/7	200	200
	1	7/11/05	244,130	7/11	7/11-14	200	200
	1	7/14/05	176,127	7/14		200	400
	2,3,4,5	7/18/05	230,353	7/18	7/18-21	200	200
	2,3,4	7/21/05	142,653	7/21		200	200
	2,3,6	7/25/05	127,842	7/25			50
	7	7/28/05	262,056	7/28			50
	2,3,7	8/1/05	38,493	8/1			50
	1	6/26/06	13,352	6/26	6/26-29	135	460
	1	6/29/06	25,083	6/29		265	448
	1	7/3/06	35,007	7/3	7/3-6	192	538
	1	7/6/06	32,491	7/6		208	600
	2,3	7/10/06	1,650	7/10	7/10-13	154	400
	2,3	7/13/06	1,544	7/13		46	152
	2,3	7/17/06	26,418	7/17	7/17	300	589
	1	7/31/06	89,680	7/31			507
	1	8/2/06	56,418	8/2-5			520
	1	8/7/06	19,154	8/7			520
	1	8/10/06	13,928	8/9-11			513
	1	6/25/07	5,658	6/25	6/25-28	109	412
	1	6/28/07	15,728	6/28		291	460
	1	7/2/07	22,201	7/2	7/2-5	105	455
	1	7/5/07	61,693	7/5		295	466
	2,3,4	7/9/07	102,853	7/9	7/9-12	156	530
	2,3,4	7/12/07	190,338	7/12		244	499
	2,3,4	7/16/07	481,878	7/16	7/16	400	611
	2,3,4	7/19/07	439,023	7/19	7/19	400	526
	2,3,6	7/23/07	127,247	7/23			460
	2,3,6	7/26/07	62,192	7/26			460
	2,3,7	7/30/07	84,275	7/30			413
	2,3,8	8/2/07	35,780	8/2			404
	2,3,8	8/6/07	15,926	8/6			368
	2,3	8/9/07	26,455	8/9			419

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Table 2.–Page 2 of 7.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Analyzed	Collected
Kasilof Terminal Area Drift Gillnet (Central District, East Side Subdistrict)							
	9	7/24/06	118,160	7/24		187	200
	9	7/25/06	54,078	7/25	7/24-27	56	200
	9	7/26/06	14,196	7/26		21	100
	9	7/27/06	16,432	7/27		36	200
Kasilof Terminal Area Drift/Set Gillnet (Central District, East Side Subdistrict)							
	9	7/17/06	21,094	7/16-17			100
	9	7/19/06	4,651	7/18-19			100
	9	7/20/06	36,275	7/20			100
	9	7/22/06	21,929	7/21-22			100
	9	7/23/06	39,415	7/23			100
	9	7/27/07	3,464	7/27			100
Kasilof Terminal Area Set Gillnet (Central District, East Side Subdistrict)							
	9	7/24/06	68,098	7/24		182	200
	9	7/25/06	51,187	7/25	7/24-27	93	200
	9	7/26/06	24,493	7/26		51	100
	9	7/27/06	21,739	7/27		74	200
Kasilof Section Set Gillnet (Central District, East Side Subdistrict)							
a	1	7/4/05	62,603	7/2-4		50	50
b	1	7/4/05	29,881	7/2-4	7/2-9	50	50
a	1	7/7/05	58,873	7/6-9		50	50
b	1	7/7/05	26,398	7/6-9		50	50
a	1	7/11/05	71,035	7/11-15		50	50
b	1	7/11/05	27,858	7/11-12	7/11-15	200	200
b	1	7/14/05	15,253	7/13-15		156	156
a	1	7/18/05	63,369	7/16-21	7/16-18	50	50
b	1	7/18/05	50,641	7/16-18		200	200
b	1	7/21/05	21,824	7/19-21		200	200
a	1	7/25/05	154,327	7/23-28	7/19-28	50	50
b	1	7/25/05	47,054	7/23-26		50	50
b	1	7/28/05	41,644	7/27-31			50
a	1	8/1/05	95,176	7/30-8/4			50
b	1	8/4/05	36,597	8/1-7			50
a	1	6/26/06	19,285	6/26		66	200
b	1	6/26/06	8,270	6/26	6/26-7/1	81	100
a	1	6/29/06	57,478	6/29-7/1		193	200
b	1	6/29/06	29,772	6/29-7/1		60	60

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Table 2.–Page 3 of 7.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Analyzed	Collected
a	1	7/3/06	17,752	7/2-3	7/2-8	67	200
b	1	7/3/06	6,992	7/2-3		44	130
a	1	7/6/06	45,909	7/6-8		169	200
b	1	7/6/06	31,858	7/6-8		120	120
a	1	7/10/06	13,979	7/10	7/10-13	142	200
b	1	7/10/06	3,290	7/10		34	200
a	1	7/13/06	15,984	7/12-13		200	200
b	1	7/13/06	2,840	7/12-13		24	67
a	10	7/15/06	80,250	7/15	7/15-16	177	300
b	10	7/15/06	63,467	7/15		131	250
a	10	7/16/06	45,690	7/16		92	200
a	1	7/17/06	17,110	7/17	7/17-22	50	200
b	1	7/17/06	10,701	7/17		27	200
a	10	7/20/06	54,600	7/19-22		179	200
b	10	7/20/06	52,781	7/19-22		144	210
a	1	7/31/06	9,906	7/31-8/1			130
b	1	7/31/06	10,461	7/31-8/1			130
a	1	8/2/06	14,334	8/2-5			130
b	1	8/2/06	26,145	8/2-5			130
a	1	8/7/06	4,707	8/6-9			200
b	1	8/7/06	11,767	8/6-9			130
a	1	6/25/07	6,466	6/25	6/25-7/5	23	200
b	1	6/25/07	1,901	6/25		7	118
a	1	6/28/07	45,499	6/28-30		160	200
b	1	6/28/07	9,525	6/28-30		35	130
a	1	7/2/07	16,501	7/2		58	200
b	1	7/2/07	2,516	7/2		9	130
a	1	7/5/07	26,545	7/4-5		93	200
b	1	7/5/07	4,661	7/4		15	130
a	1	7/9/07	76,393	7/9	7/9-12	170	200
b	1	7/9/07	3,291	7/9		17	188
a	1	7/12/07	42,464	7/11-12		95	200
b	1	7/12/07	12,527	7/11-12		18	200
a	1	7/16/07	57,649	7/16	7/16-21	97	250
b	1	7/16/07	27,218	7/16		46	187
a	1	7/19/07	115,143	7/18-21		193	250
b	1	7/19/07	38,127	7/18-21		64	200
a	1	7/23/07	45,486	7/22-23			250
b	1	7/23/07	23,371	7/22-23			200
a	1	7/26/07	28,088	7/25-28			200

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Table 2.–Page 4 of 7.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Analyzed	Collected
b	1	7/26/07	23,639	7/25-28			200
a	1	7/30/07	18,739	7/30-31			130
b	1	7/30/07	12,452	7/30-31			130
a	1	8/2/07	11,090	8/2-5			130
b	1	8/2/07	4,775	8/2-5			130
a	1	8/6/07	16,187	8/5-7			130
b	1	8/6/07	6,648	8/5-7			130
a	1	8/9/07	10,446	8/8-9			130
b	1	8/9/07	8,864	8/8-9			130
		Kenai Section Set Gillnet (Central District, East Side Subdistrict)					
c	1	7/11/05	40,134	7/11-12	7/11-12	200	200
d	1	7/11/05	100,348	7/11-12		50	50
c	1	7/14/05	14,712	7/13-14	7/13-14	200	200
d	1	7/14/05	27,137	7/13-14		50	50
c	1	7/18/05	92,841	7/16-19	7/16-19	200	200
d	1	7/18/05	129,636	7/16-19		50	50
c	1	7/21/05	27,702	7/20-23		200	200
d	1	7/21/05	229,936	7/20-24	7/20-26	50	50
c	1	7/25/05	22,676	7/24-26		50	50
c	1	7/28/05	27,630	7/27-30			50
d	1	7/28/05	190,259	7/25-31			50
c	1	8/1/05	25,298	7/31-8/1			50
c	1	8/4/05	34,905	8/3-7			50
d	1	8/4/05	197,568	8/1-7			50
c	1	7/10/06	2,833	7/10		67	200
d	1	7/10/06	6,960	7/10	7/10-13	165	403
c	1	7/13/06	975	7/13		25	106
d	1	7/13/06	6,058	7/13		143	272
c	1	7/17/06	7,939	7/17	7/17	97	200
d	1	7/17/06	21,789	7/17		303	400
c	1	7/31/06	18,026	7/31-8/1			130
d	1	7/31/06	82,070	7/31-8/1			130
c	1	8/2/06	29,488	8/2-5			130
d	1	8/2/06	77,670	8/2-5			130
c	1	8/7/06	12,468	8/6-9			130
d	1	8/7/06	41,550	8/6-9			200

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Table 2.–Page 5 of 7.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Analyzed	Collected
c	1	7/9/07	1,652	7/9		62	100
d	1	7/9/07	5,106	7/9	7/9-12	193	300
c	1	7/12/07	795	7/12		30	100
d	1	7/12/07	3,033	7/12		115	300
c	1	7/16/07	1,351	7/16		10	100
d	1	7/16/07	8,272	7/16	7/16-19	64	300
c	1	7/19/07	5,139	7/19		40	100
d	1	7/19/07	37,093	7/19		286	300
c	1	7/23/07	25,867	7/21-23		30	100
d	1	7/23/07	183,402	7/21-23	7/21-28	215	350
c	1	7/26/07	26,204	7/26-28		31	100
d	1	7/26/07	105,336	7/26-28		124	300
c	1	7/30/07	14,061	7/30-31			130
d	1	7/30/07	54,201	7/30-31			130
c	1	8/2/07	4,323	8/1-2			130
d	1	8/2/07	43,823	8/1-2			130
c	1	8/6/07	10,041	8/5-7			130
d	1	8/6/07	45,861	8/5-7			130
c	1	8/9/07	8,152	8/8-9			130
d	1	8/9/07	29,934	8/8-9			130
		Kalgin Island Subdistrict Set Gillnet (Central District)					
	1	8/6/05	36,467	8/4-11			100
	1	6/26/06	2,867	6/23-26			109
	1	6/29/06	1,291	6/29			117
	1	7/3/06	1,375	7/3			100
	1	7/6/06	560	7/6			77
	1	7/10/06	861	7/10			112
	1	7/13/06	471	7/13			53
	1	7/17/06	1,656	7/17			101
	1	7/20/06	1,434	7/20			112
	1	7/24/06	3,271	7/24			118
	1	7/27/06	2,690	7/27			80
	1	7/31/06	4,503	7/31-8/1			85
	1	8/3/06	4,130	8/3			93
	1	8/10/06	6,106	8/7-10			100
	1	8/16/06	3,731	8/14-17			100
	1	6/25/07	2,754	6/22-25			100
	1	6/28/07	2,364	6/28			100
	1	7/2/07	2,642	7/2			100
	1	7/5/07	2,894	7/5			100

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Table 2.–Page 6 of 7.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Analyzed	Collected
	1	7/9/07	2,461	7/9			100
	1	7/12/07	1,395	7/12			100
	1	7/16/07	575	7/16			85
	1	7/19/07	3,148	7/19			100
	1	7/23/07	4,596	7/23			100
	1	7/26/07	5,196	7/26			100
	1	7/29/07	4,596	7/29-31			100
	1	8/2/07	3,533	8/2			100
	1	8/6/07	2,234	8/6			100
	1	8/9/07	8,809	8/9-13			100
		Western Subdistrict Set Gillnet (Central District)					
	1	7/11/05 7/21/05	12,127	7/11-21			100
	1	6/26/06	810	6/19-26			132
	1	6/29/06	2,137	6/29-7/1			128
	1	7/3/06	2,682	7/3			116
	1	7/6/06	2,444	7/5-6			100
	1	7/10/06	3,280	7/8-10			102
	1	7/13/06	4,477	7/12-13			108
	1	7/17/06	3,764	7/17-18			83
	1	7/20/06	5,151	7/20-22			119
	1	7/24/06	1,492	7/23-25			105
	1	7/27/06	3,236	7/26-27			85
	1	7/31/06	1,695	7/29-31			46
	1	6/25/07	2,666	6/18-25			100
	1	6/28/07	1,926	6/28			100
	1	7/2/07	3,592	7/1-2			100
	1	7/9/07	5,709	7/7-9			100
	1	7/5/07	5,951	7/4-5			100
	1	7/12/07	6,465	7/10-13			100
	1	7/16/07	2,510	7/14-16			100
	1	7/19/07	8,639	7/18-20			100
	1	7/23/07	4,540	7/21-23			100
	1	7/26/07	6,287	7/25-26			100
	1	7/30/07	2,167	7/27-30			100
	1	8/2/07	1,704	8/2-6			100
	1	8/9/07	3,675	8/9-20			100
		Eastern Subdistrict Set Gillnet (Northern District)					
	1	7/14/05 7/18/05	2,396	7/14-18			100
	1	7/3/06	463	7/3			50

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Table 2.–Page 7 of 7.

Sub-strata[a]	Restrictions[b]	Date(s) Sampled	Harvest Represented	Harvest Dates Represented	Mixture Date(s)	Analyzed	Collected
	1	7/6/06	619	7/6			40
	1	8/7/06	713	8/7			250
	1	8/10/06	696	8/10			198
	1	7/2/07	326	7/2			33
	1	7/5/07	419	7/5			40
	1	7/9/07	393	7/9			40
	1	7/12/07	222	7/12			28
	1	7/16/07	229	7/16			40
	1	7/19/07	1,466	7/19			40
	1	7/23/07	1,280	7/23			40
	1	8/9/07	2,138	8/9-20			80
			General Subdistrict Set Gillnet (Northern District)				
	1	7/18/05	3,250	7/18			30

Note: Corresponding restrictions to the fisheries and substrata are provided when applicable.

[a] a-Cohoe/Ninilchik; b-South K. Beach; c-North K. Beach; d-North and South Salamatof.

[b] (see Figures 1 and 4–8) 1-No Restrictions; 2-Kasilof Corridor; 3-Kenai Corridor; 4-Area 1; 5-Area 2; 6-South of Blanchard line; 7-South of north end of Kalgin Island; 8-South of a line from Collier's Dock / Northwest Point on Kalgin Island / Latitude 60.5208°N to western shore; 9-Kasilof Terminal Area; 10-within 1/2 mile of shore.

Table 3.–Forty five single nucleotide polymorphism markers used for this project with subsets noted for each analysis.

Marker	Marker Set [a]	mtDNA	Linked Markers	H_s	F_{st}	Reference [b]
One_ACBP-79	1,2,3			0.429	0.139	A
One_ALDOB-135	1,2,3			0.219	0.099	A
One_CO1	1,2,3	yes		NA	NA	A
One_ctgf-301	1,2,3			0.066	0.035	A
One_Cytb_17	1,2,3	yes		NA	NA	A
One_Cytb_26	1,2,3	yes		NA	NA	A
One_E2-65	1,2,3			0.359	0.166	B
One_GHII-2165	1,2,3			0.239	0.152	A
One_GPDH-201	1,2,3			0.463	0.067	B
One_GPDH2-187	1,2,3			0.177	0.096	B
One_GPH-414	1,2,3			0.399	0.067	A
One_hsc71-220	1,2,3			0.286	0.146	A
One_HGFA-49	1,2,3			0.260	0.097	B
One_HpaI-71	1,2,3			0.352	0.103	A
One_HpaI-99	1,2,3			0.139	0.121	A
One_IL8r-362	1,2			0.097	0.206	C
One_KPNA-422	1,2,3			0.260	0.118	A
One_LEI-87	1,2,3			0.448	0.091	A
One_MARCKS-241	1,2,3			0.051	0.096	C
One_MHC2_190	1,2,3		1	NA	NA	A
One_MHC2_251	1,2,3		1	NA	NA	A
One_Ots213-181	1,2,3			0.226	0.060	A
One_p53-534	1,2,3			0.065	0.242	A
One_ins-107	1,2,3			0.429	0.108	B
One_Prl2	1,2,3			0.452	0.094	A
One_RAG1-103	1,2,3			0.085	0.131	A
One_RAG3-93	1,2,3			0.111	0.080	A
One_RFC2-102	1,2,3			0.331	0.145	B
One_RFC2-285	1,2,3			0.080	0.105	B
One_RH2op-395	2,3			0.001	0.002	A
One_serpin-75	1,2,3			0.045	0.178	B
One_STC-410	1,2,3			0.314	0.230	A
One_STR07	1,2,3			0.344	0.158	A
One_Tf_ex11-750	1,2,3			0.355	0.169	A

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Table 3.–Page 2 of 2.

Marker	Marker Set [a]	mtDNA	Linked markers	Hs	Fst (W&C)	Reference [b]
One_Tf_in3-182	1,2,3			0.046	0.101	A
One_U301_92	2,3			0.265	0.083	A
One_U401-224	1,2,3			0.457	0.082	C
One_U404-229	1,2			0.037	0.097	C
One_U502-167	2			0.049	0.065	C
One_U503-170	1,2			0.143	0.077	C
One_U504-141	1,2			0.394	0.088	C
One_U508-533	1,2			0.091	0.281	C
One_VIM-569	1,2,3			0.228	0.132	A
One_ZNF-61	1,2			0.276	0.182	C
One_Zp3b-49	1,2,3			0.144	0.392	B

Note: Expected heterozygosity (Hs) and Fst for baseline samples and reference are listed for each marker. MtDNA markers are noted, and linked markers are numerically coded by linkage group. Composite haplotype loci were assembled for both of these marker classes for use in GSI analyses.

[a] 1) 2005 and 2006 mixtures, proof tests; 2) 2007 mixtures and simulations; 3) fish wheel.

[b] A) Elfstrom et al. (2006); B) Smith et al. (2005a); C) ADF&G unpublished data.

Table 4.–Tissue collections of sockeye salmon sampled for genetic studies taken from fish captured in fish wheels operated within four of the major drainages into Cook Inlet, Alaska.

Map No.	River	Location	Date	N
101	Kasilof	Kasilof River (fish wheel, rkm 11.3)	7/22/1992-7/23/1992	190
			7/11/2005-7/20/2005	190
102	Kenai	Kenai River (fish wheel, rkm 30.6)	7/31/1994-8/1/1994	190
			7/11/2005-7/20/2005	190
103	Yentna	Yentna River (fish wheel, rkm 6.5)	7/15/1992	190
			7/9/2005-8/12/2005	190
104	Susitna	Susitna River (Sunshine fish wheel, rkm 116)	7/26/1992	190

Note: Map numbers correspond to fish wheel sites on Figure 2.

Table 5.–Allocation proportions (90% confidence interval) for mixtures of simulated fish that originate from all populations that contribute to each reporting group (100% simulations).

Reporting Group	West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
West	**0.97**	0.01	0.01	0.00	0.00	0.01	0.00
	(0.95 - 0.99)	(0.00 - 0.03)	(0.00 - 0.02)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)
Yentna	0.00	**0.98**	0.02	0.00	0.00	0.00	0.00
	(0.00 - 0.01)	(0.95 - 0.99)	(0.00 - 0.04)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)
Susitna	0.00	0.02	**0.97**	0.00	0.00	0.00	0.00
	(0.00 - 0.01)	(0.00 - 0.04)	(0.94 - 0.99)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.01)
Knik	0.00	0.00	0.00	**0.99**	0.00	0.00	0.00
	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.98 - 1.00)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.01)
Northeast	0.00	0.00	0.00	0.00	**0.99**	0.00	0.00
	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.97 - 1.00)	(0.00 - 0.01)	(0.00 - 0.00)
Kenai	0.00	0.00	0.00	0.00	0.00	**0.98**	0.01
	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.97 - 1.00)	(0.00 - 0.03)
Kasilof	0.00	0.00	0.00	0.00	0.00	0.02	**0.98**
	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.04)	(0.96 - 1.00)

Note: Baseline frequencies from SNP loci were used to generate the simulated fish used in the mixtures. Mixed stock analyses were performed using SPAM.

Table 6.–Allocation proportions (SPAM; 90% confidence interval, BAYES; 90% credibility interval in parentheses) for mixtures of 200 known fish that were removed from the baseline populations that contribute to each reporting group (proof tests).

Reporting Group	West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
				SPAM			
West	**0.94**	0.05	0.01	0.00	0.00	0.00	0.00
	(0.87 - 1.00)	(0.04 - 0.06)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.05)	(0.00 - 0.01)
Yentna	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00
	(0.00 - 0.01)	(0.94 - 1.00)	(0.00 - 0.07)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)
Susitna	0.01	0.05	**0.92**	0.00	0.00	0.02	0.00
	(0.00 - 0.02)	(0.04 - 0.06)	(0.86 - 0.98)	(0.00 - 0.00)	(0.00 - 0.01)	(0.02 - 0.02)	(0.00 - 0.01)
Knik	0.00	0.01	0.00	**0.97**	0.01	0.01	0.00
	(0.00 - 0.04)	(0.00 - 0.01)	(0.00 - 0.01)	(0.91 - 1.00)	(0.00 - 0.02)	(0.01 - 0.02)	(0.00 - 0.01)
Northeast	0.02	0.03	0.00	0.04	**0.90**	0.02	0.00
	(0.00 - 0.03)	(0.02 - 0.03)	(0.00 - 0.05)	(0.03 - 0.06)	(0.86 - 0.95)	(0.01 - 0.02)	(0.00 - 0.02)
Kenai	0.00	0.01	0.00	0.01	0.00	**0.98**	0.00
	(0.00 - 0.01)	(0.01 - 0.01)	(0.00 - 0.01)	(0.01 - 0.01)	(0.00 - 0.00)	(0.91 - 1.00)	(0.00 - 0.02)
Kasilof	0.00	0.00	0.00	0.01	0.00	0.00	**0.99**
	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.02)	(0.94 - 1.00)
				BAYES:Flat prior			
West	**0.99**	0.00	0.00	0.00	0.00	0.00	0.00
	(0.98 - 1.00)	(0.00 - 0.02)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.01)
Yentna	0.00	**0.99**	0.00	0.00	0.00	0.00	0.00
	(0.00 - 0.01)	(0.98 - 1.00)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)
Susitna	0.00	0.00	**0.99**	0.00	0.00	0.01	0.00
	(0.00 - 0.01)	(0.00 - 0.03)	(0.95 - 1.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.01)
Knik	0.00	0.00	0.00	**0.99**	0.00	0.00	0.00
	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.97 - 1.00)	(0.00 - 0.01)	(0.00 - 0.02)	(0.00 - 0.01)
Northeast	0.00	0.00	0.00	0.00	**0.99**	0.00	0.00
	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.02)	(0.97 - 1.00)	(0.00 - 0.01)	(0.00 - 0.01)
Kenai	0.00	0.00	0.00	0.01	0.00	**0.99**	0.00
	(0.00 - 0.01)	(0.00 - 0.02)	(0.00 - 0.01)	(0.00 - 0.03)	(0.00 - 0.00)	(0.96 - 1.00)	(0.00 - 0.01)
Kasilof	0.00	0.00	0.00	0.00	0.00	0.00	**0.99**
	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.02)	(0.97 - 1.00)
				BAYES:SPAM prior			
West	**1.00**	0.00	0.00	0.00	0.00	0.00	0.00
	(0.99 - 1.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)
Yentna	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00
	(0.00 - 0.00)	(1.00 - 1.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)
Susitna	0.00	0.00	**1.00**	0.00	0.00	0.00	0.00
	(0.00 - 0.00)	(0.00 - 0.01)	(0.98 - 1.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)

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Table 6.–Page 2 of 2.

Reporting Group	West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
Knik	0.00	0.00	0.00	**1.00**	0.00	0.00	0.00
	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(1.00 - 1.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)
Northeast	0.00	0.00	0.00	0.00	**1.00**	0.00	0.00
	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.01)	(0.99 - 1.00)	(0.00 - 0.00)	(0.00 - 0.00)
Kenai	0.00	0.00	0.00	0.00	0.00	**1.00**	0.00
	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(1.00 - 1.00)	(0.00 - 0.00)
Kasilof	0.00	0.00	0.00	0.00	0.00	0.00	**1.00**
	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(1.00 - 1.00)

Note: New baselines, that excluded the 200 used in the mixture, were used for each mixed stock analysis. Mixed stock analyses were performed using SPAM, BAYES with a flat prior, and BAYES with a SPAM prior. Numbers in bold indicate allocation to the drainage of the fish wheel.

Table 7.–Stock composition estimate for mixtures of fish captured in fish wheels operated on the Kasilof, Kenai, Yentna, and Susitna rivers in 1992, 1994, and 2005.

Date(s)	N	West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
				Kasilof				
7/22-23/92	190	0.00	0.00	0.00	0.00	0.00	0.00	**1.00**
		(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(1.00 - 1.00)
7/11-20/05	190	0.00	0.00	0.00	0.00	0.00	0.00	**0.99**
		(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.02)	(0.97 - 1.00)
				Kenai				
7/31-8/1/94	190	0.00	0.00	0.00	0.01	0.00	**0.98**	0.00
		(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.04)	(0.00 - 0.00)	(0.95 - 1.00)	(0.00 - 0.03)
7/11-20/05	190	0.00	0.01	0.00	0.00	0.00	**0.99**	0.01
		(0.00 - 0.00)	(0.00 - 0.05)	(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.00)	(0.92 - 1.00)	(0.00 - 0.06)
				Yentna				
7/15/92	190	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00
		(0.00 - 0.00)	(0.96 - 1.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)
7/9-8/12/05	190	0.00	**0.94**	0.05	0.01	0.00	0.00	0.00
		(0.00 - 0.01)	(0.77 - 1.00)	(0.00 - 0.20)	(0.00 - 0.05)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)
				Susitna				
7/26/92	190	0.00	0.02	**0.98**	0.00	0.00	0.00	0.00
		(0.00 - 0.00)	(0.00 - 0.06)	(0.94 - 1.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)

Note: Credibility intervals (90%) are included in parentheses. BAYES with a SPAM prior was used to estimate the proportions.

Table 8.–Stock composition estimate and the number of fish successfully screened for mixtures of fish captured in the Cook Inlet offshore test fishery in 2006 and 2007.

Date(s)	N	West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
				2006				
7/1-9	325	0.11	0.06	0.00	0.01	0.00	0.30	0.51
		(0.08 - 0.15)	(0.04 - 0.10)	(0.00 - 0.01)	(0.00 - 0.02)	(0.00 - 0.00)	(0.24 - 0.36)	(0.45 - 0.58)
7/10-16	266	0.08	0.13	0.07	0.05	0.00	0.34	0.33
		(0.05 - 0.12)	(0.07 - 0.19)	(0.04 - 0.11)	(0.02 - 0.08)	(0.00 - 0.00)	(0.27 - 0.40)	(0.26 - 0.39)
7/17-23	401	0.10	0.09	0.02	0.02	0.00	0.61	0.16
		(0.07 - 0.13)	(0.06 - 0.13)	(0.01 - 0.03)	(0.01 - 0.03)	(0.00 - 0.00)	(0.56 - 0.67)	(0.12 - 0.21)
7/24 - 8/1	393	0.05	0.07	0.03	0.02	0.00	0.70	0.12
		(0.03 - 0.07)	(0.03 - 0.12)	(0.00 - 0.07)	(0.01 - 0.04)	(0.00 - 0.01)	(0.65 - 0.75)	(0.08 - 0.16)
				2007				
7/1-9	374	0.17	0.12	0.01	0.06	0.00	0.41	0.24
		(0.12 - 0.22)	(0.07 - 0.16)	(0.00 - 0.02)	(0.04 - 0.09)	(0.00 - 0.01)	(0.35 - 0.47)	(0.18 - 0.29)
7/10-13	444	0.07	0.15	0.02	0.04	0.00	0.54	0.18
		(0.05 - 0.10)	(0.11 - 0.19)	(0.00 - 0.04)	(0.02 - 0.07)	(0.00 - 0.00)	(0.48 - 0.60)	(0.13 - 0.23)
7/14-18	404	0.07	0.13	0.04	0.03	0.00	0.62	0.12
		(0.04 - 0.10)	(0.08 - 0.18)	(0.01 - 0.09)	(0.01 - 0.04)	(0.00 - 0.00)	(0.57 - 0.67)	(0.08 - 0.16)
7/19-23	429	0.08	0.08	0.05	0.03	0.00	0.68	0.09
		(0.06 - 0.11)	(0.05 - 0.12)	(0.02 - 0.08)	(0.01 - 0.04)	(0.00 - 0.00)	(0.63 - 0.73)	(0.06 - 0.13)
7/24-8/2	438	0.07	0.07	0.05	0.01	0.00	0.71	0.09
		(0.05 - 0.10)	(0.04 - 0.10)	(0.03 - 0.07)	(0.00 - 0.02)	(0.00 - 0.00)	(0.66 - 0.76)	(0.06 - 0.13)

Note: Credibility intervals (90%) are included in parentheses. Proportions are estimated from BAYES using a SPAM prior.

Table 9.–Stock composition estimates (P) and extrapolated harvests (H) from mixtures of fish captured in the Central District drift gillnet fishery in 2005, 2006, and 2007.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
					2005				
7/7	200	P	0.03	0.08	0.00	0.03	0.00	0.72	0.13
			(0.01 - 0.06)	(0.05 - 0.11)	(0.00 - 0.00)	(0.01 - 0.06)	(0.00 - 0.00)	(0.65 - 0.79)	(0.08 - 0.20)
		H	3,892	8,794	11	3,634	0	81,012	14,841
			(1548 - 6921)	(5373 - 12698)	(0 - 11)	(1503 - 6428)	(0 - 0)	(72577 - 88730)	(8492 - 22166)
7/11-14	400	P	0.05	0.02	0.00	0.00	0.00	0.88	0.05
			(0.03 - 0.08)	(0.01 - 0.05)	(0.00 - 0.01)	(0.00 - 0.01)	(0.00 - 0.00)	(0.84 - 0.91)	(0.03 - 0.08)
		H	20,509	9,540	504	546	0	368,019	21,139
			(11179 - 31687)	(2437 - 21433)	(0 - 2942)	(0 - 2732)	(0 - 0)	(351209 - 383400)	(10759 - 33032)
7/18-21	400	P	0.02	0.00	0.00	0.01	0.00	0.90	0.06
			(0.01 - 0.04)	(0.00 - 0.01)	(0.00 - 0.02)	(0.00 - 0.03)	(0.00 - 0.00)	(0.86 - 0.93)	(0.04 - 0.09)
		H	8,542	261	1,044	3,767	37	335,370	23,984
			(2201 - 15480)	(0 - 1902)	(0 - 7050)	(0 - 9959)	(0 - 0)	(321382 - 348015)	(13839 - 35398)
					2006				
6/26-29	400	P	0.03	0.03	0.00	0.01	0.00	0.11	0.82
			(0.01 - 0.04)	(0.01 - 0.06)	(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.08 - 0.14)	(0.78 - 0.86)
		H	1,034	1,226	12	523	0	4,059	31,578
			(511 - 1722)	(400 - 2141)	(0 - 77)	(119 - 1088)	(0 - 0)	(2898 - 5354)	(30087 - 32977)
7/3-6	399	P	0.02	0.10	0.02	0.00	0.00	0.22	0.64
			(0.01 - 0.04)	(0.07 - 0.14)	(0.01 - 0.03)	(0.00 - 0.01)	(0.00 - 0.00)	(0.17 - 0.27)	(0.58 - 0.69)
		H	1,438	6,986	1,161	142	0	14,613	43,158
			(472 - 2639)	(4813 - 9328)	(472 - 2099)	(0 - 931)	(0 - 0)	(11353 - 18184)	(39297 - 46803)
7/10-13	200	P	0.02	0.01	0.00	0.00	0.00	0.20	0.77
			(0.00 - 0.04)	(0.00 - 0.02)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.02)	(0.14 - 0.27)	(0.70 - 0.83)
		H	52	22	5	1	15	646	2,454
			(0 - 124)	(0 - 74)	(0 - 27)	(0 - 0)	(0 - 58)	(452 - 862)	(2228 - 2650)

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Table 9.–Page 2 of 2.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
7/17	300	P	0.00	0.02	0.02	0.01	0.00	0.41	0.54
			(0.00 - 0.01)	(0.00 - 0.05)	(0.00 - 0.05)	(0.00 - 0.03)	(0.00 - 0.00)	(0.34 - 0.49)	(0.46 - 0.62)
		H	32	491	515	259	0	10,853	14,268
			(0 - 193)	(0 - 1210)	(69 - 1279)	(11 - 724)	(0 - 0)	(8853 - 12887)	(12245 - 16260)
					2007				
6/25-28	400	P	0.23	0.11	0.00	0.01	0.00	0.28	0.38
			(0.03 - 0.36)	(0.00 - 0.33)	(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.23 - 0.34)	(0.32 - 0.43)
		H	4,874	2,265	0	137	0	6,078	8,033
			(695 - 7675)	(73 - 7049)	(0 - 0)	(0 - 618)	(0 - 0)	(4908 - 7290)	(6835 - 9260)
7/2-5	400	P	0.10	0.15	0.00	0.03	0.00	0.42	0.30
			(0.07 - 0.14)	(0.11 - 0.19)	(0.00 - 0.01)	(0.01 - 0.05)	(0.00 - 0.00)	(0.35 - 0.49)	(0.24 - 0.36)
		H	8,608	12,517	302	2,206	0	35,235	25,034
			(5990 - 11401)	(9337 - 15948)	(0 - 1250)	(940 - 3935)	(0 - 0)	(29757 - 40798)	(19723 - 30294)
7/9-12	399	P	0.06	0.10	0.03	0.02	0.00	0.55	0.24
			(0.04 - 0.09)	(0.06 - 0.14)	(0.00 - 0.06)	(0.01 - 0.04)	(0.00 - 0.01)	(0.49 - 0.61)	(0.19 - 0.30)
		H	17,533	28,469	7,945	5,893	704	161,314	71,363
			(11083 - 24980)	(18002 - 41926)	(0 - 17152)	(1818 - 11024)	(0 - 4222)	(144250 - 178583)	(55941 - 87312)
7/16	400	P	0.03	0.13	0.02	0.03	0.00	0.64	0.15
			(0.01 - 0.05)	(0.10 - 0.17)	(0.01 - 0.04)	(0.01 - 0.04)	(0.00 - 0.00)	(0.58 - 0.70)	(0.11 - 0.20)
		H	14,023	62,548	11,469	12,673	0	307,968	73,197
			(5831 - 23998)	(46164 - 80715)	(4963 - 19516)	(5831 - 21058)	(0 - 0)	(280212 - 335050)	(50645 - 97580)
7/19	398	P	0.02	0.11	0.00	0.03	0.00	0.69	0.15
			(0.01 - 0.03)	(0.08 - 0.15)	(0.00 - 0.00)	(0.02 - 0.06)	(0.00 - 0.00)	(0.63 - 0.74)	(0.10 - 0.20)
		H	7,946	50,224	88	14,663	0	301,038	65,063
			(2634 - 14751)	(34771 - 66644)	(0 - 44)	(6805 - 24234)	(0 - 0)	(275706 - 325228)	(45088 - 86883)

Note: Credibility intervals (90%) are included in parentheses. The number of fish successfully screened from each stratum (N) is indicated. BAYES with a SPAM prior was used to estimate the proportions. The 90% confidence intervals of harvest estimates may not include the point estimate for very low extrapolated harvest numbers because less than 5% of iterations had values above zero.

Table 10.–Stock composition estimates (P) and extrapolated harvests (H) from mixtures of fish captured in the Kasilof Terminal Area drift and set gillnet fisheries (Central District, East Side Subdistrict) in 2006.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
Drift Gillnet									
7/24-27	300	P	0.00	0.00	0.00	0.01	0.00	0.03	0.96
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)	(0.01 - 0.06)	(0.93 - 0.98)
		H	61	0	20	1,724	0	7,039	194,041
			(0 - 365)	(0 - 0)	(0 - 0)	(0 - 4220)	(0 - 0)	(2881 - 12395)	(188341 - 198606)
Set Gillnet									
7/24-27	400	P	0.00	0.00	0.00	0.00	0.00	0.07	0.93
			(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.04 - 0.10)	(0.90 - 0.96)
		H	414	0	0	0	0	11,404	153,699
			(17 - 1258)	(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(7018 - 16403)	(148667 - 158118)

Note: Credibility intervals (90%) are included in parentheses. The number of fish successfully screened from each stratum (N) is indicated. BAYES with a SPAM prior was used to estimate the proportions. The 90% credibility intervals of harvest estimates may not include the point estimate for very low extrapolated harvest numbers because less than 5% of iterations had values above zero.

Table 11.–Stock composition estimates (P) and extrapolated harvests (H) from mixtures of fish captured in the Kasilof Section set gillnet fishery (Central District, East Side Subdistrict) in 2005, 2006, and 2007.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
					2005				
7/2-9	200	P	0.00	0.00	0.00	0.00	0.00	0.17	0.83
			(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.11 - 0.24)	(0.76 - 0.89)
		H	36	871	0	0	0	29,632	147,217
			(0 - 53)	(18 - 2666)	(0 - 0)	(0 - 0)	(0 - 0)	(18895 - 41915)	(134827 - 158060)
7/11-15	406	P	0.00	0.00	0.01	0.00	0.00	0.48	0.50
			(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.00)	(0.43 - 0.54)	(0.45 - 0.55)
		H	23	422	936	0	0	55,292	57,473
			(0 - 11)	(11 - 1495)	(0 - 2351)	(0 - 0)	(0 - 0)	(49528 - 61239)	(51537 - 63237)
7/16-18	250	P	0.00	0.00	0.00	0.00	0.00	0.38	0.62
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.32 - 0.44)	(0.56 - 0.68)
		H	0	0	0	0	0	43,312	70,686
			(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(36666 - 50039)	(63960 - 77322)
7/19-28	300	P	0.00	0.00	0.00	0.00	0.00	0.43	0.57
			(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.36 - 0.50)	(0.50 - 0.64)
		H	0	357	0	0	0	95,398	127,450
			(0 - 0)	(0 - 1875)	(0 - 0)	(0 - 0)	(0 - 0)	(81090 - 110531)	(112339 - 141757)
					2006				
6/26-7/1	400	P	0.00	0.00	0.00	0.00	0.00	0.13	0.87
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.10 - 0.16)	(0.84 - 0.90)
		H	23	57	0	0	0	14,867	99,846
			(0 - 80)	(0 - 482)	(0 - 0)	(0 - 0)	(0 - 0)	(11733 - 18369)	(96333 - 103003)
7/2-8	400	P	0.00	0.02	0.00	0.01	0.00	0.08	0.89
			(0.00 - 0.00)	(0.00 - 0.05)	(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.05 - 0.11)	(0.85 - 0.92)
		H	62	2,030	10	1,251	10	8,160	90,999
			(0 - 400)	(0 - 5085)	(0 - 0)	(0 - 3362)	(0 - 0)	(5167 - 11666)	(87329 - 94085)

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Table 11.–Page 2 of 2.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
7/10-13	400	P	0.00	0.00	0.00	0.00	0.00	0.14	0.86
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.1 0 - 0.18)	(0.82 - 0.89)
		H	4	0	14	4	0	5,031	31,036
			(0 - 7)	(0 - 0)	(0 - 115)	(0 - 11)	(0 - 0)	(3779 - 6425)	(29650 - 32285)
7/15-16	400	P	0.00	0.01	0.00	0.00	0.00	0.16	0.83
			(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.13 - 0.20)	(0.79 - 0.86)
		H	19	1,951	0	0	0	30,854	156,564
			(0 - 0)	(0 - 4849)	(0 - 0)	(0 - 0)	(0 - 0)	(24187 - 37995)	(149328 - 163382)
7/17-22	400	P	0.00	0.00	0.00	0.01	0.00	0.13	0.86
			(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)	(0.10 - 0.16)	(0.82 - 0.89)
		H	257	14	0	1,663	0	17,237	116,022
			(0 - 1000)	(0 - 0)	(0 - 0)	(554 - 3231)	(0 - 0)	(13005 - 21820)	(111290 - 120388)
					2007				
6/25-7/5	399	P	0.01	0.07	0.00	0.02	0.00	0.13	0.78
			(0.00 - 0.02)	(0.04 - 0.09)	(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.09 - 0.17)	(0.73 - 0.83)
		H	898	7,487	11	1,761	0	14,361	89,119
			(102 - 2204)	(4635 - 10714)	(0 - 0)	(364 - 3590)	(0 - 0)	(9748 - 19644)	(83313 - 94640)
7/9-12	299	P	0.00	0.04	0.00	0.01	0.00	0.46	0.49
			(0.00 - 0.00)	(0.00 - 0.07)	(0.00 - 0.00)	(0.00 - 0.03)	(0.00 - 0.00)	(0.39 - 0.54)	(0.42 - 0.56)
		H	13	4,916	13	1,603	0	62,449	65,694
			(0 - 0)	(323 - 10087)	(0 - 0)	(0 - 4404)	(0 - 0)	(53062 - 72159)	(56213 - 74960)
7/16-21	400	P	0.00	0.04	0.02	0.04	0.00	0.58	0.32
			(0.00 - 0.01)	(0.02 - 0.07)	(0.00 - 0.03)	(0.02 - 0.06)	(0.00 - 0.01)	(0.53 - 0.64)	(0.26 - 0.37)
		H	381	9,811	4,120	9,573	476	138,572	75,227
			(0 - 2834)	(4525 - 16789)	(1143 - 8240)	(5025 - 14836)	(0 - 1738)	(125308 - 151812)	(62392 - 88230)

Note: Credibility intervals (90%) are included in parentheses. The number of fish successfully screened from each stratum (N) is indicated. BAYES with a SPAM prior was used to estimate the proportions. The 90% credibility intervals of harvest estimates may not include the point estimate for very low extrapolated harvest numbers because less than 5% of iterations had values above zero.

Table 12.–Stock composition estimates (P) and extrapolated harvests (H) from mixtures of fish captured in the Kenai Section set gillnet fishery (Central District, East Side Subdistrict) in 2005, 2006, and 2007.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
2005									
7/11-12	250	P	0.00	0.00	0.00	0.00	0.00	0.67	0.32
			(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.61 - 0.74)	(0.26 - 0.39)
		H	112	140	42	14	0	94,797	45,376
			(0 - 660)	(0 - 941)	(0 - 112)	(0 - 14)	(0 - 0)	(85708 - 103760)	(36455 - 54451)
7/13-14	250	P	0.00	0.00	0.00	0.00	0.00	0.78	0.22
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.72 - 0.84)	(0.16 - 0.28)
		H	4	0	0	0	0	32,678	9,160
			(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(30196 - 34992)	(6846 - 11642)
7/16-19	250	P	0.00	0.03	0.01	0.01	0.00	0.42	0.53
			(0.00 - 0.00)	(0.01 - 0.05)	(0.00 - 0.04)	(0.00 - 0.02)	(0.00 - 0.00)	(0.36 - 0.49)	(0.47 - 0.6)
		H	22	5,562	2,292	2,069	0	94,330	118,224
			(0 - 0)	(1646 - 11079)	(0 - 7809)	(356 - 4939)	(0 - 0)	(80336 - 108791)	(103719 - 132441)
7/20-26	300	P	0.00	0.00	0.00	0.00	0.00	0.56	0.44
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.50 - 0.61)	(0.39 - 0.5)
		H	0	0	0	0	0	156,107	124,207
			(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(139568 - 172337)	(107977 - 140746)
2006									
7/10-13	400	P	0.00	0.00	0.00	0.00	0.00	0.43	0.56
			(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.37 - 0.49)	(0.50 - 0.62)
		H	2	56	0	67	0	7,281	9,419
			(0 - 0)	(0 - 271)	(0 - 0)	(0 - 244)	(0 - 0)	(6281 - 8287)	(8425 - 10407)
7/17	400	P	0.00	0.00	0.00	0.00	0.00	0.75	0.25
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.69 - 0.80)	(0.20 - 0.30)
		H	0	0	0	83	0	22,168	7,477
			(0 - 0)	(0 - 0)	(0 - 0)	(0 - 318)	(0 - 0)	(20596 - 23666)	(5990 - 9052)

-continued-

Table 12.–Page 2 of 2.

Date	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
					2007				
7/9-12	400	P	0.00	0.02	0.01	0.01	0.00	0.86	0.09
			(0.00 - 0.01)	(0.00 - 0.05)	(0.00 - 0.02)	(0.00 - 0.03)	(0.00 - 0.00)	(0.81 - 0.91)	(0.05 - 0.14)
		H	43	162	89	149	0	9,143	999
			(3 - 122)	(21 - 476)	(0 - 227)	(0 - 311)	(0 - 0)	(8607 - 9621)	(570 - 1485)
7/16-19	399	P	0.00	0.03	0.00	0.00	0.00	0.89	0.07
			(0.00 - 0.01)	(0.01 - 0.05)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.85 - 0.93)	(0.04 - 0.12)
		H	83	1,665	0	0	0	46,307	3,806
			(0 - 399)	(674 - 2826)	(0 - 0)	(0 - 0)	(0 - 0)	(43921 - 48433)	(1872 - 5994)
7/21-28	400	P	0.00	0.13	0.00	0.04	0.00	0.72	0.11
			(0.00 - 0.00)	(0.09 - 0.17)	(0.00 - 0.01)	(0.02 - 0.06)	(0.00 - 0.00)	(0.67 - 0.77)	(0.08 - 0.15)
		H	0	43,146	579	13,496	0	245,042	38,545
			(0 - 0)	(30366 - 57426)	(0 - 3613)	(6237 - 21573)	(0 - 0)	(228376 - 261469)	(26345 - 51973)

Note: Credibility intervals (90%) are included in parentheses. The number of fish successfully screened from each stratum (N) is indicated. BAYES with a SPAM prior was used to estimate the proportions. The 90% credibility intervals of harvest estimates may not include the point estimate for very low extrapolated harvest numbers because less than 5% of iterations had values above zero.

Table 13.–Stock composition estimates (P) and extrapolated harvests (H) from mixtures of fish captured in the Kasilof and Kenai Section set gillnet fisheries (Central District, East Side Subdistrict) analyzed by subsections in 2005, 2006, and 2007.

Dates	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
					Cohoe/Ninilchik 2005				
7/2-28	250	P	0.00	0.00	0.01	0.00	0.00	0.42	0.57
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.02)	(0.00 - 0.00)	(0.00 - 0.00)	(0.36 - 0.49)	(0.50 - 0.64)
		H	0	164	3,569	0	0	173,928	232,546
			(0 - 0)	(0 - 164)	(0 - 9148)	(0 - 0)	(0 - 0)	(145829 - 202888)	(203545 - 260728)
					South K. Beach 2005				
7/2-26	906	P	0.00	0.00	0.00	0.00	0.00	0.39	0.61
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.35 - 0.42)	(0.58 - 0.64)
		H	0	175	0	0	0	84,674	134,038
			(0 - 0)	(0 - 919)	(0 - 0)	(0 - 0)	(0 - 0)	(77559 - 92095)	(126573 - 141153)
					North K. Beach 2005				
7/11-26	850	P	0.00	0.00	0.00	0.00	0.00	0.65	0.35
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.61 - 0.68)	(0.32 - 0.39)
		H	0	20	20	20	0	128,386	69,620
			(0 - 0)	(0 - 119)	(0 - 79)	(0 - 0)	(0 - 0)	(121176 - 135437)	(62589 - 76810)
					North and South Salamatof 2005				
7/11-24	200	P	0.00	0.02	0.00	0.01	0.00	0.82	0.14
			(0.00 - 0.00)	(0.01 - 0.04)	(0.00 - 0.03)	(0.00 - 0.03)	(0.00 - 0.00)	(0.75 - 0.89)	(0.08 - 0.21)
		H	0	9,741	2,046	5,406	0	400,020	69,844
			(0 - 0)	(2533 - 20164)	(0 - 13979)	(195 - 13248)	(0 - 0)	(365439 - 433578)	(37844 - 102428)
					Cohoe/Ninilchik 2006				
6/26-7/22	1335	P	0.00	0.02	0.00	0.01	0.00	0.16	0.82
			(0.00 - 0.00)	(0.01 - 0.03)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.13 - 0.18)	(0.79 - 0.84)
		H	294	8,170	0	2,319	0	57,083	300,171
			(0 - 1399)	(5079 - 11593)	(0 - 0)	(920 - 4085)	(0 - 0)	(49243 - 65437)	(291449 - 308268)
					South K. Beach 2006				
6/26-7/22	665	P	0.00	0.00	0.00	0.00	0.00	0.07	0.93
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.05 - 0.09)	(0.91 - 0.95)
		H	0	0	0	0	0	15,160	194,811
			(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(0 - 0)	(11065 - 19758)	(190213 - 198885)

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Table 13.–Page 2 of 2.

Dates	N		West	Yentna	Susitna	Knik	Northeast	Kenai	Kasilof
					North K. Beach 2006				
7/10-17	189	P	0.00	0.00	0.00	0.00	0.00	0.26	0.73
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.20 - 0.34)	(0.66 - 0.80)
		H	6	0	0	7	0	3,108	8,627
			(0 - 43)	(0 - 0)	(0 - 0)	(0 - 46)	(0 - 0)	(2300 - 3988)	(7744 - 9437)
					North and South Salamatof 2006				
7/10-17	611	P	0.00	0.00	0.00	0.00	0.00	0.68	0.31
			(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.00)	(0.00 - 0.01)	(0.00 - 0.00)	(0.64 - 0.73)	(0.27 - 0.36)
		H	0	11	0	49	0	23,817	10,929
			(0 - 0)	(0 - 25)	(0 - 0)	(0 - 222)	(0 - 0)	(22267 - 25311)	(9436 - 12467)
					Cohoe/Ninilchik 2007				
6/25-7/21	878	P	0.01	0.06	0.00	0.02	0.00	0.37	0.54
			(0.00 - 0.01)	(0.04 - 0.08)	(0.00 - 0.01)	(0.01 - 0.03)	(0.00 - 0.00)	(0.33 - 0.41)	(0.50 - 0.58)
		H	2,513	23,470	773	8,004	116	141,943	209,879
			(657 - 5027)	(16317 - 31435)	(0 - 3480)	(4369 - 12257)	(0 - 851)	(126902 - 157525)	(194103 - 225191)
					South K. Beach 2007				
6/25-7/21	205	P	0.00	0.04	0.01	0.00	0.00	0.45	0.50
			(0.00 - 0.00)	(0.00 - 0.08)	(0.00 - 0.03)	(0.00 - 0.02)	(0.00 - 0.00)	(0.37 - 0.54)	(0.42 - 0.59)
		H	0	3,661	599	389	0	44,994	50,122
			(0 - 0)	(0 - 8121)	(0 - 3312)	(0 - 2165)	(0 - 0)	(36494 - 53664)	(41652 - 58603)
					North K. Beach 2007				
7/9-28	203	P	0.01	0.01	0.01	0.00	0.00	0.61	0.36
			(0.00 - 0.02)	(0.00 - 0.04)	(0.00 - 0.04)	(0.00 - 0.00)	(0.00 - 0.00)	(0.52 - 0.69)	(0.28 - 0.45)
		H	317	811	860	0	0	37,038	21,975
			(18 - 958)	(12 - 2306)	(0 - 2355)	(0 - 0)	(0 - 0)	(31834 - 42254)	(16832 - 27234)
					North and South Salamatof 2007				
7/9-28	997	P	0.00	0.06	0.00	0.03	0.00	0.85	0.06
			(0.00 - 0.00)	(0.05 - 0.08)	(0.00 - 0.00)	(0.02 - 0.04)	(0.00 - 0.00)	(0.82 - 0.88)	(0.04 - 0.08)
		H	0	21,732	68	9,377	0	291,282	19,816
			(0 - 0)	(15948 - 28098)	(0 - 342)	(5921 - 13279)	(0 - 0)	(281186 - 300660)	(12321 - 27927)

Note: Credibility intervals (90%) are included in parentheses. The number of fish successfully screened from each stratum (N) is indicated. BAYES with a SPAM prior was used to estimate the proportions. The 90% credibility intervals of harvest estimates may not include the point estimate for very low extrapolated harvest numbers because less than 5% of iterations had values above zero.

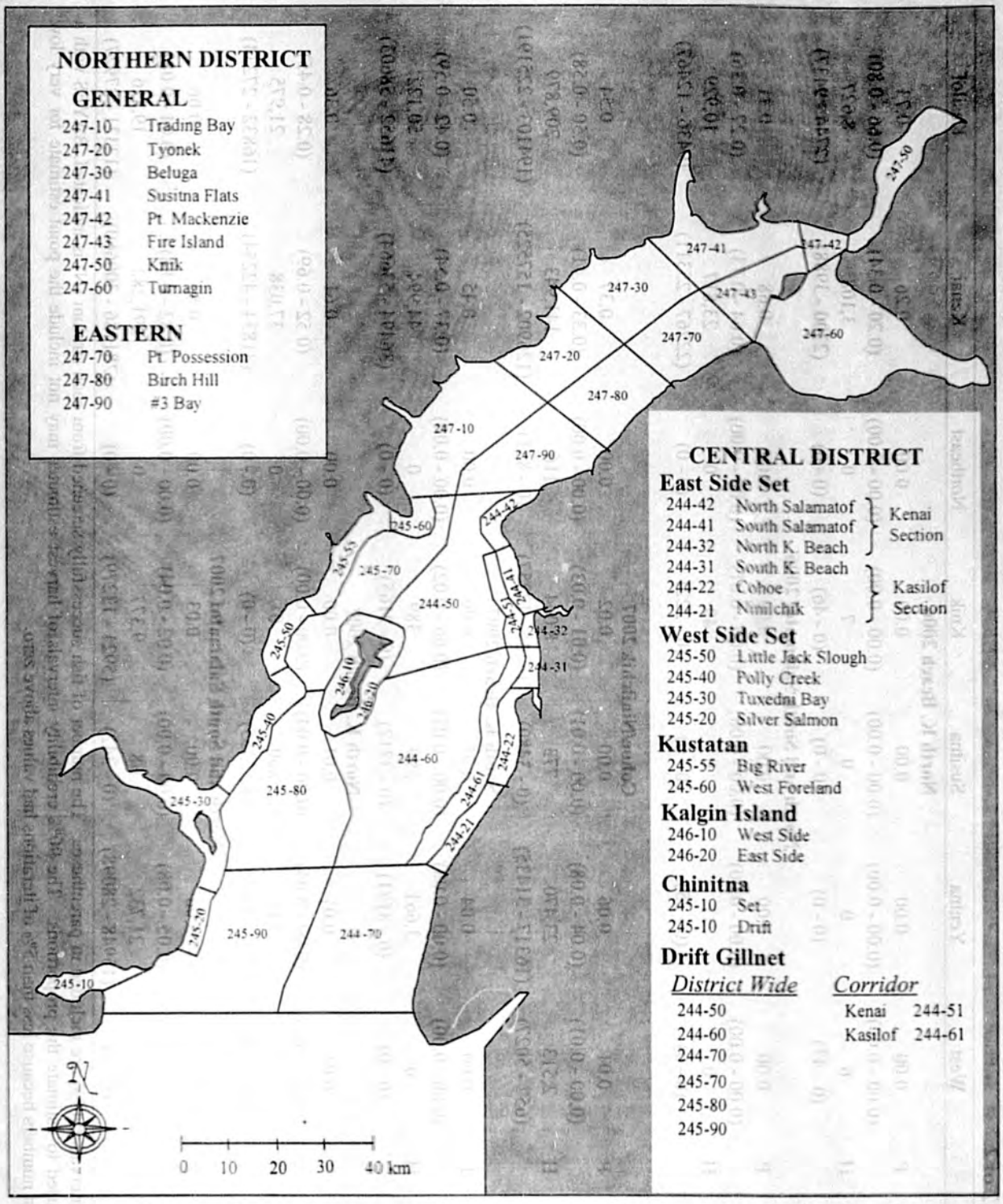

Figure 1.–Map of Upper Cook Inlet showing management fishing boundaries (statistical areas) for subdisticts, sections, and subsections within the Northern and Central Districts for both set and drift gillnet fisheries.

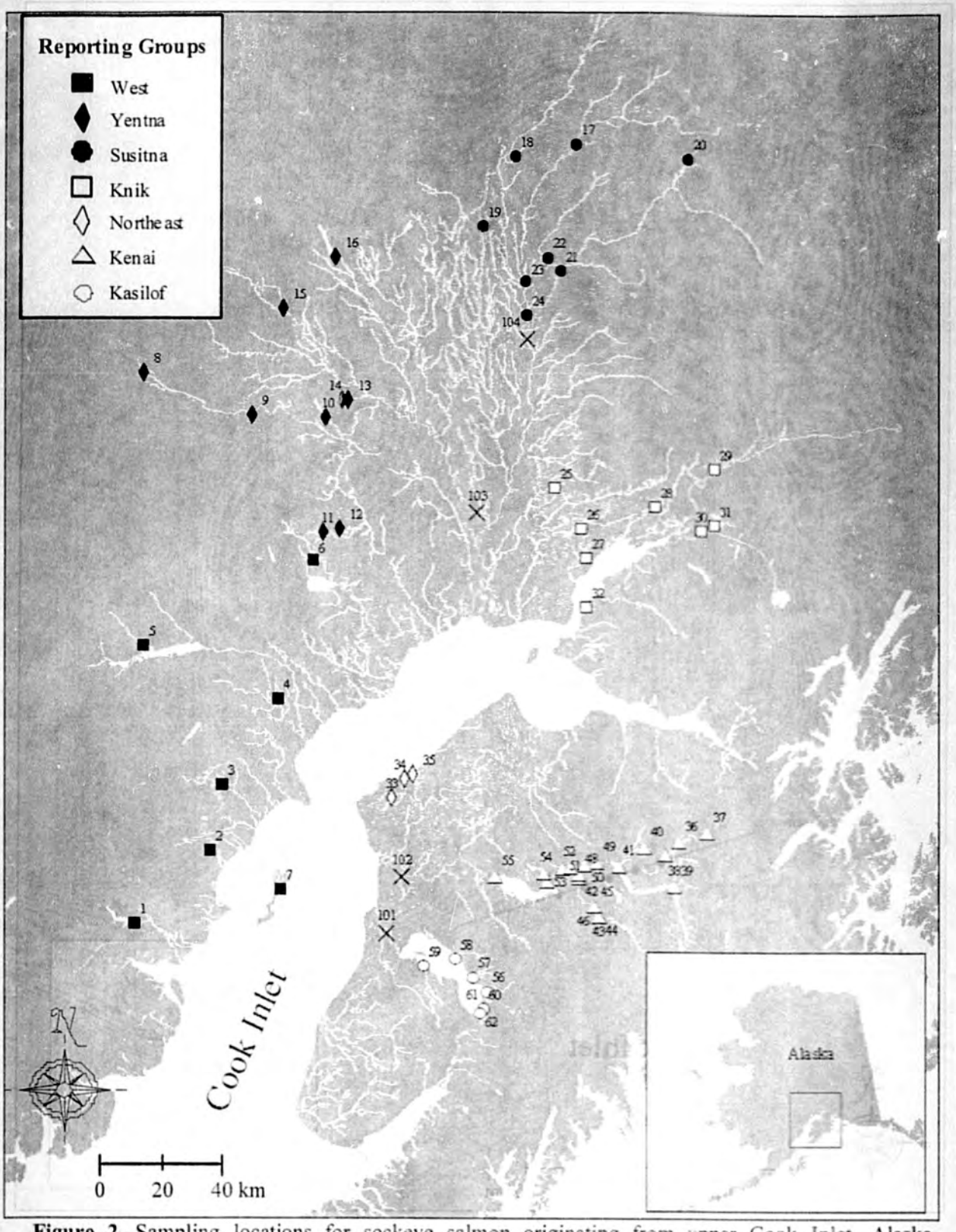

Figure 2.–Sampling locations for sockeye salmon originating from upper Cook Inlet, Alaska, 1992-2006 used to compile a genetic baseline.

Note: Fish wheels are designated by an "X". Symbols identify the seven regional reporting groups (see text).

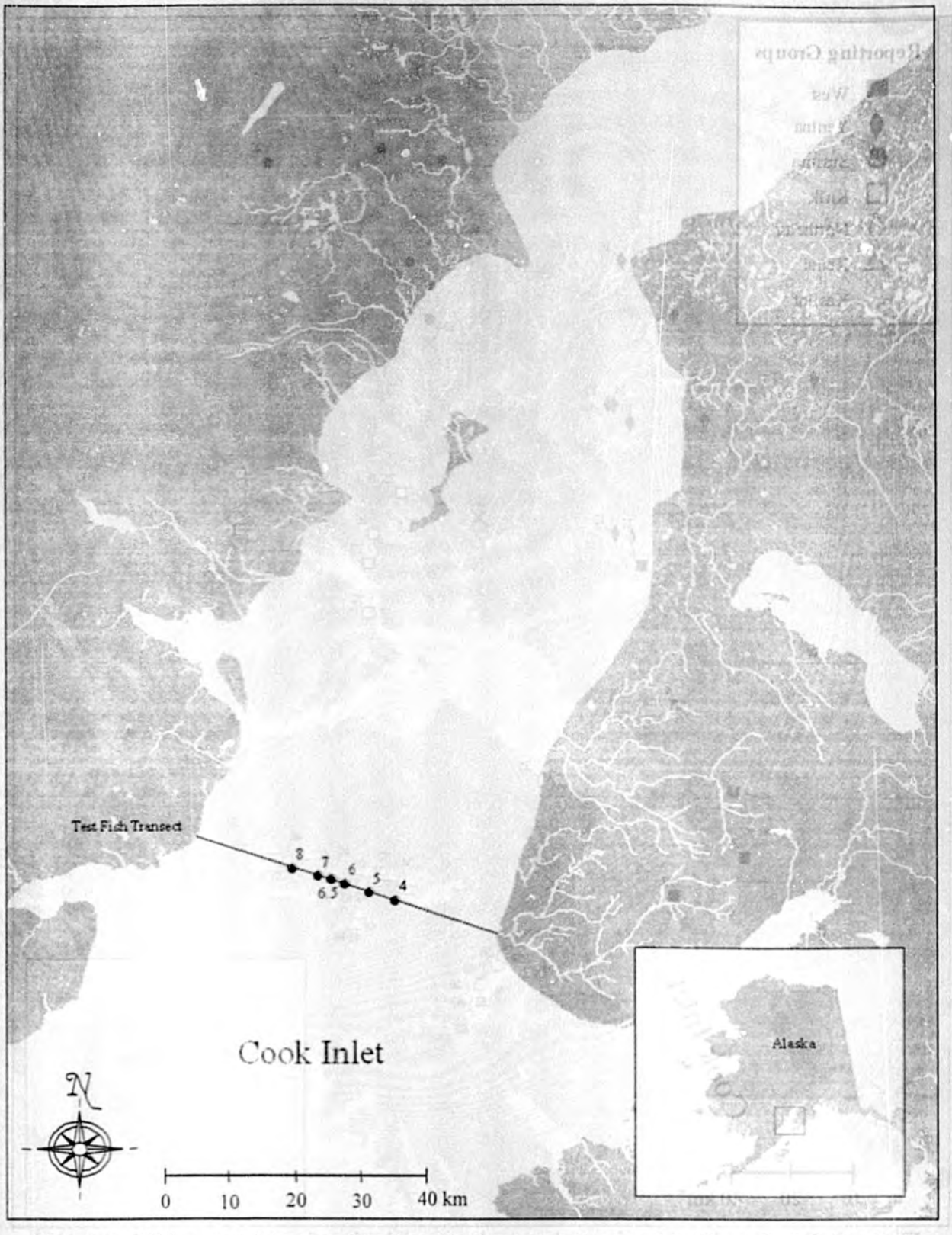

Figure 3.–Offshore test fishery stations for sockeye salmon migrating into Upper Cook Inlet, Alaska.

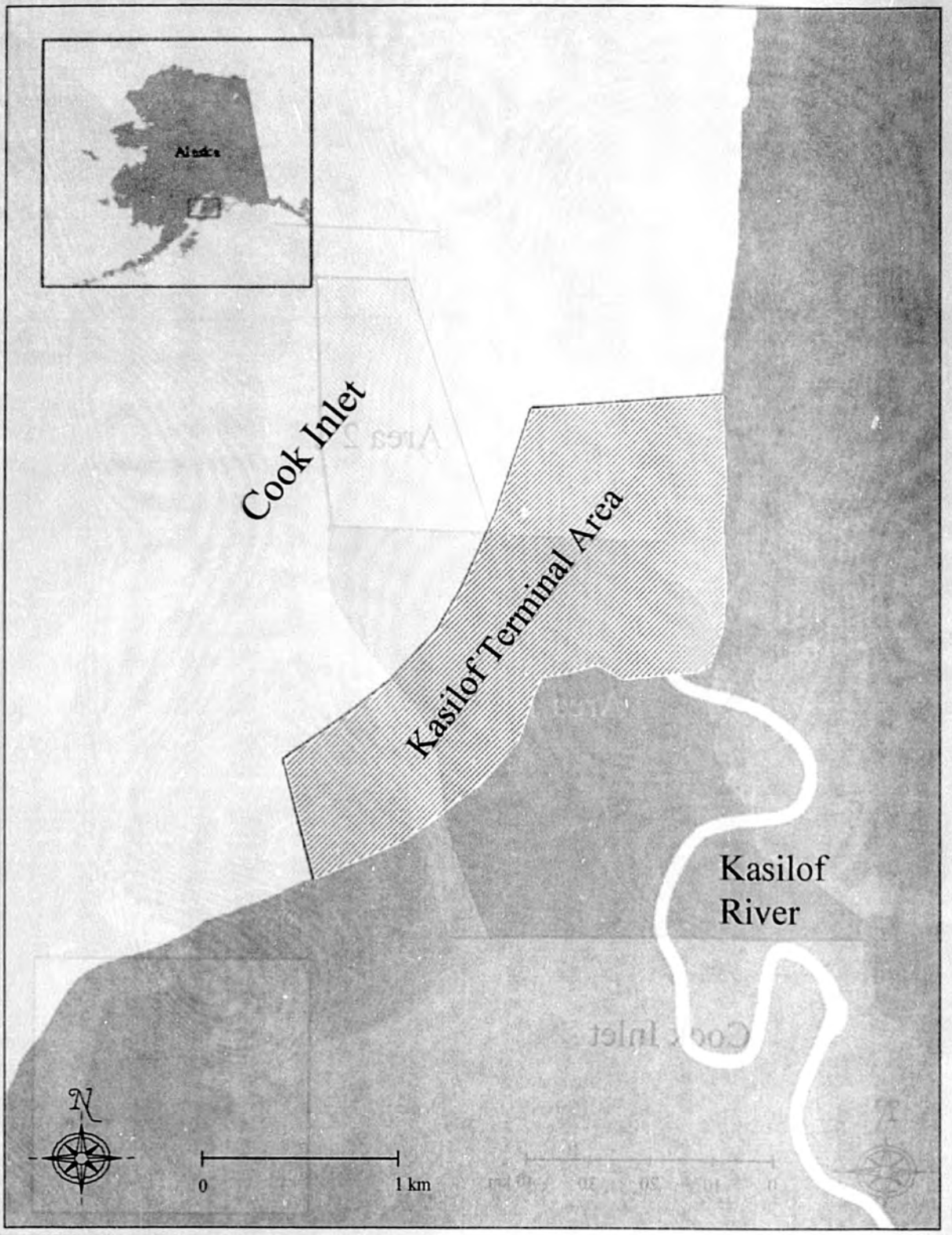

Figure 4.–Map of the mouth of the Kasilof River showing management fishing boundaries for the Kasilof Terminal Area (Central District, East Side Subdistrict).

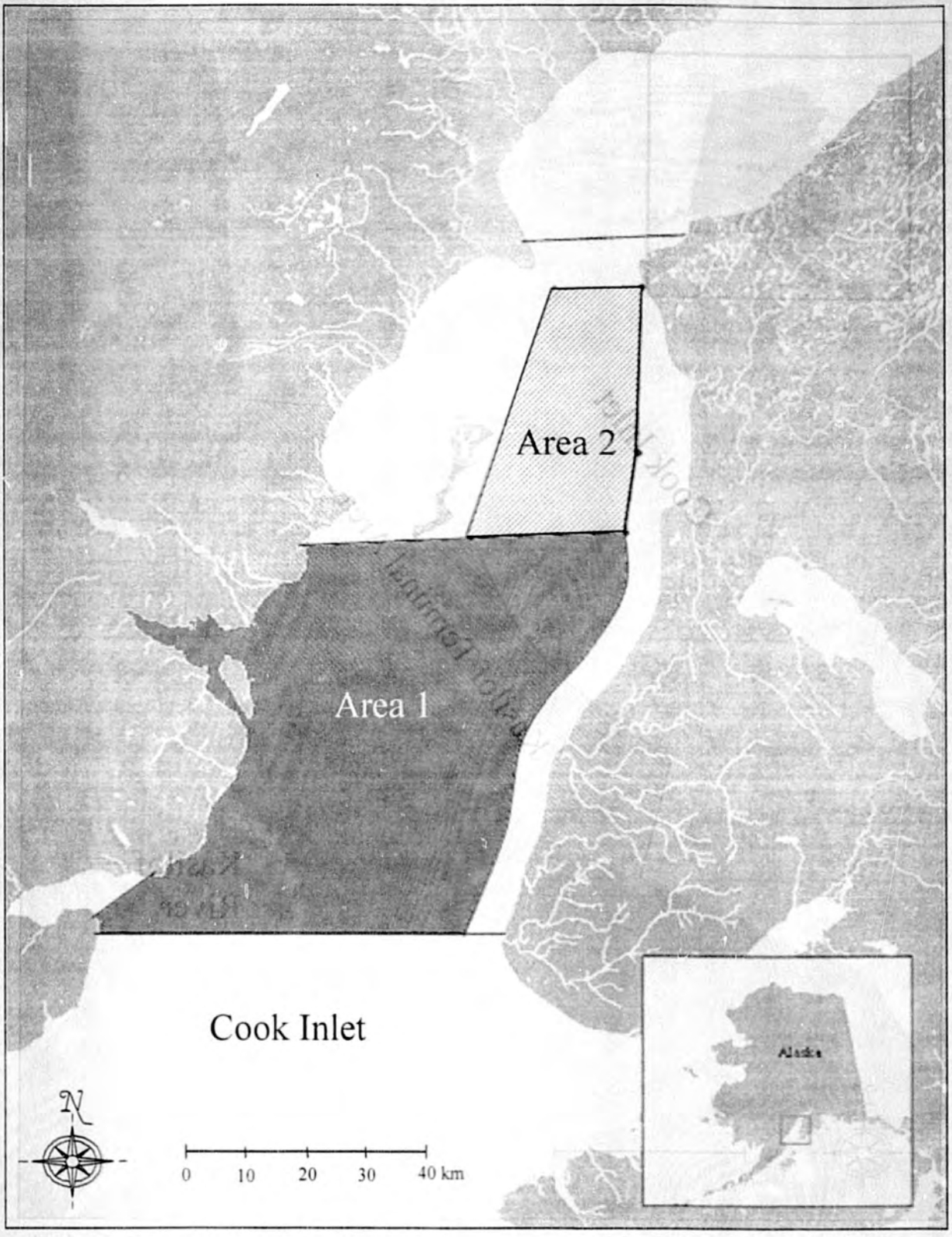

Figure 5.–Map of Central Cook Inlet showing management fishing boundaries for Area 1 and Area 2 for drift gillnet fisheries.

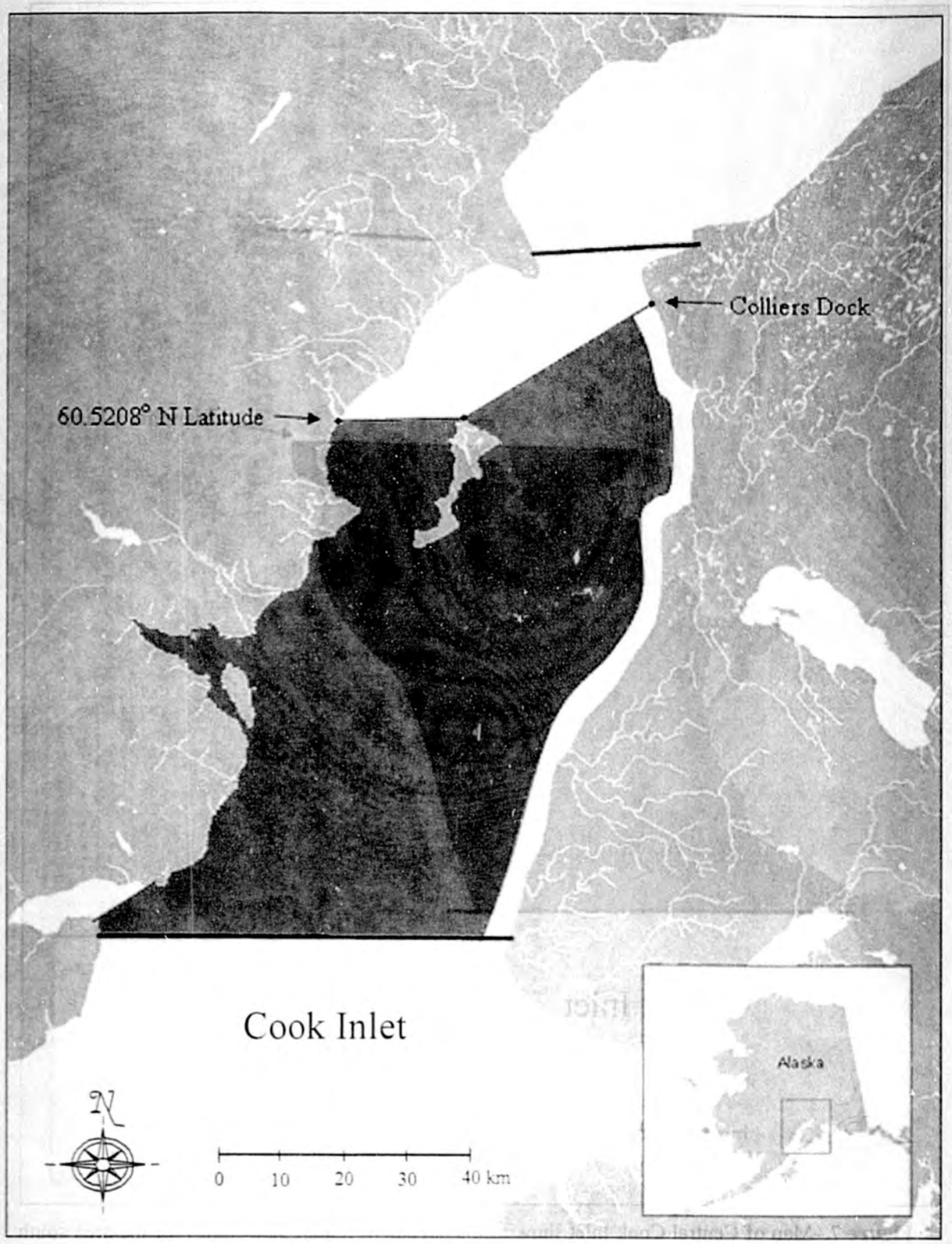

Figure 6.–Map of Central Cook Inlet showing management fishing boundaries for the area south of a line from Collier's Dock to Northwest Point on Kalgin Island to 60.5208° N on the western shore and north of the southern limit of the Central District.

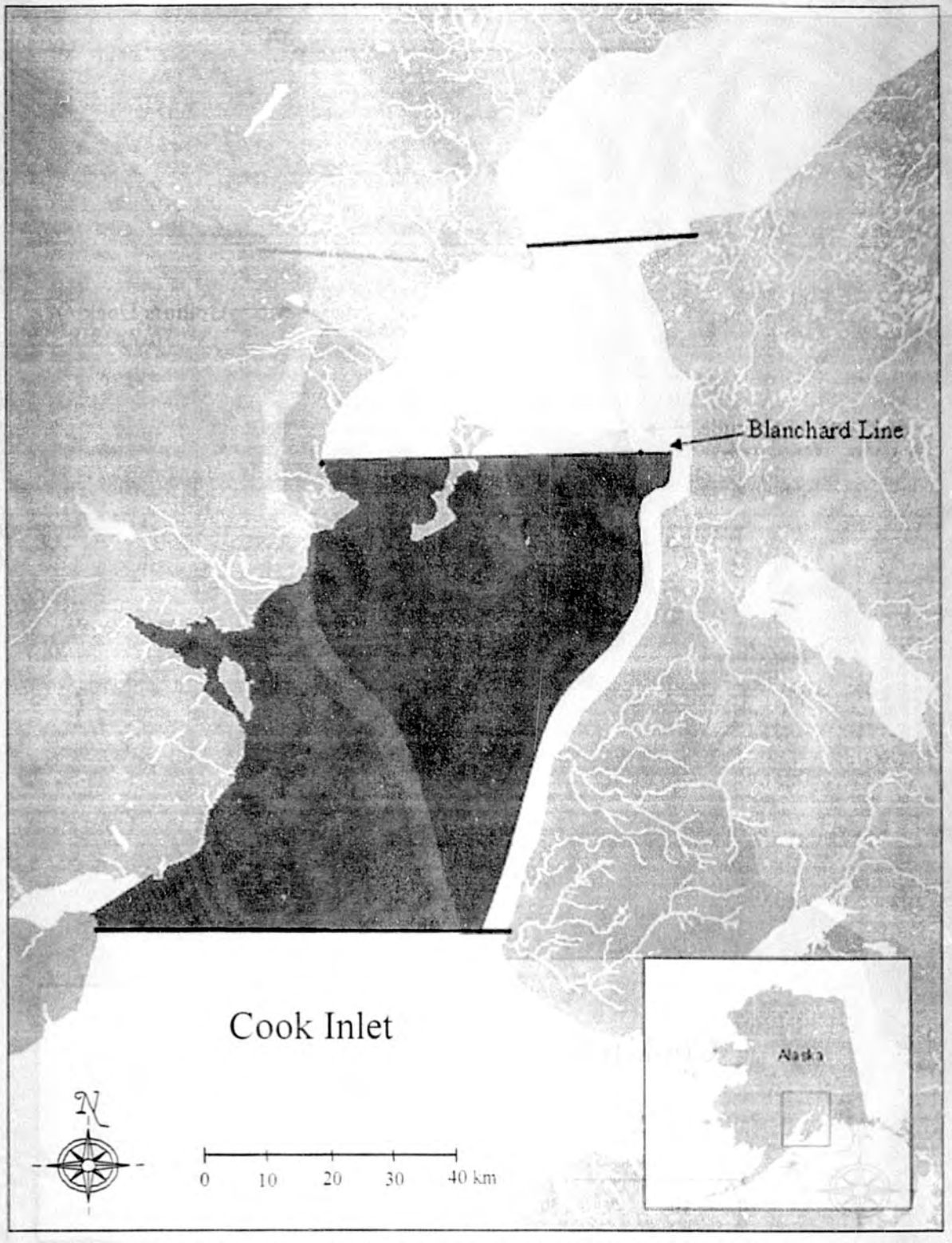

Figure 7.–Map of Central Cook Inlet showing management fishing boundaries for the area south of the Blanchard Line and north of the southern limit of the Central District.

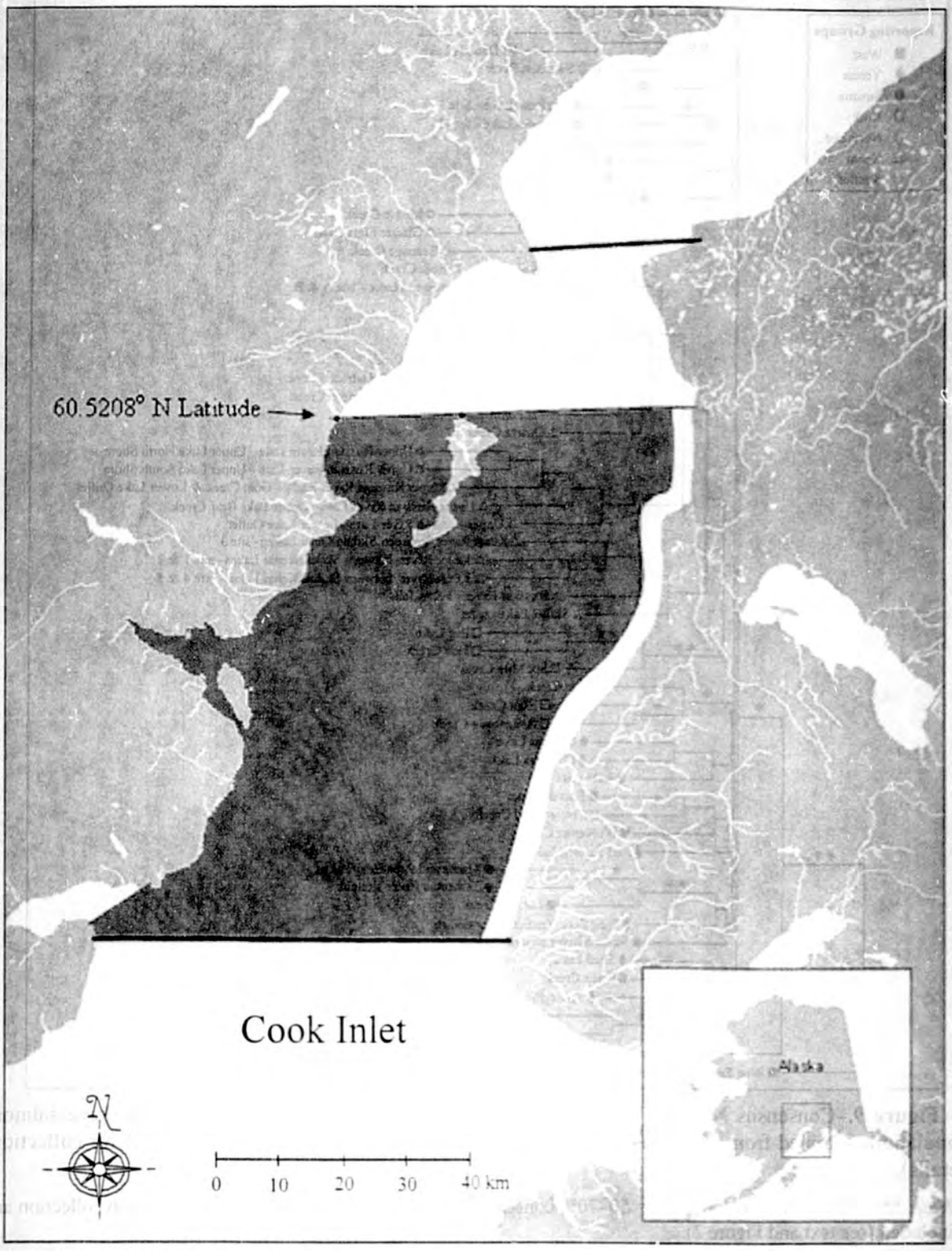

Figure 8.–Map of Central Cook Inlet showing management fishing boundaries for the area south of the longitudinal line that intersects with the north end of Kalgin Island and north of the southern limit of the Central District.

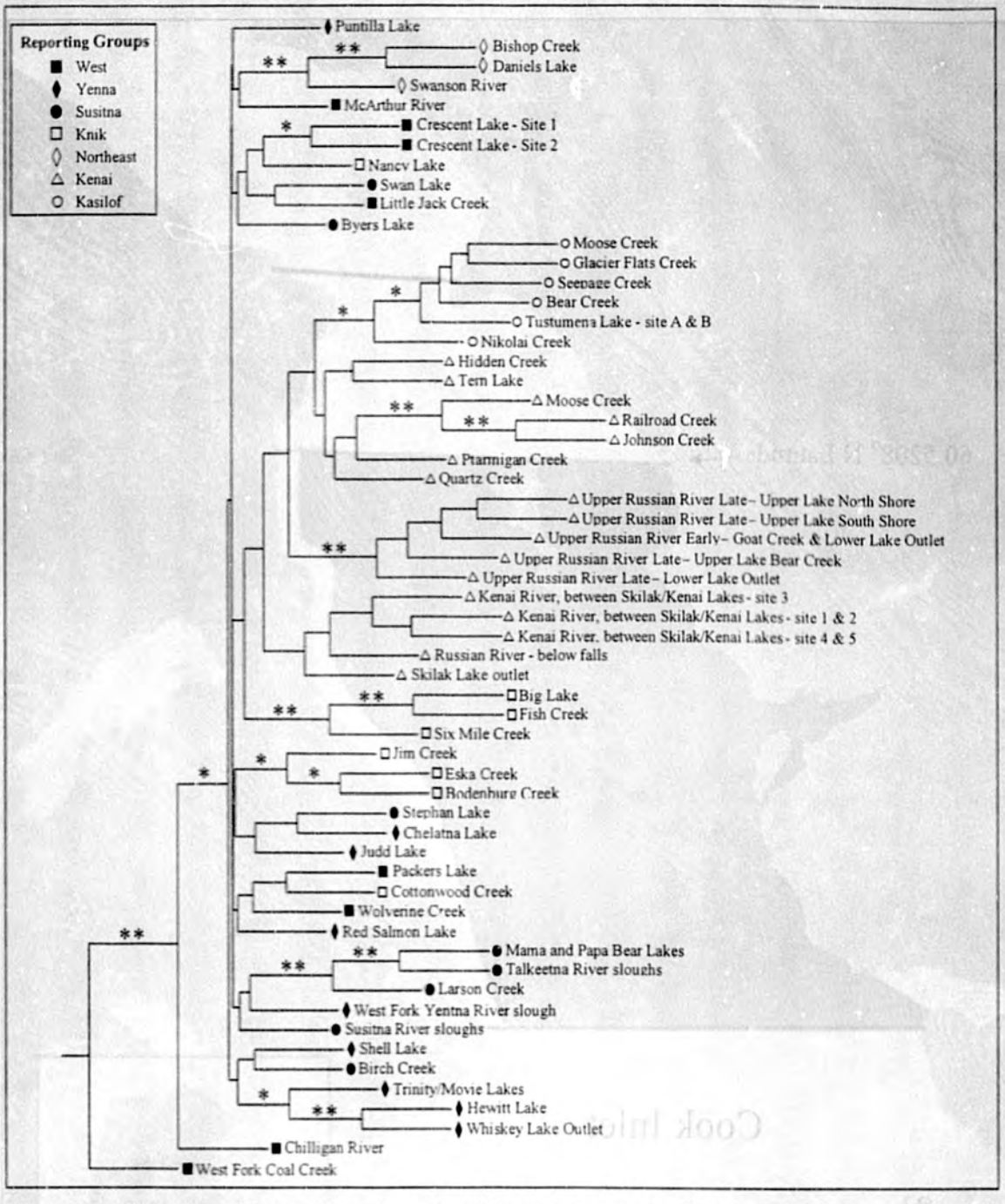

Figure 9.–Consensus N-J tree based on the Nei (1978) genetic distances between sockeye salmon populations sampled from spawning areas in drainages of Cook Inlet, Alaska (see Table 1 for collection details).

Note: ** = 70% consensus nodes; * = 50–70% consensus nodes. Reporting group symbols for each collection are included (see text and Figure 2).

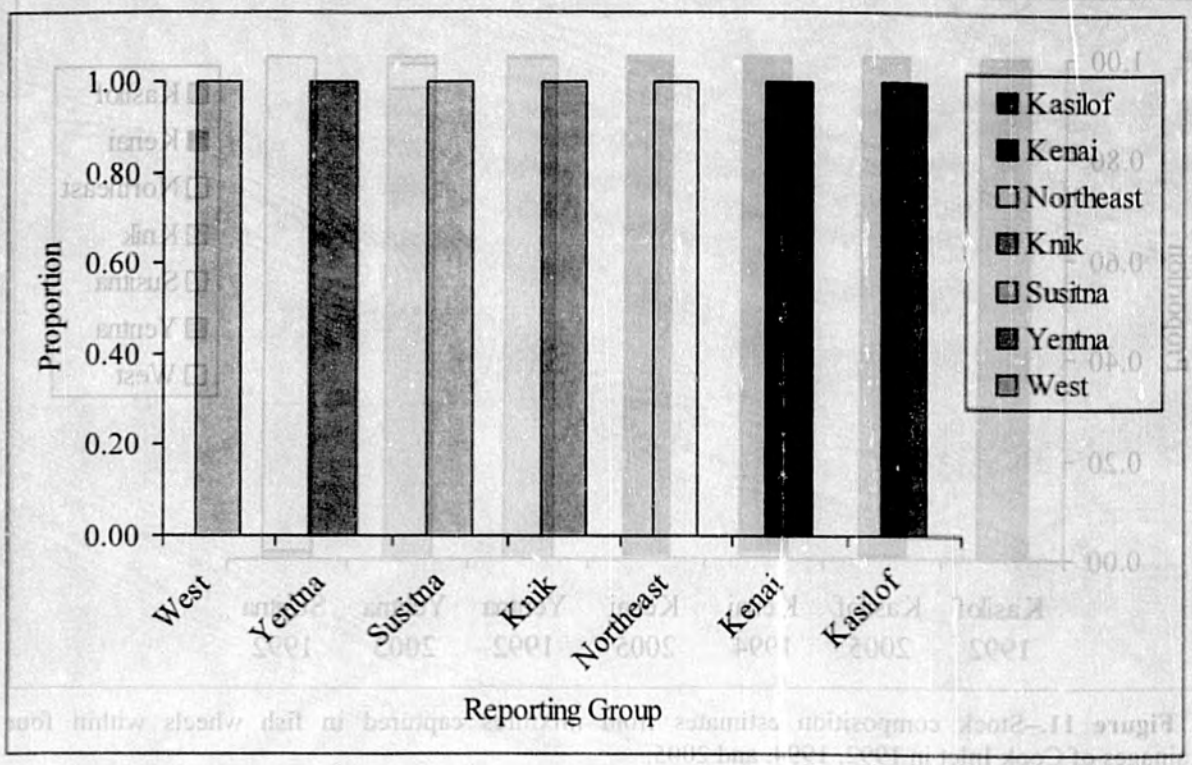

Figure 10.–Stock composition estimates from mixtures of 200 fish from each reporting group.

Note: New baselines were created to determine stock composition estimates for each reporting group, and these baselines excluded the 200 fish used in the mixtures.

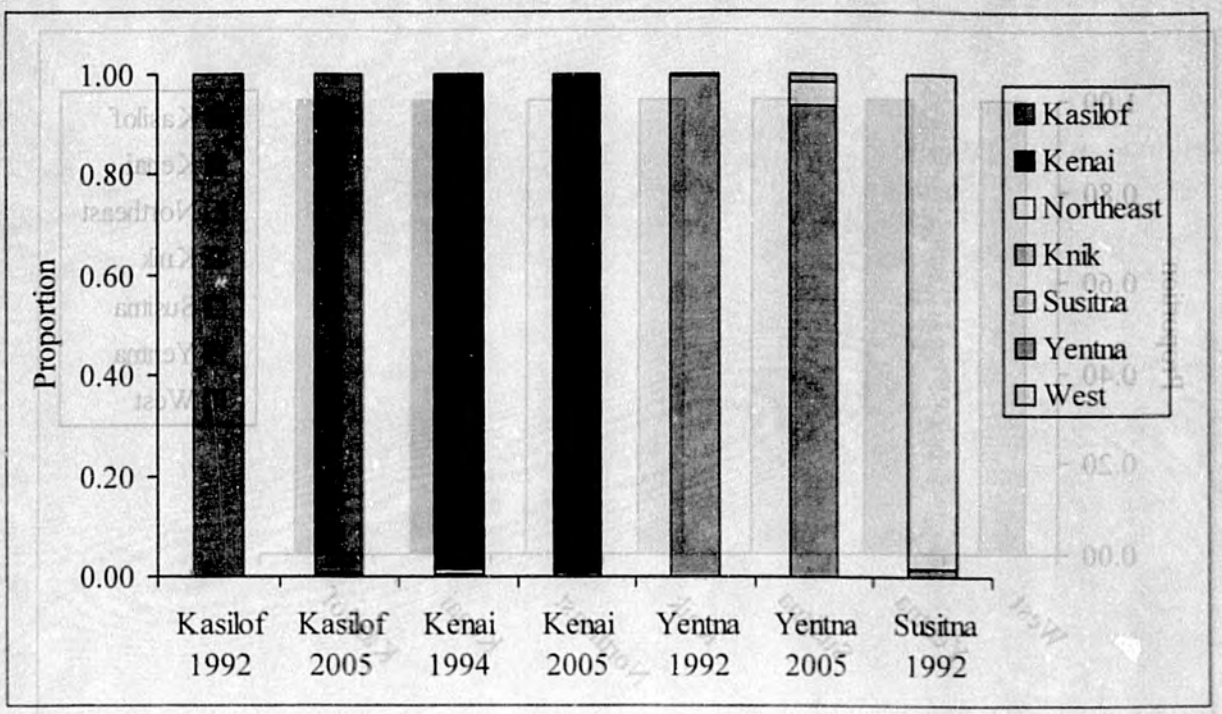

Figure 11.–Stock composition estimates from mixtures captured in fish wheels within four drainages of Cook Inlet in 1992, 1994, and 2005.

Note: BAYES with a SPAM prior was used to estimate the proportions.

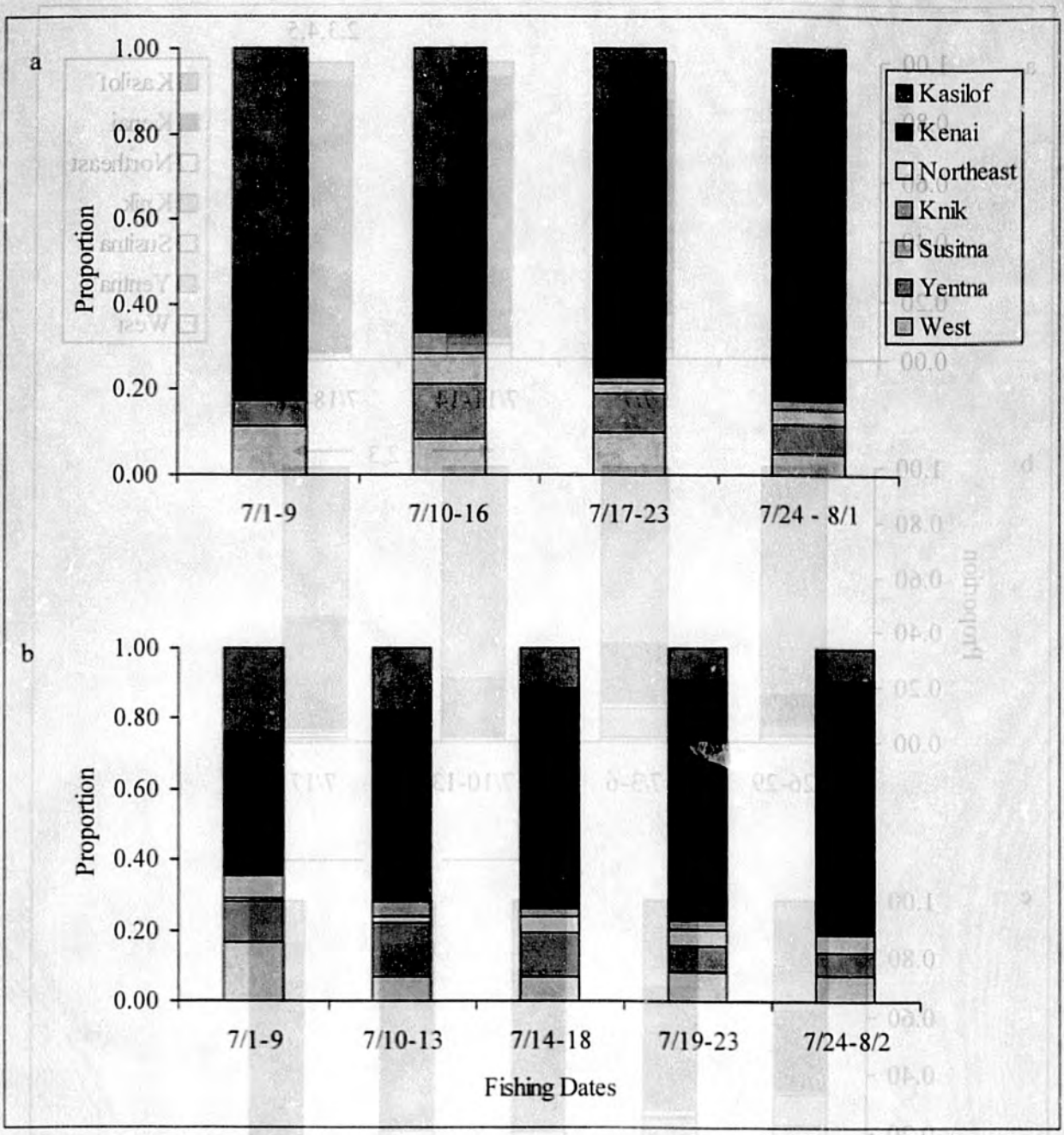

Figure 12.–Stock composition estimates for the Cook Inlet offshore test fishery taken in a) 2006, and b) 2007.

Note: BAYES with a SPAM prior was used to estimate the proportions.

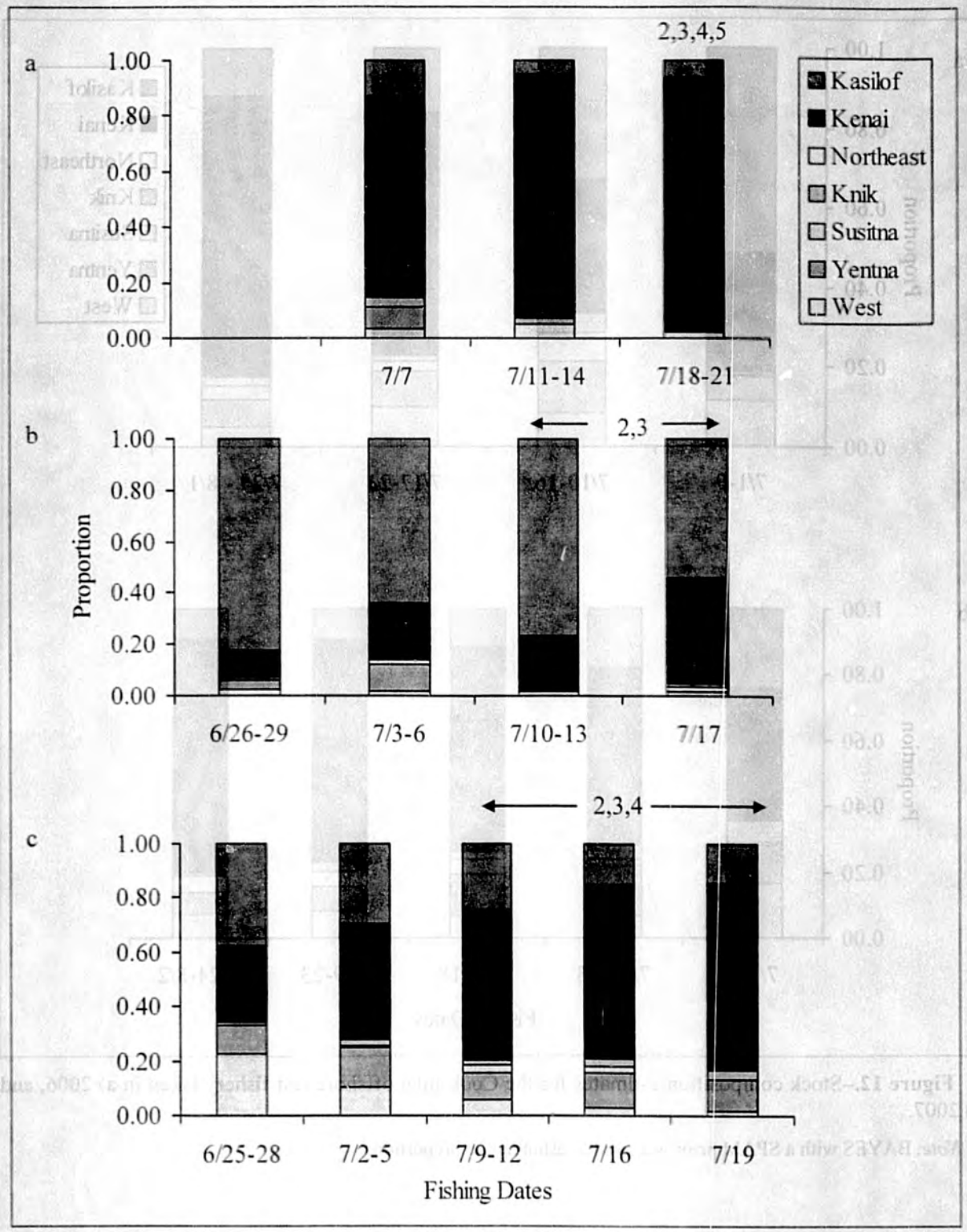

Figure 13.–Stock composition estimates for the Central District drift gillnet fishery from a) 2005, b) 2006, and c) 2007.

Note: Numbers above the bars indicate fisheries were restricted to particular areas: 2-Kasilof Corridor; 3-Kenai Corridor; 4-Area 1; 5-Area 2 (see Figures 1 and 4–8 and Table 2). BAYES with a SPAM prior was used to estimate the proportions.

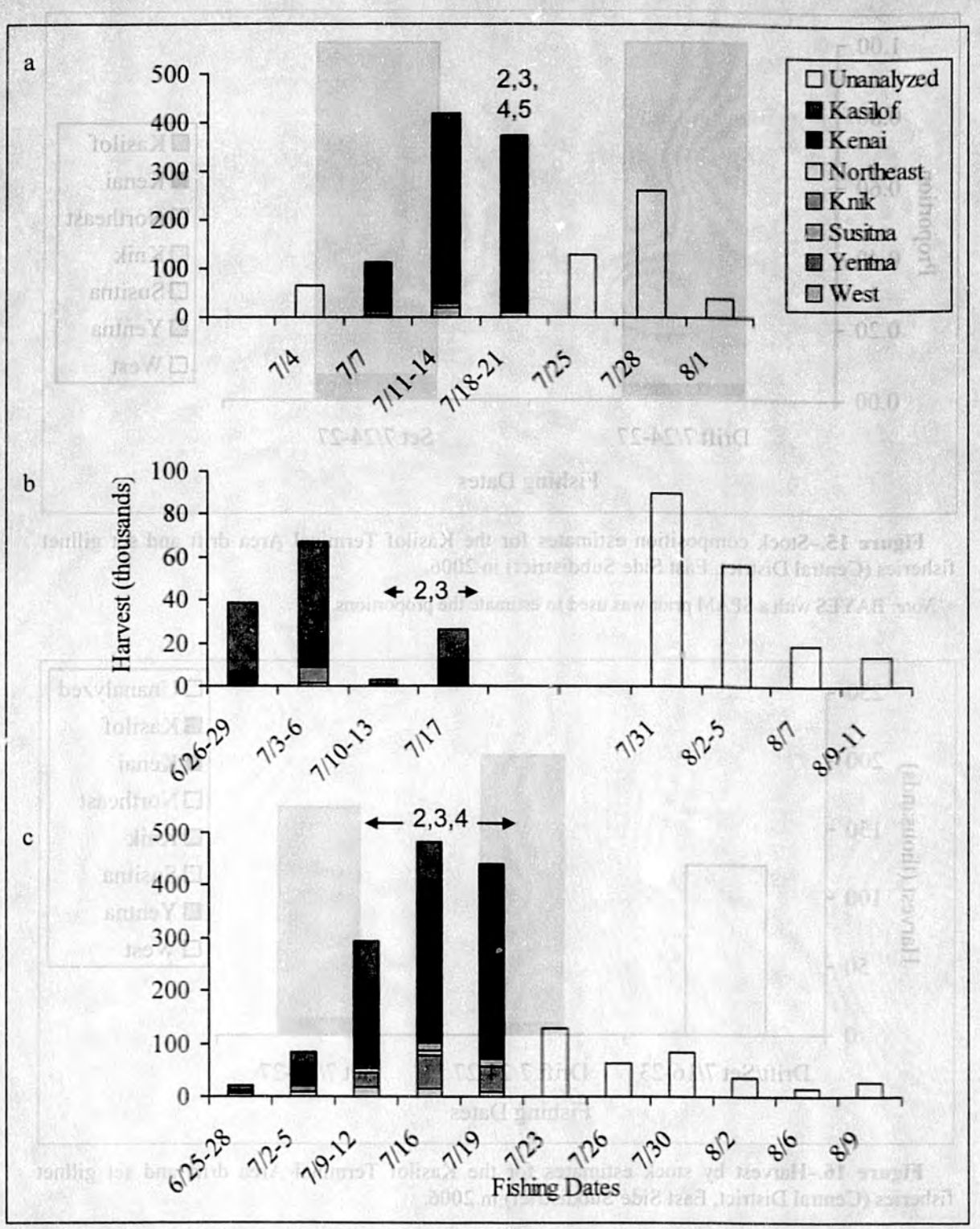

Figure 14.–Harvest by stock estimates for the Central District drift gillnet fishery from a) 2005, b) 2006, and c) 2007.

Note: Numbers above the bars indicate fisheries were restricted to particular areas: 2-Kasilof Corridor; 3-Kenai Corridor; 4-Area 1; 5-Area 2 (see Figures 1 and 4–8 and Table 2). BAYES with a SPAM prior was used to estimate the proportions.

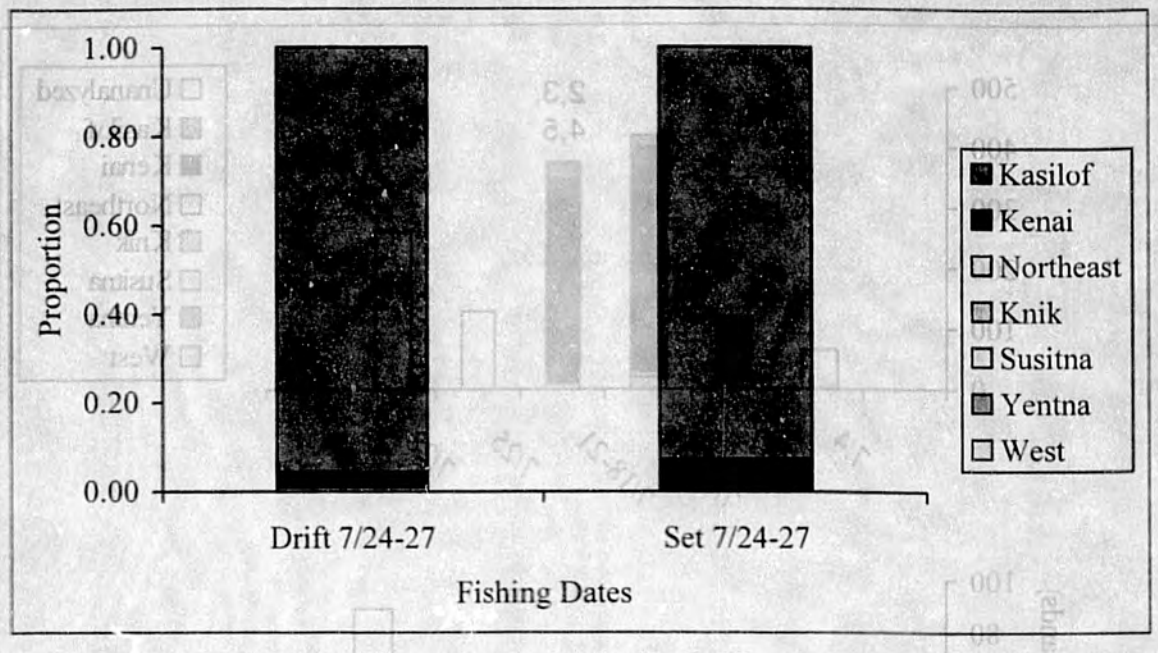

Figure 15.–Stock composition estimates for the Kasilof Terminal Area drift and set gillnet fisheries (Central District, East Side Subdistrict) in 2006.

Note: BAYES with a SPAM prior was used to estimate the proportions.

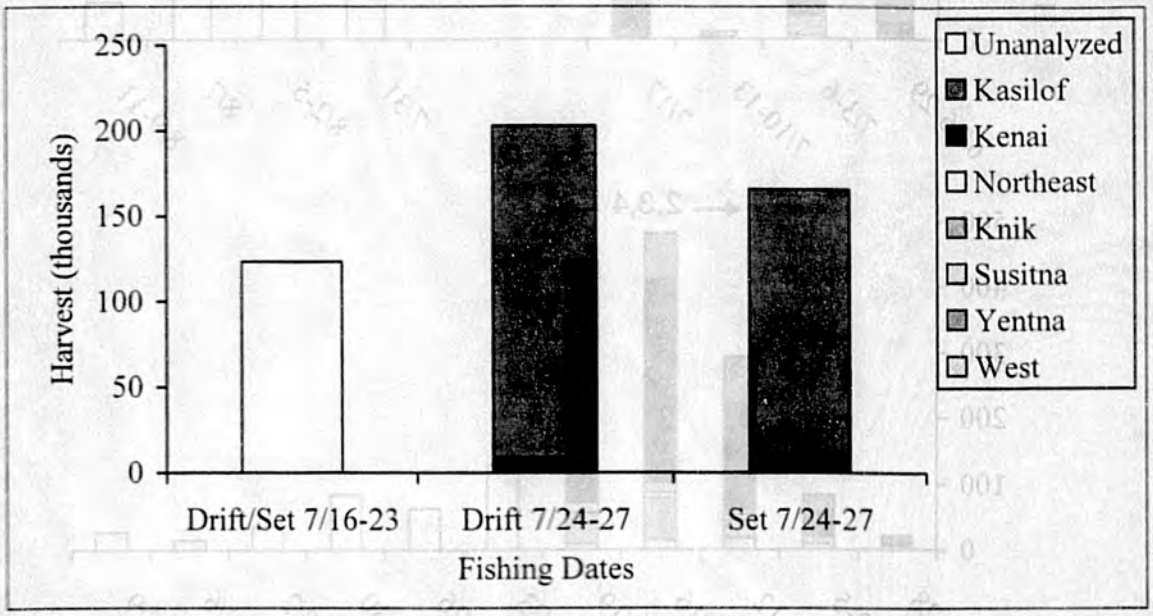

Figure 16.–Harvest by stock estimates for the Kasilof Terminal Area drift and set gillnet fisheries (Central District, East Side Subdistrict) in 2006.

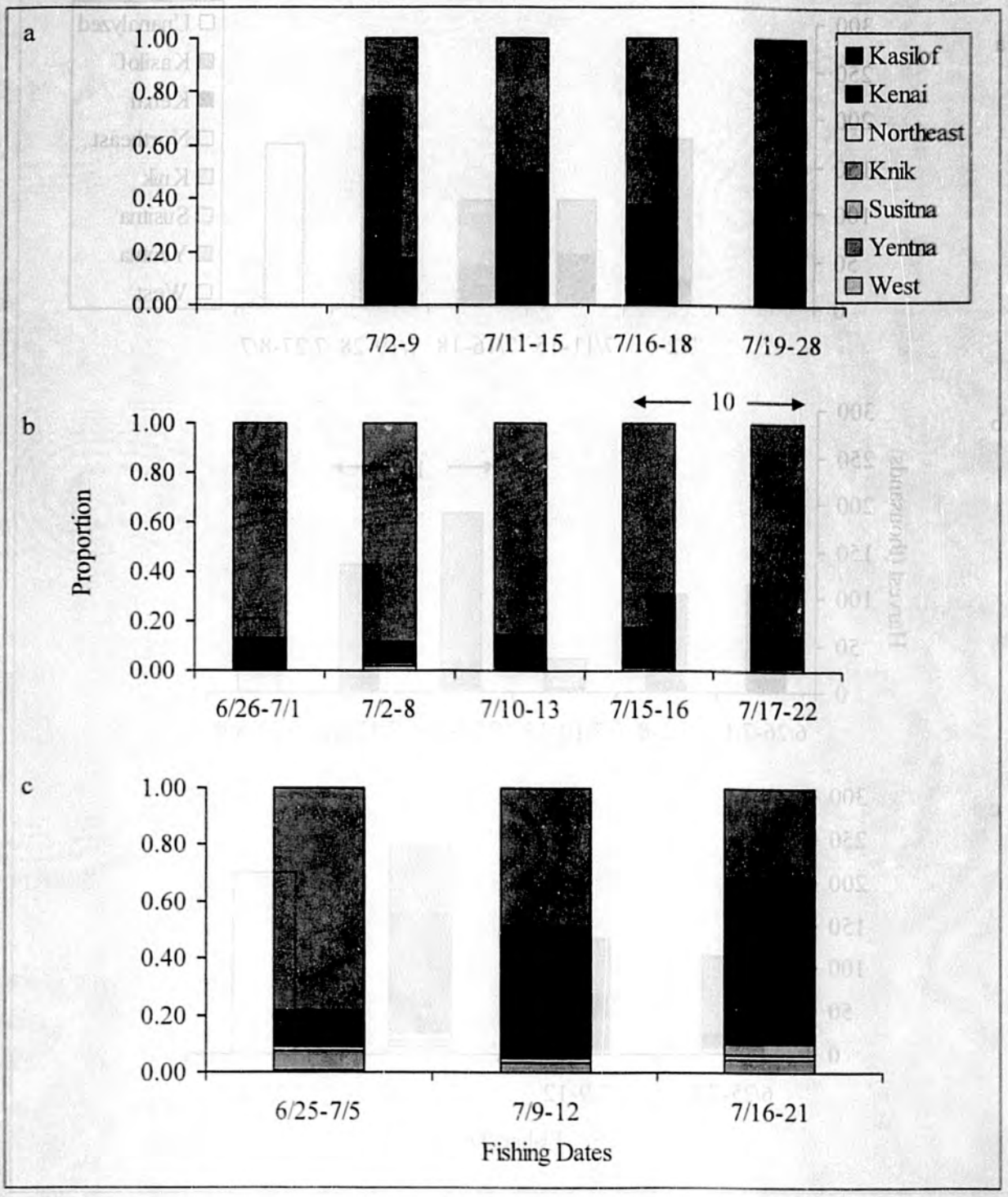

Figure 17.–Stock composition estimates for the Kasilof Section set gillnet fishery (Central District, East Side Subdistrict) from a) 2005, b) 2006, and c) 2007.

Note: Numbers above the bars indicate fishery restrictions during openings (10- Restricted to within 1/2 mile of shore: see Table 2). BAYES with a SPAM prior was used to estimate the proportions.

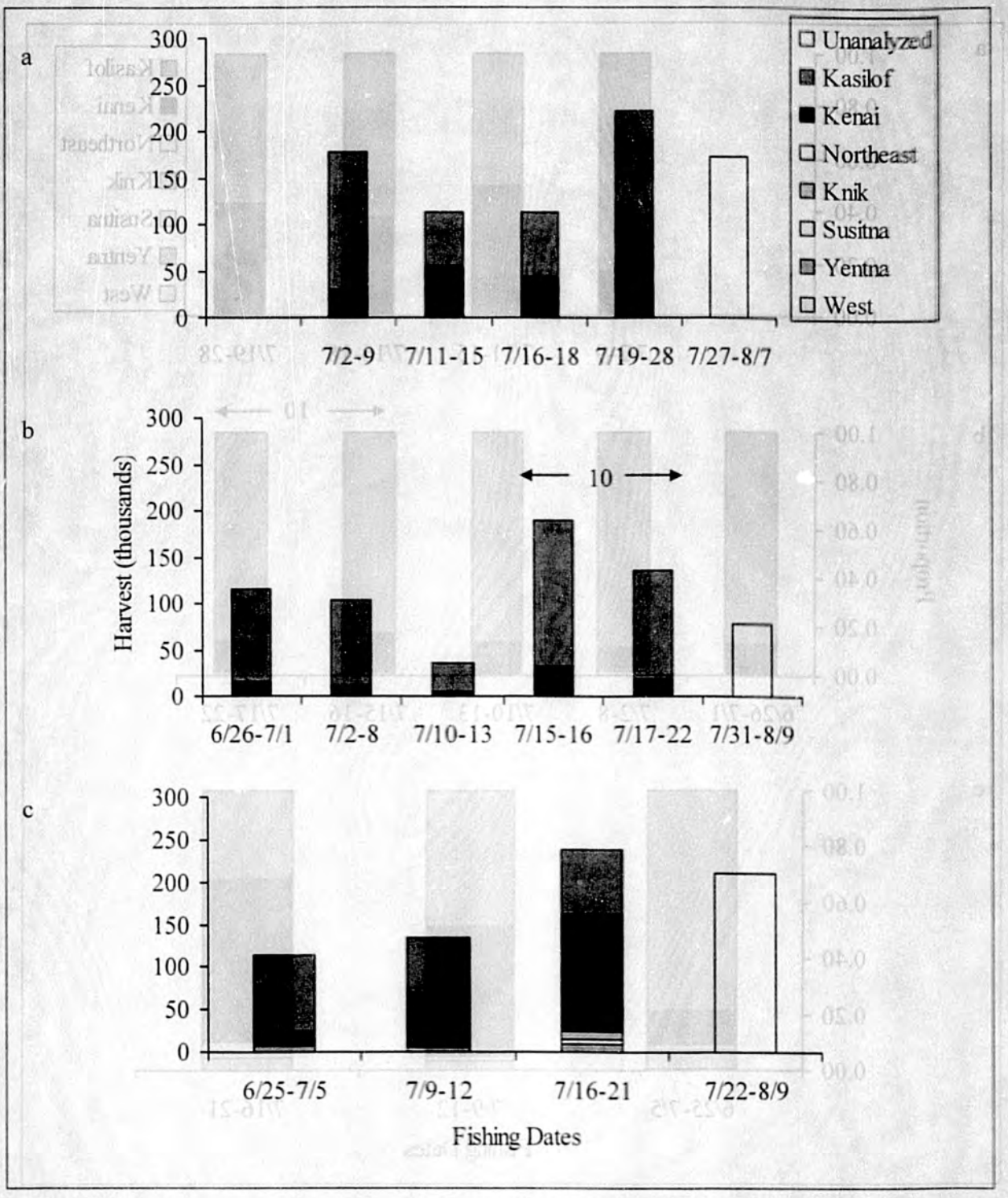

Figure 18.–Harvest by stock estimates for the Kasilof Section set gillnet fishery (Central District, East Side Subdistrict) from a) 2005, b) 2006, and c) 2007.

Note: Numbers above the bars indicate fishery restrictions during openings (10- Restricted to within 1/2 mile of shore: see Table 2). Fishing dates between subsections sometimes overlapped (see Table 2).

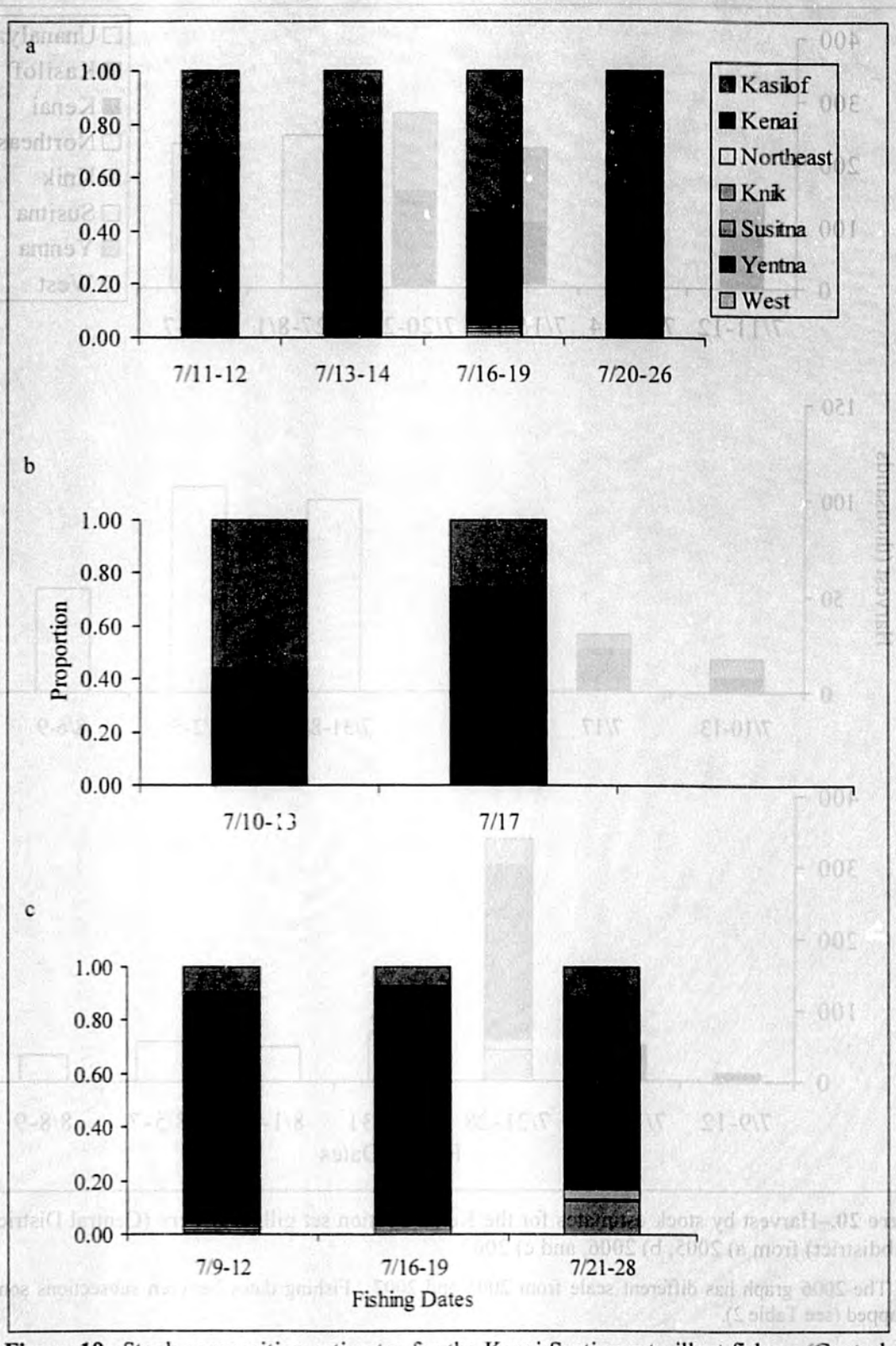

Figure 19.–Stock composition estimates for the Kenai Section set gillnet fishery (Central District, East Side Subdistrict) from a) 2005, b) 2006, and c) 2007.

Note: BAYES with a SPAM prior was used to estimate the proportions.

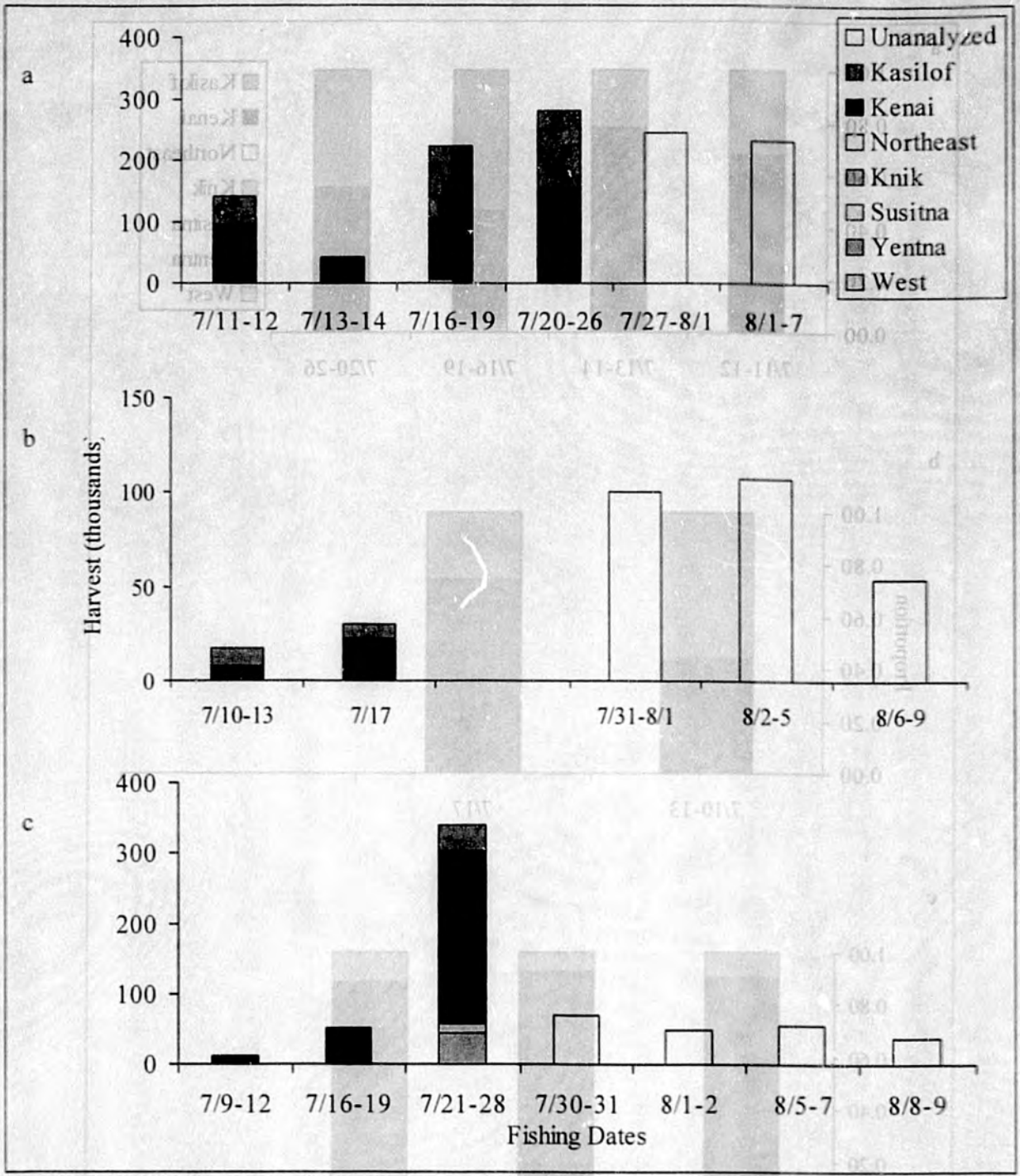

Figure 20.–Harvest by stock estimates for the Kenai Section set gillnet fishery (Central District, East Side Subdistrict) from a) 2005, b) 2006, and c) 2007.

Note: The 2006 graph has different scale from 2005 and 2007. Fishing dates between subsections sometimes overlapped (see Table 2).

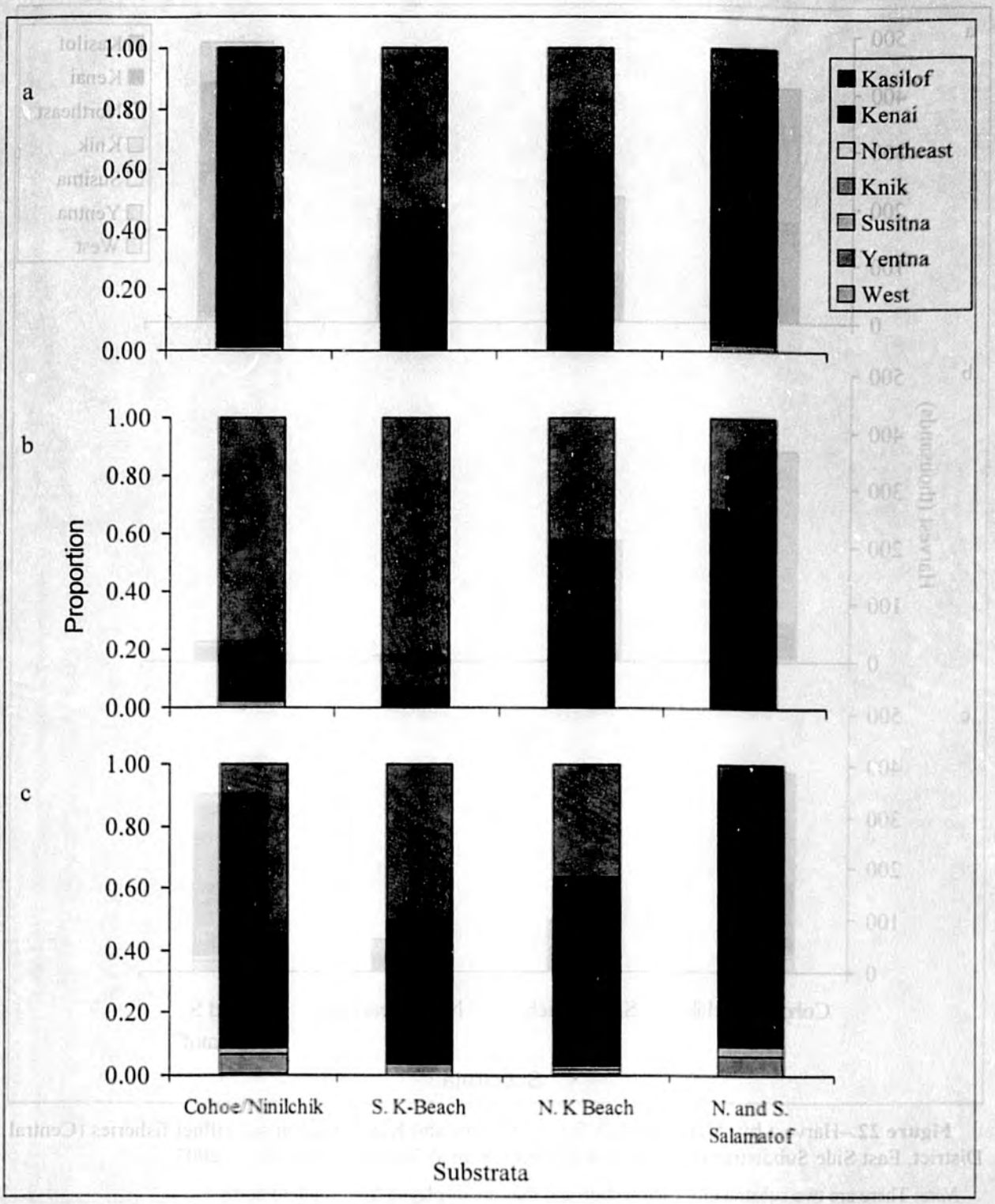

Figure 21.–Stock composition estimates for the Kasilof and Kenai Section set gillnet fisheries (Central District, East Side Subdistrict) divided into substrata from a) 2005, b) 2006, and c) 2007.

Note: There are two substrata for each section and they are displayed from south to north. BAYES with a SPAM prior was used to estimate the proportions.

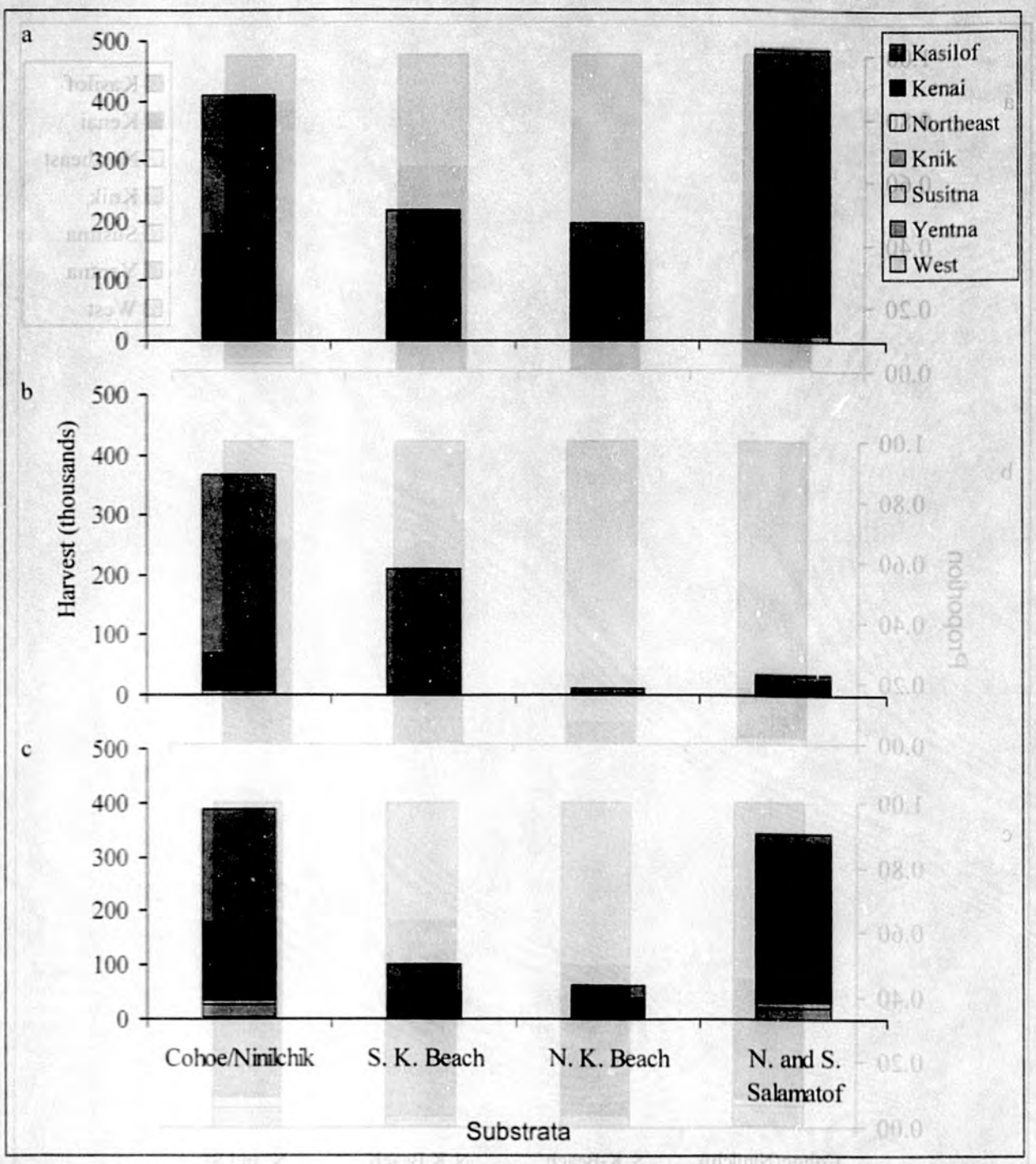

Figure 22.–Harvest by stock estimates for the Kasilof and Kenai Section set gillnet fisheries (Central District, East Side Subdistrict) divided into substrata from a) 2005, b) 2006, and c) 2007.

Note: There are two substrata for each section and they are displayed from south to north.

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES
NEWS RELEASE

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Date Issued: 4/14/2008

UPPER COOK INLET
2008 OUTLOOK FOR COMMERCIAL SALMON FISHING

SOCKEYE SALMON

A run of 5.6 million sockeye salmon is forecasted to return to UCI in 2008 with a harvest by all user groups of 3.9 million fish. The forecasted harvest in 2008 is about 0.2 million fish below the 20-year average harvest by all user groups. The sockeye salmon run forecast for the Kenai River of 3.1 million is 16% less than the 20-year average run of 3.7 million. Age-1.3 sockeye salmon typically comprise about 65% of the run to the Kenai River. The sibling model predicted a return of 2.6 million age-1.3 sockeye salmon to the Kenai River while the fry model predicted a return of 2.5 million age 1.3-sockeye salmon. Age-2.3 sockeye salmon typically comprise about 20% of the run to the Kenai River. A sibling model based upon the return of age-2.2 sockeye salmon in 2007 was used to forecast the return (286,000) of age-2.3 sockeye salmon to the Kenai River in 2008. The return of age-2.2 sockeye salmon in 2007 was 58% less than the 20-year average return for this age class. The predominant age classes in the 2008 run should be age-1.3 (85%) and age-2.3 (9%).

The sockeye salmon run forecast for the Kasilof River of 1.3 million is 33% greater than the 20-year average run of 968,000. Age-1.3 sockeye salmon typically comprise about 35% of the run to the Kasilof River. A sibling model based upon the return of age-1.2 sockeye salmon in 2007 was used to forecast the return (376,000) of age-1.3 sockeye salmon in 2008. The return of age 1.2-sockeye salmon last year was 57% greater than the 20-year average return for this age class. Age-1.2 sockeye salmon typically comprise about 30% of the run to the Kasilof River. A sibling model based upon an above average return of age-1.1 sockeye salmon in 2007 was used to forecast the return of age-1.2 sockeye salmon to Kasilof River. The sibling model predicted a return of 484,000 age-1.2 sockeye salmon. However, we are less confident in this forecast, because a smolt model predicted a return of only 252,000 age-1.2 sockeye salmon. Age-1.2 sockeye salmon migrated as smolts from the Kasilof River in 2006, when their estimated abundance was only 2.6 million, about

one-half of the 20-year average. The predominant age classes in the 2008 run should be age-1.2 (38%) and age 1.3 (29%).

The sockeye salmon run forecast for the Susitna River of 344,000 is 24% less than the 20-year average run of 453,000. The accuracy of the Susitna River forecast is uncertain due to the unknown amount of undercounting of the escapement which has recently been documented. The Board of Fish designated the Susitna River sockeye stocks as a stock of yield concern at the February 2008 meeting. The department has developed an "Action Plan" for management of those stocks. Proposed studies to determine the amount of undercounting with the Bendix Sonar are currently waiting funding in the legislature. The run forecast for Fish Creek of 53,000 fish is 67% less than the 20-year average run of 159,000. The sockeye salmon run forecast for Crescent River of 100,000 is 7% less than the 20-year average run of 108,000.

Forecast runs to individual freshwater systems are as follows:

System	Run	Goal
Crescent River	100,000	30,000–70,000
Fish Creek	53,000	20,000–70,000[a]
Kasilof River	1,286,000	150,000–250,000[b]
Kenai River	3,064,000	750,000–950,000[c]
Susitna River	344,000	90,000–160,000
Minor Systems	727,000	N/A

[a] Escapement goal includes up to 5,000 fish for broodstock for the hatchery program in Big Lake.

[b] The Kasilof River has an optimum escapement goal (OEG) of 150,000 to 300,000 to facilitate meeting the lower end of the Kenai River goal.

[c] The Kenai River is an abundance-based escapement goal; 750,000 to 950,000 is the appropriate inriver sonar goal for a 2 million to 4 million Kenai River sockeye salmon run.

[d] The escapement goal for the Yentna River is 90,000 to 160,000 sockeye salmon counted by sonar. In Kenai runs of over 4 million, there is a Yentna River OEG of 75,000 to 180,000 sockeye. The Yentna River is thought to account for approximately 50% of the total Susitna River run.

OTHER SPECIES' HARVEST PROJECTIONS

Very little information is available on which to base outlooks for the commercial harvests of the other salmon species. Using recent harvest trends and factoring in the expected intensity of the sockeye-based fishery, the following numbers represent our best estimate of the 2008 harvest:

Pink Salmon	380,000
Chum Salmon	100,000
Coho Salmon	200,000
Chinook Salmon	20,000

2008 REGULATORY CHANGES

There were many regulatory changes made by the Alaska Board of Fisheries during the February meeting that will be implemented during the 2008 season. The following summary is for informational purposes only and is not a comprehensive review. Regulation booklets are currently

being printed and will be available prior to the beginning of fisheries. Regulation language will be available from department offices prior to booklets being published.

One of the most important changes at the 2008 Alaska Board of Fisheries meeting was the clarification that managing to meet established escapement goals is the Department's primary objective.

Northern District Set Gillnet

- The Northern District king salmon fishery will open on the first Monday on or after May 25 and remain open for 12-hour (7:00 a.m. to 7:00 p.m.) fishing periods on Mondays through June 24, unless closed by emergency order. The area from an ADF&G regulatory marker located 1 mile south of the Theodore River to the Susitna River remains open for one period only, on the second regular Monday period, this year that period will be June 2.
- Susitna River sockeye salmon were found by the Board to be a stock of yield concern. An action plan was developed to conservatively manage the commercial fishery while research continues to better understand the productivity of this stock. This action plan allows the Northern District set gillnet fishery to fish with no more than one net per permit from July 20 through August 6, unless the Department determines that the Yentna River escapement goal will be achieved. If so, the gear restriction may be relaxed by emergency order.

Upper Subdistrict Set Gillnet Fishery

- From the beginning of the fishing season through July 7, or until the Kenai and East Forelands Sections set gillnet fisheries open, there is to be a weekly no-fishing window of 36-hours in duration. The Board directed the department to make this a fixed window in time, and to begin it sometime between 7:00 p.m. on Thursdays and 7:00 a.m. on Fridays. The maximum number of emergency order hours that may utilized during this time frame remains at 48-hours per week.
- Use of the Kasilof River Special Harvest Area (KRSHA) should now occur only on rare occasions. The Board directed the department to use its emergency order authority to fish in traditional areas with more time than allowed for in the management plans, if needed, to allow additional harvests if Kasilof River sockeye salmon escapements were likely to exceed the escapement goal. The KRSHA is to be used only in cases when fishing in traditional areas does not provide for meeting escapement objectives.

Central District Drift Gillnet Fishery

- The Board outlawed the use of spotter planes 1-hour before a fishery opens and while the fishery is being prosecuted.
- The Board passed a regulation allowing permit "stacking". This allows two drift gillnet permit holders to fish on one boat and be allowed to fish a total of 200 fathoms of gear instead of the normal limit of 150 fathoms. Prior to fishing, the boat must be registered (see 5 AAC 21.333).
- After the opening of the set gillnet fishery in the Upper Subdistrict, fishing with drift gillnets may not occur within 1.5 miles of the mean high tide mark of the Kenai Peninsula shoreline in that area of the Kenai and Kasilof Sections of the Upper Subdistrict south of the Kenai River, nor within 1 mile of the mean high tide mark of the Kenai Peninsula shoreline in that area of

the Kenai and East Forelands Sections of the Upper Subdistrict north of the Kenai River, whenever the set gillnet fishery in that area is closed.

Single strand fishing gear

- Beginning with the 2008 season, commercial fishermen in UCI may now fish their full allotment of gear using single strand (monofilament) mesh. No registration with the Department is required prior to using single strand mesh gear.

2008 FISHING STRATEGY

Based on the sockeye salmon run forecast to Cook Inlet for 2008, restrictions during regular periods other than those directed by the management plans, are not anticipated. In the drift gillnet fishery, mandated restrictions require the fishing periods on July 10 and July 14 be restricted to the Kenai and Kasilof Sections and Drift Gillnet Area Number One (Figure 2). In addition, in runs of between 2 and 4 million sockeye salmon to the Kenai River; two regular fishing periods between July 16 and July 31 will be restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Areas One & Two (Figure 2). The date these two restrictions will occur on is dependant on how accurate the forecast is and how the season develops.

The use of the Kasilof Terminal fishery is unlikely in 2008.

Northern District Set Gillnet

- The Northern District king salmon fishery will be open for Monday periods between May 25 and June 24. In 2008 the fishery is scheduled to occur for five regular Monday periods, May 26, June 2, 9, 16 and 23. The area from an ADF&G regulatory marker located 1 mile south of the Theodore River to the Susitna River is open for one period only, on the second regular Monday period, this year that period will be on June 2. Fishing periods are from 7:00 a.m. to 7:00 p.m.
- During the regular season the number of nets from July 20 to August 6 will be reduced to a single net per permit until the escapement goal is projected to be achieved.

Central District Fisheries

Big River Fishery

The Big River Sockeye Salmon Management Plan was amended in 2005 to allow fishing in a portion of the Kalgin Island Subdistrict along the western shore from Light Point at 60° 29.00' N. lat., 151° 50.50' W. long. to the Kalgin Island Light on the southern end of the island at 60° 20.80' N. lat., 152° 05.09' W. long.

Upper Subdistrict Set Gillnet Fishery

Kasilof Section Prior to July 8

- The Kasilof Section opens on the first regular period on or after June 25, unless the department estimates that 50,000 sockeye salmon are in the Kasilof River prior to that date, at which time the commissioner may open the fishery, by Emergency Order (EO); however, the fishery may not open earlier than June 20.
- From the beginning of the fishery through July 7 the department may not allow more than 48 hours of additional fishing time per week (Sun through Sat) and will try to close the fishery

for 36 consecutive hours per week, which will begin between 7:00 p.m. on Thursdays and 7:00 a.m. on Fridays.

- Beginning July 8, or after the Kenai and East Forelands Sections open, the Kasilof Section will be managed in combination with the Kenai and East Forelands Sections.

Kenai, Kasilof and East Forelands Sections

After July 8, or after the Kenai and East Forelands Sections fishing season opens, the following fishing scenarios are possible depending on run strength to the Kenai River:

- If the Kenai assessment shows the run to be **less than 2 million Kenai sockeye salmon,** there will be no more than 24 hours of additional fishing time per week in the Upper Subdistrict and there are no mandatory window closures. If the Kenai and East Forelands Sections are not fished during regular or additional openings, the department may limit regular and additional periods in the Kasilof Section to within ½ mile of shore. After July 15, if the Kasilof escapement is projected to exceed 300,000 sockeye salmon, an additional 24-hours of fishing time per week is available within ½ mile of shore in the Kasilof Section.
- If the Kenai assessment is **between 2 and 4 million Kenai River sockeye salmon,** the Department may allow up to 51 hours of additional fishing time per week and will close the Upper Subdistrict for a 36-hour closed period, which will begin between 7:00 p.m. on Thursdays and 7:00 a.m. on Fridays. In addition there will be a second 24-hour closed fishing period per week to be implemented at the Department's discretion. If the Kenai and East Forelands Sections are not fished, the department may limit regular and extra periods in the Kasilof Section to within ½ mile of shore.
- If the Kenai assessment changes to a run of **more than 4 million Kenai River sockeye salmon**, the department may allow up to 84 hours of additional fishing time per week and will close the Upper Subdistrict set gillnet fishery for a 36 hour period, which will begin between 7:00 p.m. on Thursdays and 7:00 a.m. on Fridays. There are no other mandatory no-fishing windows at this run strength. If the Kenai and East Forelands Sections are not fished, the department may limit regular and extra periods in the Kasilof Section to within ½ mile of shore.
- The Upper Subdistrict set gillnet fishery will close no later than August 15 and all restrictions and additional time regulations from July carry over into August. From August 11-15 the fishery is open for regular periods only.

Central District Drift Gillnet Fishery

- The drift fishery opens the third Monday in June or June 19, whichever is later.
- From July 9 through July 15,
  - Drift gillnet fishing is restricted for two regular fishing periods to the Kenai and Kasilof Sections and Drift Area One described below.
- From July 16 through July 31,
  - In runs of less than 2 million sockeye salmon to the Kenai River there will be two regular 12-hour fishing periods restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Area One;

- In runs of between 2 and 4 million sockeye salmon to the Kenai River; there will be two regular 12-hour fishing periods restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and in Drift Areas One & Two;
- In runs of over 4 million sockeye salmon to the Kenai River, there are no mandatory restrictions.

- From August 16 until closed by emergency order,
  - Drift Areas Three & Four are open for regular periods (Figure 3);
  - Chinitna Bay may be opened by emergency order.

Drift Fishing Areas

(1) Drift Area One: includes those waters of the Central District south of Kalgin Island at 60° 20.43' N. lat. (Figure 2);

(2) Drift Area Two: includes those waters of the Central District enclosed by a line from 60° 20.43' N. lat., 151° 54.83' W. long. to a point at 60° 41.08' N. lat., 151° 39.00' W. long. to a point at 60° 41.08' N. lat., 151° 24.00' W. long. to a point at 60° 27.10' N. lat., 151° 25.70' W. long. to a point at 60° 20.43' N. lat., 151° 28.55' W. long. (Figure 2);

(3) Drift Area Three; includes those waters of the Central District within one mile of mean lower low water (zero tide) south of a point on the West Foreland at 60° 42.70' N. lat., 151° 42.30' W. long. (Figure 3);

(4) Drift Area Four; includes those waters of the Central District enclosed by a line from 60° 04.70' N. lat., 152° 34.74' W. long. to the Kalgin Buoy at 60° 04.70' N. lat., 152° 09.90' W. long. to a point at 59° 46.15' N. lat., 152° 18.62' W. long. to a point on the western shore at 59° 46.15' N. lat.,

153° 00.20' W. long., not including the waters of the Chinitna Bay Subdistrict (Figure 3).

SET NET REGISTRATION AND BUOY STICKERS

All Cook Inlet setnet fishermen are still required to register prior to fishing for one of three areas of Cook Inlet: 1) the Upper Subdistrict of the Central District; 2) the Northern District; or, 3) all remaining areas of Cook Inlet (Greater Cook Inlet). Once registered for one of these three areas, fishermen may fish only in the area for which they are registered for the remainder of the year. No transfers will be permitted. Set gillnet permit holders fishing in the Northern District or the Greater Cook Inlet area can register at Department offices in Soldotna, Homer, or Anchorage or by mail. Forms are available at area offices or on the department's homepage at http://www.cf.adfg.state.ak.us/region2/ucihome.php. Fishermen wishing to register in the Upper Subdistrict must register in the **Soldotna ADF&G office only,** and must purchase buoy stickers at the time of registering.

SEASON OPENING DATES

Season opening dates for the various fisheries around the inlet are as follows:

- *Big River Fishery:* June 2 and continuing through June 23 unless the 1,000 Chinook salmon harvest limit is reached prior to that date. Weekly fishing periods are Mondays, Wednesdays, and Fridays from 7:00 a.m. to 7:00 p.m.

- *Northern District King Salmon Fishery:* May 26. There will be up to five fishing periods, the remaining periods are scheduled on June 2, 9, 16 and June 23. In that area from one mile south of the Theodore River to the Susitna River, there is only one open period during this fishery, which will occur on June 2 in 2008.
- *Western Subdistrict Set Net Fishery:* June 16.
- *All remaining set gillnet fisheries except the Upper Subdistrict:* June 26.
- *Upper Subdistrict Set Net Fishery:* June 26 for the Kasilof Section (that portion south of the Blanchard Line) unless opened earlier by EO (if 50,000 sockeye are in the river before the June 26 opener), but will not open before June 20. The Kenai and East Forelands Sections (that portion north of the Blanchard Line) will open July 10. All sections of the Upper Subdistrict will close for the season on or before August 15.
- *Drift Gillnet Fishery*: June 19.

GENERAL INFORMATION

The UCI commercial fisheries information line will again be available by calling 262-9611. The most recent emergency order announcement is always available on the recorded message line and catch, escapement and test fishing information is included whenever possible. All emergency order announcements are also faxed to processors as quickly as possible and posted to the Upper Cook Inlet web page at http://www.cf.adfg.state.ak.us/region2/ucihome.php. For very general information, we invite you to visit the Commercial Fisheries web page on the Internet at http://www.cf.adfg.state.ak.us/. If you would like to receive emails of all UCI commercial fisheries emergency orders, please log onto the following site (http://csfish.adfg.state.ak.us/newsrelease/select.php?dist=SOL) and click on "Subscribe" and you will be automatically signed up to receive the emergency orders as soon as they are posted to the website.

If, during the summer, fishermen have information or questions concerning the commercial fishery, the Soldotna Commercial Fisheries Division staff can be reached by phone at 262-9368, by fax at 262-4709 or by mail at 43961 Kalifornsky Beach Road, Suite B, Soldotna, 99669.

Latitude and Longitude are based on the North American Datum of 1983 (NAD 83) which is equilivalent to the World Geodetic System 1984 (WGS 84).

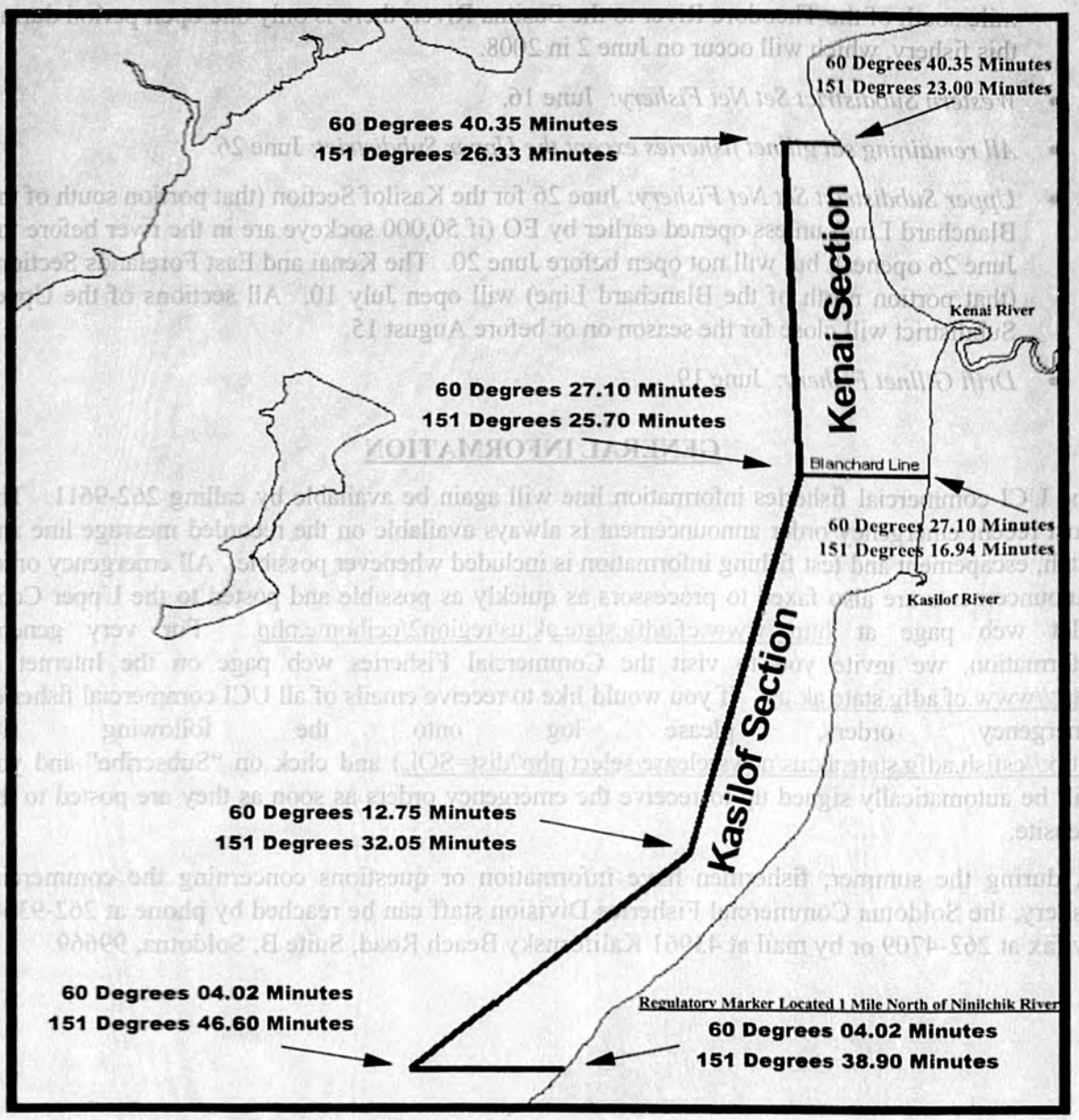

Figure 1. Map of the Kenai and Kasilof Sections with waypoint descriptions.

Drift Gillnet Area 1 & Area 2 Descriptions

AREA 2 DESCRIPTION	COORDINATES
1. Southwest Corner	60° 20.43' N. lat., 151° 54.83' W. long.
2. Northwest Corner	60° 41.08' N. lat., 151° 39.00' W. long.
3. Northeast Corner	60° 41.08' N. lat., 151° 24.00' W. long.
4. Blanchard Line Corridor Boundary	60° 27.10' N. lat., 151° 25.70' W. long.
5. Southeast Corner	60° 20.43' N. lat., 151° 28.55' W. long.

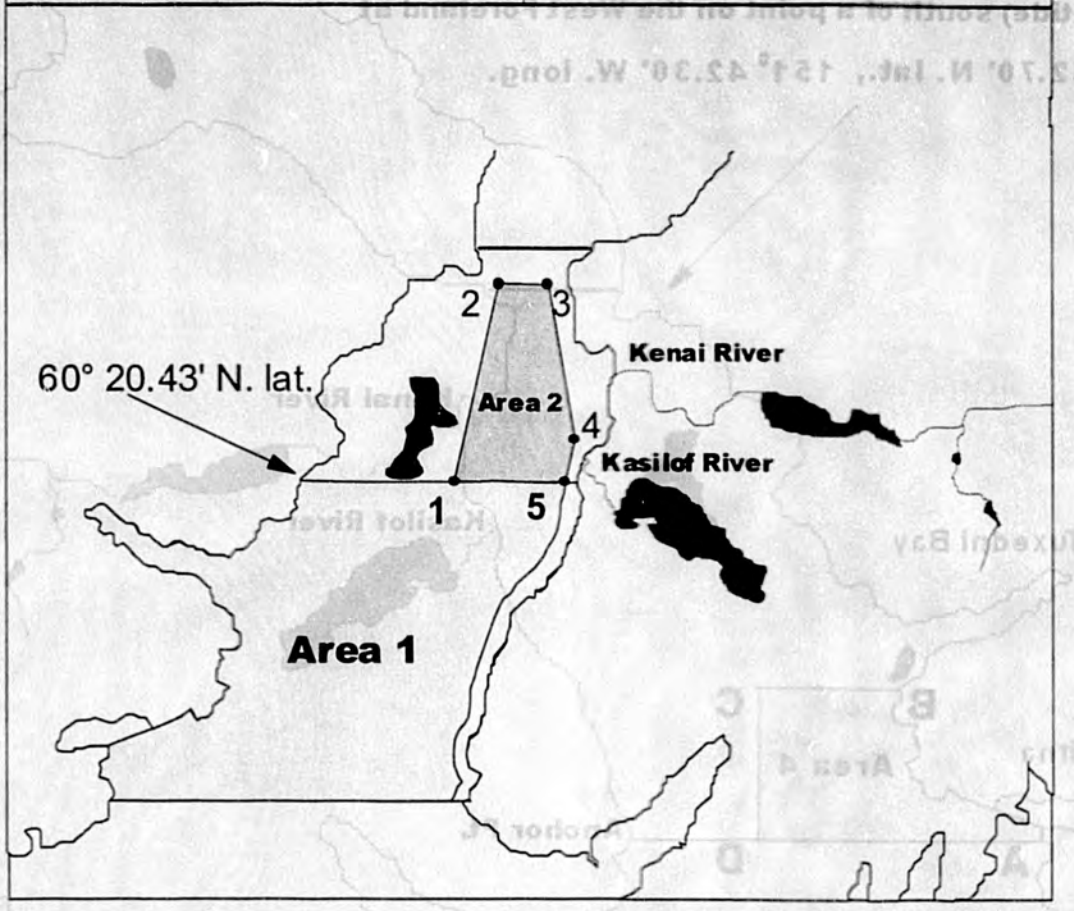

Figure 2. Map of drift gillnet fishing areas one and two.

AREA 4 LOCATION	COORDINATES
A. Southwest Corner	59° 46.15' N. lat., 153° 00.20' W. long.
B. Northwest Corner	60° 04.70' N. lat., 152° 34.74' W. long.
C. Northeast Corner (Kalgin Buoy)	60° 04.70' N. lat., 152° 09.90' W. long.
D. Southeast Corner	59° 46.15' N. lat., 152° 18.62' W. long.

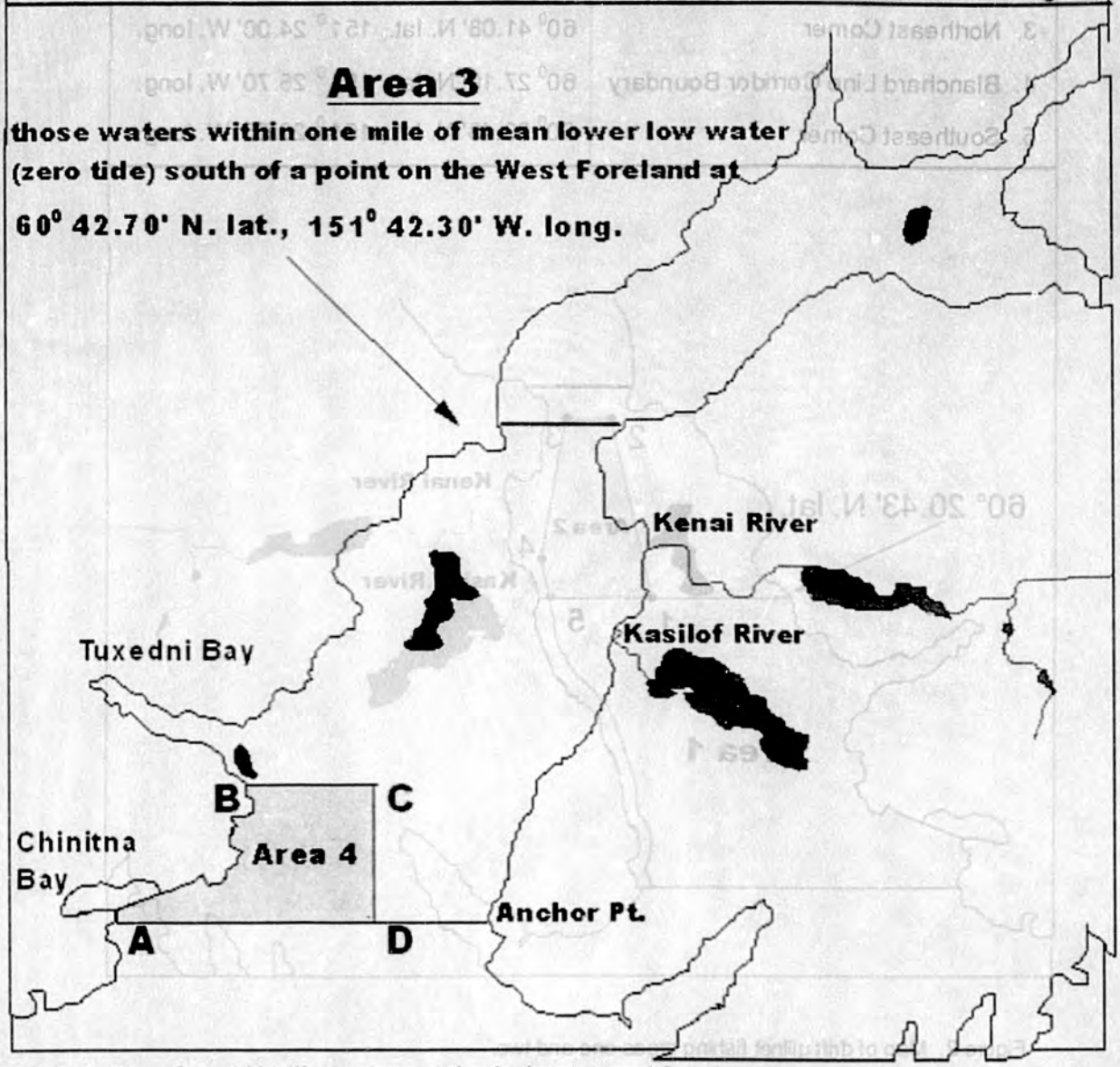

Figure 3. Map of the drift gillnet areas open beginning August 16.

ALASKA DEPARTMENT OF FISH & GAME

SUSITNA SOCKEYE SALMON ACTION PLAN

February 2008

SUSITNA RIVER SOCKEYE SALMON STOCK STATUS AND ACTION PLAN, 2008

INTRODUCTION

SYNOPSIS

In response to the guidelines established in the Sustainable Salmon Fisheries Policy (SSFP; 5 AAC 39.222), the Alaska Board of Fisheries has identified the Susitna River sockeye salmon stock as a stock of yield concern. For this determination, the estimated Susitna River commercial harvest for the most recent 5-year average was compared to the previous 10- and 20-year averages for the Central District drift and Northern District fisheries. Identification of Susitna River sockeye salmon as a stock of yield concern is based on the definition of "yield concern" contained in SSFP. A "yield concern" is defined as "a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs; a yield concern is less severe than a management concern, which is less severe than a conservation concern" [5 AAC 39.222 (f) (42)]. The policy defines "chronic inability" as "the continuing or anticipated inability to meet escapement thresholds over a four to five year period, which is approximately the generation time of most salmon species" [5 AAC 39.222 (f) (5)].

This report describes the existing management plans and Emergency Order authority that the department follows to conserve Susitna River sockeye salmon. In light of increased uncertainty of the department's ability to accurately assess escapements of sockeye salmon into the Susitna River, a research plan has been developed to improve the department's ability to assess sockeye salmon stocks within the drainage. With these ongoing studies, the department will have better information on the productivity and sustainability of the stock at the 2011 Upper Cook Inlet Board of Fisheries meeting.

STOCK ASSESSMENT

Since 1981 the Yentna River daily sonar estimates have been used as an indicator of sockeye salmon escapement into the Susitna River drainage. The sockeye salmon escapement in the Yentna River has been thought to be approximately one half of the total Susitna River sockeye salmon escapement based on a combination of 1981–1985 capture-recapture abundance estimates passing Sunshine (1982-1985; Susitna River rkm 116), and sonar abundance estimates passing Yentna (1981-1985; Yentna River rkm 7) and Susitna Station (1981; Susitna River rkm 116; Westerman and Willette 2006).

Based on Bendix sonar estimates since 1981, the number of Yentna River spawners has ranged from approximately 37,000 to 181,000 sockeye salmon. The sonar estimate of sockeye salmon escapement into the Yentna River has not met the current SEG range of 90,000 to 160,000 for 5 of the past 8 years.

Although sockeye salmon escapements are estimated via a Bendix sonar system, there is great uncertainty surrounding their accuracy and precision. The high variability observed between various methods of escapement assessment (i.e., ongoing Bendix estimates compared with recent

estimates from capture-recapture and DIDSON sonar projects; Yanusz et al. 2007) has added to the uncertainty regarding our previous assessments.

In the Central District drift gillnet fishery, the estimated commercial harvest of Susitna River sockeye salmon for the most recent 5-year average (2003–2007) is 59% of the previous 10-year (1993–2002) average and 49% of the previous 20-year (1983–2002) average. In the Northern District, the most recent 5-year average is 31% of the previous 10-year average and 22% of the previous 20-year average. Since the total Upper Cook Inlet (UCI) commercial harvest averages 2.9 million sockeye salmon and the age composition allocation model estimate of the Susitna sockeye salmon harvest is only 8.4% of the total, the department has low confidence in the accuracy of our estimate of the Susitna sockeye salmon harvest.

ESCAPEMENT GOAL HISTORY

An escapement goal of 200,000 sockeye salmon was established for the Susitna River in 1979. It was set using a return-per-spawner value of 4, and an assumption that the Susitna River could produce about 800,000 adult sockeye salmon. A review of the goal in 1989 based on euphotic volume of rearing lakes suggested the existing goal was valid. In 1986, the sonar site at Susitna Station was destroyed by a flood, and no alternative hydroacoustic site could be found on the mainstem of the Susitna. Therefore, hydroacoustic estimates from a Yentna River site were used to assess total Susitna River escapement. Based on comparisons of estimates for the Yentna and the Susitna Rivers over 5 years, 1981-1985, it was decided that an escapement of 100,000 to 150,000 sockeye salmon into the Yentna River should result in a total escapement of at least 200,000 sockeye salmon into the entire Susitna drainage (Fried 1994). This was based on the average proportion of the total Susitna River escapement, which entered the Yentna River (49%) during the 5 years studied, as well as the range of annual proportions (41-59%) for these 5 years.

In 2001, the biological escapement goal for the Yentna River was changed to a sustainable escapement goal of 90,000-160,000 sockeye salmon based on Yentna sonar data from 1981-2000, because reliable estimates of total return to the system were not available (Bue and Hasbrouck *Unpublished*). Escapement goal reviews since 2001 have resulted in no change recommended to this goal type or range (Hasbrouck and Edmundson 2007, Fair et al. 2007). In 2005, an optimal escapement goal of 75,000-180,000 Yentna River sockeye salmon was adopted by the Alaska Board of Fisheries contingent on the sockeye salmon run to the Kenai River being projected to exceed 4 million.

ACTION PLAN FOR ADDRESSING STOCK OF CONCERN

MANAGEMENT ACTIONS IN COMMERCIAL FISHERIES

Northern District Set Gillnet

In light of recent department data revealing concerns about the validity of Yentna River sockeye salmon enumeration data, it is the intent of the Board that Susitna River sockeye salmon stocks will be conservatively managed while the Department continues its studies in this drainage. Until the UCI BOF finfish meeting in 2011, Susitna River sockeye salmon will be managed as follows:

(1) From the beginning of the regular commercial salmon fishing season, which occurs on or after June 25, through July 19, the Northern District set gillnet fishery will fish no more than two regular 12-hour Monday and Thursday fishing periods per week.

(2) From July 20 through August 6, the Northern District set gillnet fishery will fish regular 12-hour Monday and Thursday fishing periods, but will be limited to no more than one 35-fathom set gillnet per permit. If it is determined by the Department that the Yentna River sockeye salmon [SEG or OEG] will be achieved during this time frame, the Department may increase the allowable fishing gear from one 35-fathom set gillnet per permit to two 35-fathom set gillnets per permit or the full complement of three set gillnets that are not more than 105 fathoms in aggregate length per permit.

(3) On the first regular fishing period after August 6, and thereafter, the Northern District set gillnet fishery will again return to a full complement of fishing gear of three set gillnets that are not more than 105 fathoms in aggregate length per permit, unless restricted or closed by emergency order.

Central District Drift Gillnet

The Central District drift gillnet fishery will be managed to conserve Susitna drainage sockeye salmon.

In the Central District drift gillnet fishery, there are two time periods in July where area restrictions are implemented by management plan to conserve northern bound salmon stocks. First, from July 9-15 the department must restrict the drift gillnet fishing fleet for two regular fishing periods to Area 1 (Figure 1) of the Central District (section A below), which is that area south of the south end of Kalgin Island, and to the Kenai and Kasilof Sections (the corridor).

From July 16-31 there are two regular period area restrictions to the drift gillnet fleet that are dependent upon the size of the Kenai River sockeye salmon run. For Kenai River sockeye salmon runs less than 2 million, the department must restrict the drift fleet to Area 1 (and the Kenai and Kasilof Sections); for runs of 2 million to 4 million, the drift fleet is restricted to Area 1 and Area 2 (and the Kenai and Kasilof Sections); and for runs greater than 4 million there are no mandatory restrictions. These restrictions apply to any two regular periods during this time frame.

The purpose of the July 9-15 restrictions are to allow for the passage of northern-bound sockeye salmon, while the July 16-31 restrictions are primarily for northern-bound sockeye and coho salmon.

MANAGEMENT ACTIONS IN SPORT FISHERIES

The sockeye salmon sport fishery in the Susitna River drainage will be prosecuted with a bag limit of 3 fish. If the Northern District set gillnet fishery is closed to conserve sockeye salmon, the Susitna River drainage sport fisheries will remain open unless the board directs otherwise. The Susitna River sport harvest is not used to determine spawning escapement or in the development of escapement goals.

RESEARCH PLAN

The department currently assesses Yentna River sockeye salmon escapement and commercial and sport harvests annually. The following research projects include current and proposed projects used to gather detailed information about sockeye salmon stocks in the Susitna River.

CURRENT SUSITNA RIVER DRAINAGE SOCKEYE SALMON RESEARCH PROJECTS

YENTNA RIVER SALMON ESCAPEMENT

Objectives: The primary objectives of this project are to estimate (1) the daily and cumulative escapement of sockeye salmon into the Yentna River, and (2) the age, length, and sex composition of those escapements.

Description: Fish passage into the Yentna River is estimated using side-looking (formerly referred to as side-scanning) Bendix sonar. Fish caught and sampled at companion fish wheels are used to apportion sonar counts to estimate species composition of fish passage (i.e., estimate abundance of sockeye salmon) and the age, length, and sex composition of the inriver sockeye salmon run.

COMPARING BENDIX AND DIDSON SONAR PASSAGE ESTIMATES IN THE YENTNA RIVER

Objective: The primary objective of this project is to compare the Bendix sonar estimates of migrating salmon in the Yentna River with estimates from a Dual frequency IDentification SONar (DIDSON).

Description: A DIDSON sonar is placed on both banks of the Yentna River to collect fish passage data independent of the existing Bendix sonar. Both types of sonar equipment are operated at the same time and ensonify the same/similar area of the river so that the passage data is directly comparable.

INRIVER ABUNDANCE AND SPAWNER DISTRIBUTION OF SUSITNA RIVER SOCKEYE SALMON

Objectives: The primary objectives of this study are to (1) estimate the inriver abundance of adult sockeye salmon migrating into the Susitna River with a capture-recapture experiment, and (2) identify sockeye salmon spawning areas in the Susitna River.

Description: In 2006-2008, a capture-recapture experiment is conducted to estimate sockeye salmon abundance in the entire Susitna River. Radio telemetry is used to estimate the spawning distribution throughout the watershed.

EVALUATION OF SOCKEYE SALMON PRODUCTION FROM LAKES IN THE SUSITNA RIVER WATERSHED

Objectives: The primary objectives of this study are to (1) evaluate limnological conditions in seven lakes considered important (major) to sockeye salmon production and compare current conditions to those observed in the 1980s and 1990s, (2) estimate the abundance and mean body size of juvenile sockeye salmon and other juvenile fishes rearing in each lake in the fall, (3) estimate the age composition of the juvenile sockeye salmon in each lake, and (4) evaluate the survival from potential egg deposition to fall fry and from fall fry to smolt.

Description: Estimates of smolt and fall fry abundance, and limnological characteristics such as water chemistry and zooplankton abundance by species are collected (Chelatna, Shell, Byers, Swan, Larson, Stephan, and Judd lakes). Analyses focus on determining carrying capacity of the lakes for sockeye salmon fry and assessing the adequacy of spawning escapements over time.

BIOLOGICAL COMPOSITION OF COMMERCIAL SOCKEYE SALMON HARVEST IN UPPER COOK INLET

Objective: The primary objective of this project is to estimate the age and sex composition of the commercial salmon harvest.

Description: Sockeye salmon harvested in various commercial fisheries in UCI are sampled using a stratified systematic sampling design. Area strata are determined *a priori* using established fishery districts and subdistricts. Temporal stratification is determined post season based on catch patterns in each fishery and the number of samples collected.

STOCK COMPOSITION OF THE UPPER COOK INLET SOCKEYE SALMON COMMERCIAL HARVEST

Objectives: The primary objectives of this study are to (1) estimate the stock composition of sockeye salmon harvested in major commercial fisheries in spatial/time strata, and (2) compare stock composition among substrata (i.e., fish processors for the drift gillnet fishery and beaches within each management subdistrict for the set gillnet fishery).

Description: This project uses new single nucleotide polymorphism (SNPs) genetic stock identification (GSI) methods to estimate stock-specific composition of the commercial harvest in UCI.

PROPOSED SUSITNA RIVER DRAINAGE SOCKEYE SALMON RESEARCH PROJECTS

A recent review of Division of Commercial Fisheries and Sport Fish Division programs in the Susitna River drainage identified the need for improved escapement, smolt, and habitat information for sockeye salmon. The following research programs are planned to gather further detailed information about sockeye salmon stocks in the Susitna River drainage:

SUSITNA RIVER SOCKEYE SALMON MAJOR SYSTEM ADULT WEIRS

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon spawners entering 7 major rearing lakes in the Susitna River watershed.

Description: Adult weirs will be collaboratively operated by the Department and the Cook Inlet Aquaculture Association (CIAA) on 7 major sockeye salmon rearing lakes (Chelatna, Shell, Byers, Swan, Larson, Stephan, and Judd lakes) in the Susitna River watershed to estimate spawner abundance. The age, sex, and length composition of the adult sockeye salmon escapement will be estimated at each weir. Environmental conditions will be recorded daily (i.e., percent cloud cover, precipitation, and stream and air temperature). Sockeye salmon spawner abundance estimates will be used to (1) evaluate the accuracy of sockeye salmon passage estimates from the Yentna River sonar project, (2) help set escapement goals, and (3) estimate freshwater production of sockeye salmon in the watershed (in conjunction with smolt production project described below).

SUSITNA RIVER SOCKEYE SALMON ADDITIONAL SYSTEM ADULT WEIRS

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon spawners entering 7 additional rearing lakes in the Susitna River watershed.

Description: Adult weirs will be collaboratively operated by the Department and CIAA on 7 additional sockeye salmon rearing lakes (Whiskey, Hewitt, Lockwood, Trapper, Red Shirt, Spink, and Trinity lakes) in the Susitna River watershed to estimate spawner abundance. The age, sex, and length composition of the adult sockeye salmon escapement will be estimated at each weir. Environmental conditions will be recorded daily (i.e., percent cloud cover, precipitation, and stream and air temperature). Sockeye salmon spawner abundance estimates will be used to (1) evaluate the accuracy of sockeye salmon passage estimates from the Yentna River sonar project, (2) help set escapement goals, and (3) estimate freshwater production of sockeye salmon in the watershed (in conjunction with smolt production project described below).

SUSITNA RIVER SOCKEYE SALMON MAJOR SYSTEM SMOLT PRODUCTION

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon smolt emigrating from 7 major rearing lakes in the Susitna River watershed.

Description: The abundance of sockeye salmon smolt emigrating from 7 major sockeye salmon rearing lakes (Chelatna, Shell, Byers, Swan, Larson, Stephan, and Judd lakes) in the Susitna River watershed will be collaboratively estimated by the Department and CIAA. Fyke nets will be operated from late May through June at 6 of the lakes to provide a total smolt enumeration. At the remaining lake (Chelatna Lake), three inclined-plane traps will be operated from late May through August, and smolt population size will be estimated using standard mark-recapture techniques. Age, weight and length of smolts will be estimated from samples collected daily at each site. Smolt abundance estimates will be used to (1) forecast adult returns, and (2) estimate freshwater production of sockeye salmon in the watershed (in conjunction with adult escapement estimates).

SUSITNA RIVER SOCKEYE SALMON ADDITIONAL SYSTEM SMOLT PRODUCTION

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon smolt emigrating from 7 additional rearing lakes in the Susitna River watershed.

Description: The abundance of sockeye salmon smolt emigrating from 7 additional sockeye salmon rearing lakes (Whiskey, Hewitt, Lockwood, Trapper, Red Shirt, Spink, and Trinity lakes) in the Susitna River watershed will be collaboratively estimated by the Department and CIAA. Fyke nets will be operated from late May through June at all of these lakes to provide a total smolt enumeration. Age, weight and length of smolts will be estimated from samples collected daily at each site. Smolt abundance estimates will be used to (1) forecast adult returns, and (2) estimate freshwater production of sockeye salmon in the watershed (in conjunction with adult escapement estimates).

SUSITNA RIVER FISH PASSAGE RESTORATION

Objective: The primary objective of this project is to restore and improve salmonid access to upstream spawning and rearing habitats in the lower Susitna River.

Description: Upstream access to historically occupied salmonid habitats will be evaluated in the lower Susitna River to facilitate removal of culvert barriers or other in-stream obstructions. As many as 10 upstream fish passage barriers will be identified, prioritized according to cost-benefit

analyses of fishery values and project costs, and upstream access improved and restored. During construction and after the fish passage restoration projects have been completed, an established monitoring protocol will be used to track individual restoration project performance.

LITERATURE CITED

Bue, B. G., and J. J. Hasbrouck. *Unpublished.* Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Fair, L. F., R. A. Clark, and J. J. Hasbrouck. 2007. Review of salmon escapement goals in Upper Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-06, Anchorage.

Fried, S. M. 1994. Pacific salmon spawning escapement goals for the Prince William Sound, Cook Inlet, and Bristol Bay areas of Alaska. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Special Publication No. 8, Juneau.

Hasbrouck, J. J., and J. A. Edmundson. 2007. Escapement goals for salmon stocks in Upper Cook Inlet, Alaska: report to the Alaska Board of Fisheries, January 2005. Alaska Department of Fish and Game, Special Publication No. 07-10, Anchorage.

Westerman, D. L., and T. M. Willette. 2006. Upper Cook Inlet salmon escapement studies, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 06-49, Anchorage.

Yanusz, R., R. Merizon, D. Evans, M. Willette, T. Spencer, and S. Raborn. 2007. Inriver abundance and distribution of spawning Susitna River sockeye salmon Oncorhynchus nerka, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-83, Anchorage.

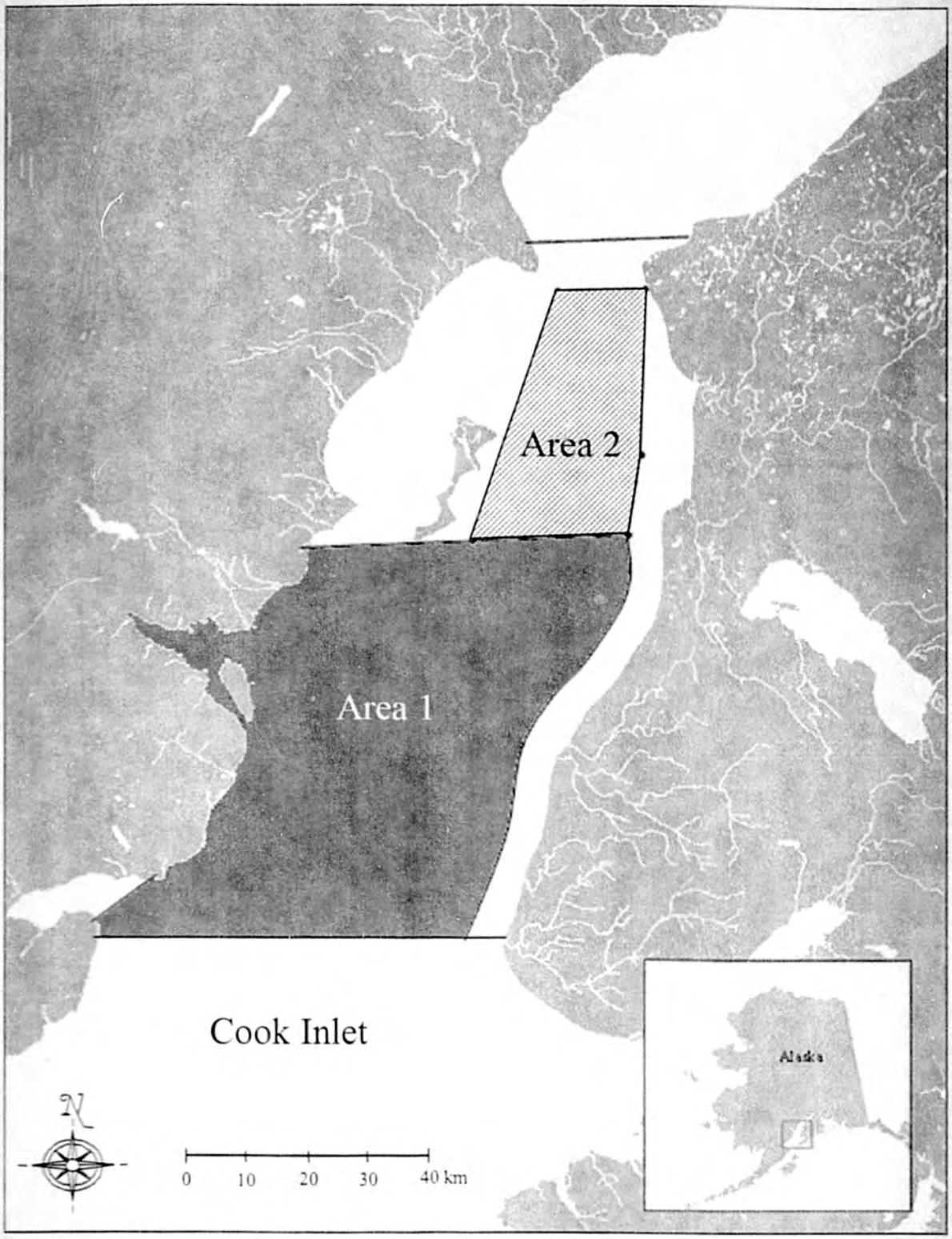

Figure 1.–Map of Central Cook Inlet showing management fishing boundaries for Area 1 and Area 2 for drift gillnet fisheries.

United Cook Inlet Drift Association

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ucida@acsalaska.net

Date: May 6, 2008

Addressee: Representative Craig Johnson
716 W 4th Ave
Anchorage, AK 99501

Dear Representative Johnson:

In the Joint Resolution that created the Cook Inlet Salmon Task Force, there are several allegations made concerning salmon escapements, professional performance of the Administration, Department of Fish and Game (ADF&G) and ethical lapses by the Board of Fish (BOF). Additionally, in the Joint Resolution there are several concerns expressed about the need for comprehensive management strategies and biological data needs. We, as an Association, feel it necessary for all members of the Task Force to read, review and analyze the public record created at the 2008 Upper Cook Inlet (UCI) BOF hearings. We fully expect the Task Force to fully review the proposals, public testimony, staff reports, written and verbal, power point presentations, committee reports, advisory committee comments and deliberations. Considering that none of you were there, it is incumbent upon you to undertake this review prior to discussing any of the allegations raised or making recommendations.

We, as an industry, in good faith prepared and participated in the 2008 UCI BOF meeting. We spent several months preparing for, attending and participating in the BOF process at a cost of over $20,000. We had an expectation of fair hearings, as did other citizens, and we now also have a legal expectation of fair treatment and hearings from the Task Force.

There are several errors of data in the concurrent resolution and we expect these to be identified and corrected as you read the public record from the 2008 UCI BOF hearings. It seems that the concurrent resolution has to either substantiate the allegations or identify errors in drafting the resolution.

We intend to fully engage the Task Force with technical data and procedural issues. We feel it is appropriate, if possible, to put all presenters under oath. We intend to meet the legal requirements of law, regulations and policies as we engage the Task Force. We are firmly committed to achieving optimum (MSY) yields using the best scientific information, having fair allocations, maintaining efficiencies, protecting habitat and ensuring the economic health of the fishing communities.

Sincerely,

Roland Maw, PhD
UCIDA Executive Director

ams

cc:
Governor Sarah Palin
Board of Fisheries Members
Kenai Peninsula Mayor Williams
Kenai Peninsula Borough Assembly
Anchorage Mayor Begich
Matanuska-Susitna Mayor Menard
Kenai Mayor Porter
Soldotna Mayor Carey
Homer Mayor Hornaday
Seward Mayor Corbridge
Denby Lloyd
John Hilsinger
Charlie Swanton
Rep. Mike Chenault
Rep. Kurt Olson
Rep. Bryce Edgmon
Rep. Les Gara
Rep. Carl Gatto
Rep. David Guttenberg
Rep. Mike Hawker
Rep. Reggie Joule
Rep. Wes Keller
Rep. Bob Lynn
Rep. Mary Nelson
Rep. Bob Roses
Sen. Gene Therriault
Sen. Donny Olson
Sen. Fred Dyson
Sen. Lyman Hoffman
Sen. Bert Stedman
Baldwin & Butler, LLC
Kenai Peninsula Fishermen's Association
Cook Inlet Aquaculture Association
Cook Inlet Fisherman's Fund
United Fishermen of Alaska
Alaska Trollers Association
Cordova District Fishermen United
Inlet Fish Producers
Snug Harbor Seafoods
Ocean Beauty Seafoods
Kenai River Seafoods
Icicle Seafoods
Auction Block Company
Rep. John Coghill
Rep. Nancy Dahlstrom
Rep. Paul Seaton
Rep. Anna Fairclough
Rep. Berta Gardner
Rep. Max Gruenberg
Rep. John Harris
Rep. Lindsey Holmes
Rep. Scott Jiu Wo Kawasaki
Rep. Mike Kelly
Rep. Kevin Meyer
Rep. Jay Ramras
Rep. Ralph Samuels
Sen. Gary Stevens
Sen. Hollis French
Sen. Kim Elton
Sen. Albert Kookesh
Sen. Joe Thomas
Sherry Wright, A/C Coordinator

ALASKA STATE LEGISLATURE

SENATOR THOMAS H. WAGONER

- Member, Senate Resources Committee
- Member, Community & Regional Affairs
- Member, World Trade

Official Business

Session: January – May
State Capitol, #423
Juneau, AK 99801
Phone: 907-465-2828 Fax: 907-465-4779

Interim: May – December
145 Main Street Loop; Suite 226
Kenai, AK 99611
Phone: 907-283-7996 Fax 907--283-8127

May 13, 2008

Denby Lloyd, Commissioner
Department of Fish and Game

Dear Commissioner Lloyd:

As you know, the Legislative Cook Inlet Salmon Task Force will hold the first meeting on May 22 at 5:30pm at the Kenai Peninsula College in the Kenai/Soldotna area. I assume you will be present to represent the Department of Fish and Game. Additionally, I think it would be beneficial to have Mel Morris available at all hearings to represent the Board of Fisheries.

In preparing for the hearings I have been working with some of my constituents on relevant testimony and questions of your Department that would better prepare me for the hearings. Here are the four questions:

1) At the Board of Fisheries meeting in 2008, ADF&G staff presented data from tagging studies in Upper Cook Inlet that showed over 80% of Northern District coho, chum, pink and Chinook salmon enter the Northern District despite the Central District drift and set gill net fisheries. Would you please prepare for me tables showing what percentage of these stocks enter the Northern District streams based on the data collected to date from the tagging studies and other pieces of information that you may have.

2) What is the sport fish harvest on these stocks relative to their average run size? For example, at the 2008 BOF meeting, ADF&G presented data that indicated over 1 million coho salmon enters the Northern District and yet the sport fish harvest was less than 50,000 fish. Would you please provide this comparison of average annual run strength to average annual sport fish harvest for all species? If you do not have all the data to make this comparison please present the comparison for the years you have data.

3) How many sockeye salmon does ADF&G actually want to have spawned in the Yentna River drainage and the Northern District total? Prior to the 2008

ALASKA STATE LEGISLATURE

Board of Fisheries meetings ADF&G testified that the Yentna escapements were about 25% of the total Northern District escapements and the number of spawners desired was 90,000 to 160,000 actual fish spawning.

If this figure is not correct, what is the actual number of spawning fish ADF&G desires? I am not looking for an index number but the actual number of spawners regardless of counting method. It would appear to me that ADF&G should have this number readily available for the hearings. If not please provide an explanation of why not and what data are required to do so and when it will be available. Since the goal is an SEG I would assume that you do not need the same level of data required for a BEG. In addition, please provide the level of precision that will be increased as a result of delaying making a decision now.

4) How does ADF&G plan to count the number of fish to meet the goal established in question 2? If you use a counting method that is an index of escapement, please provide the factual data to establish that relationship. For example, sonar counts to weir counts. Is that relationship significant?

I would appreciate your immediate attention to the above questions and an answer back to my office prior to the May 22nd task force meeting.

Respectfully,

Senator Tom Wagoner

One 1 year info

STATE OF ALASKA

SARAH PALIN, GOVERNOR

DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES
DIVISION OF SPORT FISH

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JUNEAU, AK 99811-5526
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May 28, 2008

The Honorable Thomas Wagoner
Alaska State Senate
145 Main Street Loop, Suite 226
Kenai, AK 99611

Dear Senator Wagoner:

This letter is in response to your request for information on total salmon run size in Upper Cook Inlet (UCI), harvest by user group, and Susitna River sockeye salmon. This information is the best available, however in some cases the data is limited and not of the highest accuracy. Also, please recognize that there may be tremendous natural variation in run strength, harvest, and escapement from year to year. In other instances, such as the 2002 tagging study referenced under question 2, information is fairly accurate but projects of such magnitude rarely occur due to a lack of funding. Hopefully the information below will answer your questions.

1) ***Would you please prepare for me tables showing what percentage of these stocks (coho, pink, chum, and Chinook salmon) enter the Northern District streams based on the data collected to date from the tagging studies and other pieces of information that you may have.***

and

2) ***What is the sport fish harvest on these stocks relative to their average run size?***

The text below is cited from the abstract in the report *Willette, M. T, R. DeCino, R. and N. Gove. 2003. Mark recapture population estimates of coho, chum, and pink salmon runs into Upper Cook Inlet, 2002. Alaska Department of Fish and Game, Regional Information Report no. 2A03-20.* Tables 1 and 2 reflect salmon run information provided from this report.

"Total population sizes for each species were estimated from recoveries of passive integrated transponder (PIT) tags in commercial fishery harvests. Recoveries of radio telemetry tags were used to estimate the total escapement of coho salmon into all UCI streams for comparison to the

estimate derived from PIT tags. Radio telemetry tag data were also used to estimate coho salmon escapements into 33 streams and 5 areas around UCI. Our best PIT tag estimate of the total population size of coho salmon returning to UCI was 2.52 million (95% CI: 2.16-2.87 million). Given a commercial harvest of 0.25 million, the total escapement of coho salmon into all UCI streams was 2.27 million (95% CI: 1.91-2.62 million), and the harvest rate in the commercial fishery was about 10%. Our radio tag estimate of the total escapement of coho salmon into all UCI streams was 1.36 million (95% CI: 0.98-1.96 million). Thus, our PIT tagging experiment estimated a population size for coho salmon entering UCI streams that was higher than the estimate obtained from radio tagging. Although, the 95% confidence intervals around the two estimates overlapped slightly, the z-test statistic indicated the two estimates were significantly different. Of the total coho salmon escapement into all UCI streams, 56% (0.76 million) returned to the Susitna and Little Susitna River drainages, 19% (0.26 million) returned to streams along the west side of UCI, 17% (0.24 million) returned to streams along Knik Arm, 5% (0.07 million) returned to streams along Turnagain Arm, and 3% (0.04 million) returned to streams on the Kenai Peninsula. However, these estimates for Turnagain Arm and Kenai Peninsula streams do not include the entire escapement because we stopped tagging before the runs to these areas were complete.

Our PIT tag estimate of the total population size of pink salmon returning to UCI was 21.28 million (95% CI: 1.60-40.96 million). However, this estimate was of questionable value due to its very low precision resulting from problems with tag recovery. Therefore, we estimated a maximum exploitation rate on pink salmon in the commercial fishery by simply summing escapements that were actually enumerated in 3 streams. Given a commercial harvest of 0.45 million, the maximum exploitation rate in the commercial fishery was about 12%. However, the actual exploitation rate must have been much lower, because we did not include escapements into numerous other streams around UCI.

Our PIT tag estimate of the total population size of chum salmon returning to UCI was 3.88 million (95% CI: 3.30-4.47 million). Given a commercial harvest of 0.24 million, the total escapement of chum salmon into all UCI streams was 3.64 million (95% CI: 3.06-4.23 million), and the exploitation rate in the commercial fishery was about 6%."

Table 1. Mark-Recapture population estimates of coho, pink, and chum salmon runs into the Upper Cook Inlet in 2002.

Species	Estimated Run Size	Commercial Harvest	Estimated UCI Sport Fish Harvest	Estimated Escapement	Estimated Commercial Harvest Rate	Estimated Sport Harvest Rate
Coho	2,520,000	246,000	174,000	2,100,000	9.8%	6.9%
Pink	21,300,000	450,000	34,000	20,816,000	2.1%	0.2%
Chum	3,880,000	240,000	5,000	3,635,000	6.2%	0.1%

Never tagged After Aug 10

coho, chum, Pinks

Table 2. Mark-Recapture population estimates of the coho salmon run into the Northern District in 2002.

Species	Estimated Northern District. Run Size [a]	Estimated Commercial Harvest [b]	Estimated Northern District Sport Fish Harvest	Estimated Escapement	Estimated Commercial Harvest Rate	Estimated Northern District Sport Harvest Rate
Coho	997,000	138,000	99,000	760,000	13.8%	9.9%

[a] Run size based upon radio telemetry escapement estimate plus estimated harvests

[b] Northern District harvest estimated using escapement distribution determined by radio tagged coho salmon.

Table 3 represents the average Northern District king salmon run size for the years 1981 to 2003. Assumptions concerning these escapement estimates are described in the report: *Delaney, K. and D, Vincent-Lang. Unpublished. Current status and recommendations for the future management of the Chinook salmon stocks of Northern Cook Inlet. A report to the Alaska Board of Fisheries, Anchorage, Alaska, November 1992.*

Table 3. Average Northern District king salmon run size and harvest estimates from 1981-2003.

Estimated Northern Dist. Run Size	Estimated Commercial Harvest	Estimated Northern Dist. Sport Fish Harvest	Tyonek Subsistence Harvest	Estimated Escapement
134,000	4,700	28,000	1,300	100,000
Harvest Rates	3.5%	20.9%	1.0%	

3) How many sockeye salmon does ADF&G actually want to have spawned in the Yentna River drainage and the Northern District total? Prior to the 2008 Board of Fisheries meetings ADF&G testified that the Yentna escapements were about 25% of the total Northern District escapements and the number of spawners desired was 90,000 to 160,000 actual fish spawning.

The current sustainable escapement goal for the Yentna River sockeye salmon is 90,000 to 160,000 fish. There is an optimal escapement goal of 75,000 to 180,000 when sockeye salmon runs into the Kenai River exceed 4 million. These escapement goals were presented to the Board of Fisheries, and even given the current information, will be the goals for the 2008 season.

Evaluation of the current goal is further discussed in the answer to question 4. The sustainable escapement goal will be re-evaluated following the 2008 field season.

4) How does ADF&G plan to count the number of fish to meet the goal established in question 3? If you use a counting method that is an index of escapement, please provide the factual data to establish that relationship. For example, sonar counts to weir counts. Is that relationship significant?

ADF&G will be using the Bendix Sonar to estimate the fish passage into the Yentna River for 2008. However, ADF&G will continue research concerning the various methods of estimating escapement in 2008. This will include mark–recapture and radio telemetry studies. Such abundance estimates will allow: (1) estimation of the total annual run of Susitna River sockeye salmon when abundance estimates and genetics-based harvest allocation estimates are combined, (2) evaluation of the accuracy of the Yentna River sonar estimate, and (3) the proportion of Yentna River sockeye salmon in the entire Susitna River sockeye salmon escapement. Additionally, ADF&G is evaluating the current sockeye salmon escapement assessment tool, a Bendix single beam sonar system, with a more advanced and proven hydroacoustic system known as DIDSON (**D**ual frequency **ID**entification **SON**ar). Preliminary spawning abundance estimates based on mark–recapture and DIDSON studies suggest that traditional Bendix estimates are much lower than the actual escapements. As shown in the table below, the high variability that we have observed between the various methods has added considerably greater uncertainty to our previous assessments.

Tables 4 and 5 below provide information that was presented at the 2008 BOF meeting (Yanusz and Willette oral report, RC 4 Tab 7). A detailed written report on the 2006 results is published (Yanusz, R., R. Merizon, D. Evans, M. Willette, T. Spencer, and S. Raborn. 2007. Inriver abundance and distribution of spawning Susitna River sockeye salmon Oncorhynchus nerka, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-83, Anchorage; http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-83.pdf) and a draft report describing 2007 results is in preparation.

Table 4. Estimates of sockeye salmon escapement in the Susitna River drainage, 2006.

2006 System Mark–Recapture	Weirs [a]	Bendix	DIDSON
Yentna Unknown [a]	126,000	93,000	160,000
Susitna 107,000 (95% CI 49,000 - 165,000)	60,000		
Sum	186,000		

[a] Because of difficulties with the project, a PIT tag estimate of escapement to the Yentna River for the period July 29, 2006 through August 18, 2006 (418,000 with 95% CI of 262,000 to 574,000) was not deemed accurate enough to present to the BOF.

Table 5. Estimates of sockeye salmon escapement in the Susitna River drainage, 2007.

2007 [b] System Mark–Recapture	Weirs	Bendix	DIDSON
Yentna 247,000	97,000	80,000	130,000
Susitna 85,000	60,000		
Sum	157,000		

[a] Weirs monitored escapement at a few select lakes and do not represent total river escapement.

[b] The 2007 estimates are preliminary.

ADF&G recognizes the need to re-evaluate the Yentna River sockeye salmon escapement goal in light of the new information available. This goal was originally developed in 1979 based on our understanding of sockeye salmon production in the Susitna drainage at that time and assumptions about the likely spawner-recruit relationship. During the 1980s the goal was changed to a Yentna River goal based on the distribution of spawners between the mainstem Susitna River and the Yentna River at that time. In the early 2000s, the goal was again amended to its current range by applying a percentile algorithm to the historical Yentna River Bendix sonar counts. A reassessment of the goal must take into account not only the changes in estimates of abundance, but also problems with species apportionment, the apparent change in distribution of fish between the mainstem Susitna and the Yentna, and a reassessment of the spawner recruit relationship. This will require a complex analysis that will take time to complete.

ADF&G is currently devising a timeline for when the critical pieces of information necessary for this re-evaluation of the Yentna River sockeye salmon escapement goal will be available. Essential information for this re-evaluation includes information from weirs, Bendix sonar, DIDSON, radio telemetry, limnology, mark-recapture, and genetic catch composition data through 2008. With these relevant sources of information in hand, ADF&G will meet to update and evaluate various alternative Yentna River sockeye salmon escapement goals.

Sincerely,

John Hilsinger
Director, Division of Commercial Fisheries

and

Charlie Swanton
Director, Division of Sport Fish